PGG Wrightson Seeds

Forage Options

SEVENTH EDITION

About PGG Wrightson Seeds

PGG Wrightson Seeds is a New Zealand based company and Australasia's largest seed company. We have been helping farmers for over 160 years.

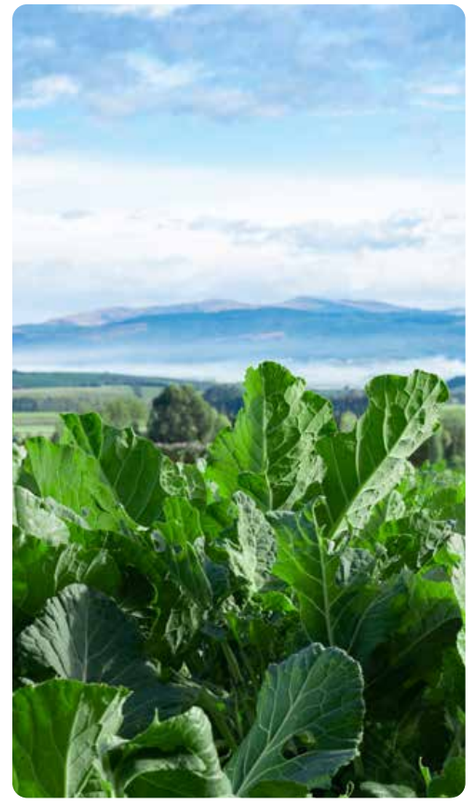
Research and development are key to our success and we invest well in excess of $15 million per annum into our forage and endophyte programmes.

We have relationships with two primary research partners:

- AgResearch
- Plant and Food Research

WHY PGG WRIGHTSON SEEDS?

- We have access to world-leading research and development
- Animal grazing trials are incorporated into plant breeding
- We have a strong focus on endophyte technology
- Staff are practical, focusing on increasing your meat, milk or wool production
- We have been helping New Zealand farmers achieve their goals for over 160 years
- We deliver market-leading technologies (for example AR37 endophyte, the Cleancrop™ Brassica System and *Raphanobrassica*)



Hugh McDonald

National Sales and Marketing Manager
PGG Wrightson Seeds

Welcome

Thank you for reading the seventh edition of our Forage Options. Over the past year, we've focused on ongoing development of our SeedsOnline app, growing the range of products and brands available and adding new features to make ordering faster and simpler. And we launched two new cultivars in spring 2020 with full commercial availability: Amigain red clover and Cleancrop™ Toto turnip.

We've also invested in sharing our expertise and making useful information available. Visit our online Knowledge Base or keep an eye on our social media channels: Facebook, Twitter and Instagram. Here, we regularly post handy tips, seasonal product information, news and even great giveaways from time to time. Another account to follow is The Rumen Room. A Facebook group run by our own in-house veterinarian Charlotte Westwood, this page is designed to generate discussions between farmers and other industry professionals. Find out more about our social channels on pages 5-6.

If you have any questions about our products or how they can help you on farm, or even some feedback on this edition of Forage Options - we invite you to get in touch. You'll find the PGG Wrightson Seeds team's contact details are on page 261.

STOCK SUITABILITY INFORMATION

The following stock type icons shown on the brassica and pasture product pages indicate stock type suitability.

SHEEP

BEEF

DAIRY

DEER

SeedsOnline

We've been working on an exciting new innovation in the technology space. Launched in August 2020 SeedsOnline is an industry first - an incredibly versatile seed ordering app that will replace the existing hard copy ordering system. Download it and have a go, or log in to find out what's new.

At PGG Wrightson Seeds we appreciate that there is a lot of information around forage products. Our aim is to help remove some of the confusion and make your decision easier. Your local PGG Wrightson Seeds Representatives are always there to help. Call your local Sales Agronomist shown on page 261 of this Forage Options manual, freephone **0800 805 505** or visit us at **www.pggwrightsonseeds.com** for more information.

We wish you a successful year.

New product releases

FULL COMMERCIAL AVAILABILITY

GRASSLANDS Amigain RED CLOVER

Amigain is the latest-generation red clover bred in New Zealand for increased persistence and performance in permanent pastures, high performance short-term pastures, silage mixes and pure sward red clover stands. In a pasture mix, Amigain provides spring, summer and autumn productivity ideal for increased animal performance, enhancing pasture management and fixing nitrogen. For more information on Amigain, refer to pages 166-167.

Toto TURNIP
Cleancrop™ Brassica System

Toto turnip is the latest addition to the Cleancrop™ Brassica System, developed under the Forage Innovation plant breeding joint venture between Plant and Food Research and PGG Wrightson Seeds.

Cleancrop™ Toto is an early-maturing, high-yielding summer turnip that can be grazed from 55 days after sowing. The tankard bulb shape improves crop utilisation by grazing animals. Toto also has herbicide tolerance to Telar® and improved turnip mosaic virus tolerance. To learn more about Toto, see page 19.

Vast TETRAPLOID PERENNIAL RYEGRASS

LIMITED AVAILABILITY SPRING 2022

We are excited to release our new tetraploid perennial ryegrass Vast in spring 2022. It will complement our existing range of market-leading tetraploids.

Vast was selected for an extremely late heading date (+36 days later than Nui), diploid density, excellent yield potential and the lowest aftermath seed head production available.

With diploid-level tiller density and a tetraploid's animal grazing preference, Vast will push the traditional boundaries that have limited the use of tetraploids in many farming systems.

Tom Buckley
Farm Manager
Owl Farm, Cambridge

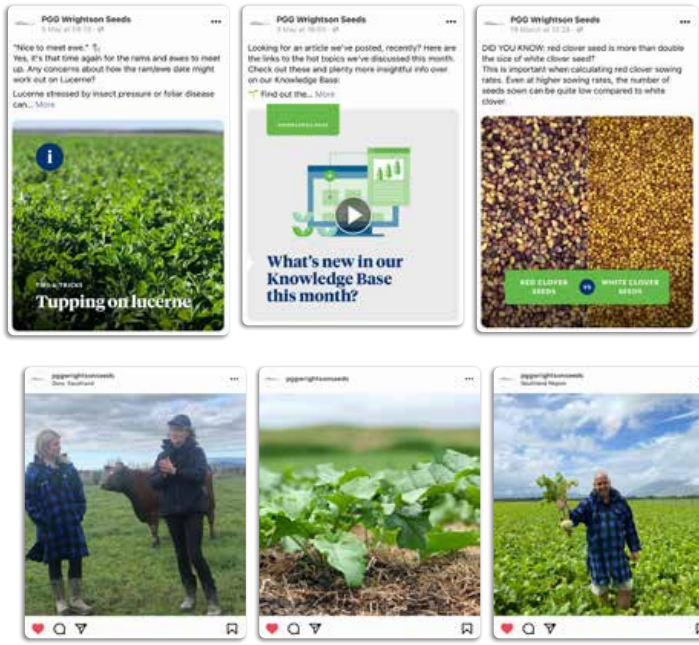
Owl Farm were impressed by Cleancrop Toto in summer 2019/20. "Even with the extremely dry conditions this summer the crop was valuable,"says Tom. "We managed to get eleven weeks of feed out of our eleven hectares of crop; that was 3 kgDM/cow/day from crops that yielded, on average, 10 tDM/ha."

Social media, website and Knowledge Base

FACEBOOK AND INSTAGRAM

Check the PGG Wrightson Seeds Facebook page for regular updates, the latest advice and occasionally, chances to win. Also join us on our Instagram page to stay up to date with what's happening in the field.

Do share your photos and stories with us via social media, as we love hearing them and having the opportunity to link with the wider PGG Wrightson Seeds community.



FOLLOW PGG WRIGHTSON SEEDS ONLINE!

Be sure to use #PGWSeeds and #Raphno!

facebook.com/pggwrightsonseeds

pggwrightsonseeds

WEBSITE

Communication and information is vital to ensure the best possible results when relying on sown seeds to produce high quality forage for animal production.

At PGG Wrightson Seeds, we understand the need to have this information on hand when required, both day and night. Our aim is to offer a site that can deliver you all the information you require in making the best decision when it comes to cropping and pasture renewal.

www.pggwrightsonseeds.com

KNOWLEDGE BASE

We're passing on our expert knowledge to help you boost your productivity this season.

The PGG Wrightson Seeds Knowledge Base has all the information you need for this season. In fact, with so much available, providing it this way gives you better access than ever before. You'll find **Expert Advice** on growing crops and feeding stock, **Tools and Resources** to help you identify problems and find solutions, and a **Community Forum**.

With the Knowledge Base, you have over 160 years' worth of farming experience and knowledge at your disposal - so get exploring! And remember to check back often, as new information and community articles are added regularly.

knowledgebase.pggwrightsonseeds.com

Charlotte Westwood and The Rumen Room

Introducing Veterinarian Nutritionist Charlotte Westwood

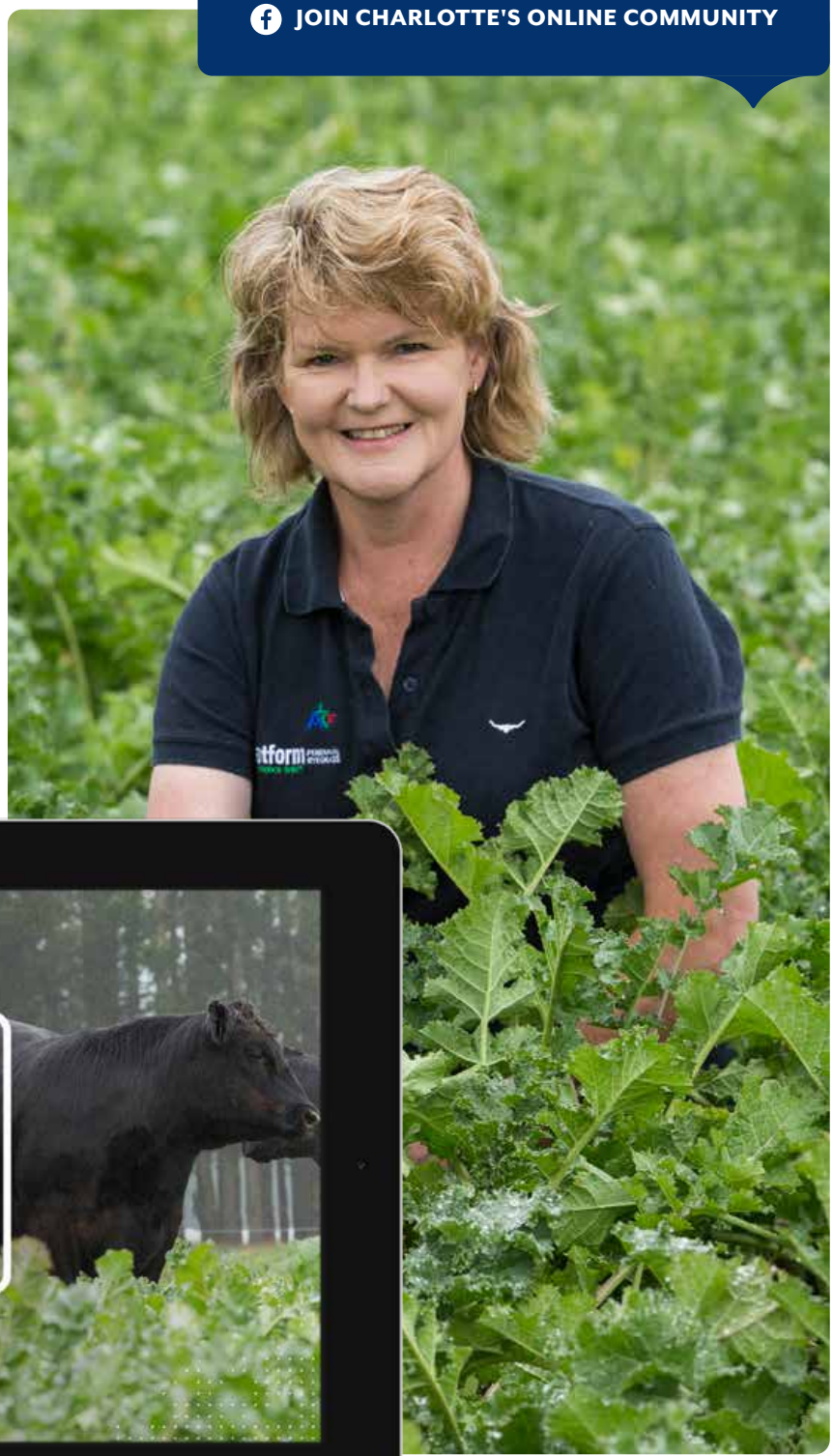
Charlotte is a qualified veterinarian (BVSc, MANZCVS, PhD) with over 30 years of experience in vet science, animal nutrition and farm systems. In her current role as Veterinary Nutritionist for PGG Wrightson Seeds, she consults widely to a number of large corporate farming businesses and is involved in research and development and extension work with PGG Wrightson Seeds retail customers. Prior to this, Charlotte worked as a cattle veterinarian and as a farm consultant in both New Zealand and Australia.

Charlotte is particularly interested in interactions between nutrition, animal health and reproductive performance of cattle and sheep within pasture, crop or total mixed ration-based farm systems. She has published a number of papers on these topics and is a regular presenter at farming-related conferences.

The Rumen Room

Join Charlotte's Facebook group '**The Rumen Room**', where she regularly posts on topics relevant to animal nutrition, farm systems and veterinary science. Charlotte and group members engage in open discussion, share information and gain advice.

JOIN CHARLOTTE'S ONLINE COMMUNITY



Seeds in Action®

Seeds in Action® sites are a unique combination of regional research as well as hands-on practical demonstration sites.

Seeds in Action sites allow anyone with an interest in forage agronomy to see our products and other seed companies' products in real-life situations in their local regional area.

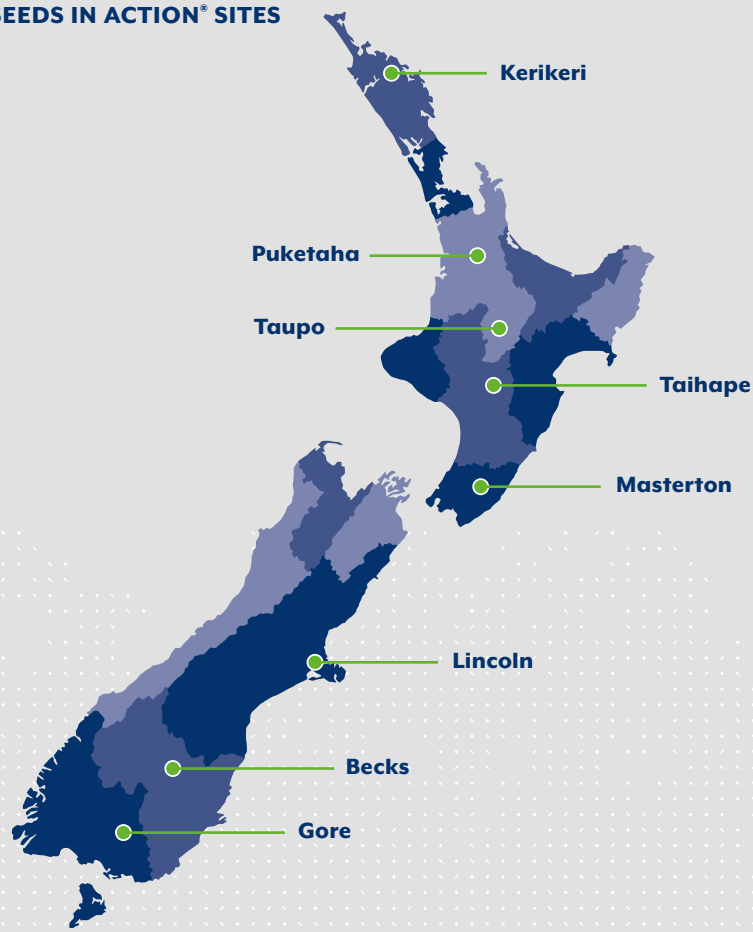
There are eight Seeds in Action sites strategically located throughout New Zealand with a variety of trials, both under commercial farming and trial conditions, designed to assist with cultivar and endophyte selection in a real-world environment. The sites also include sowing rate, cultivation method and seed treatment trials to showcase best practice.

These Seeds in Action sites are the final step in a research and development programme that has been operating in New Zealand for several decades now, with an investment of more than $15 million per year into the development of new and improved pasture and forage cultivars.

VISIT A SITE NEAR YOU

Open days are held regularly at these sites and tours can be organised by contacting your local PGG Wrightson Seeds Sales Agronomist. Please see page 261 for contact details.

SEEDS IN ACTION® SITES



"More than $15 million per year is invested into the development of new and improved forage cultivars."


cleancrop
Brassica System

Cleancrop™ Brassica System Options

The Cleancrop™ Brassica System is a crop and weed management solution all in one.

Cleancrop™ Brassica System options

Firefly KALE
Cleancrop™ Brassica System

Hawkestone SWEDE
Cleancrop™ Brassica System

Bulb Turnip
Cleancrop™ Brassica System

Rape
Cleancrop™ Brassica System

Leafy Turnip
Cleancrop™ Brassica System

Toto TURNIP
Cleancrop™ Brassica System

Cleancrop™ Brassica System options contents

CLEANCROP™ BRASSICA SYSTEM OPTIONS

Cleancrop™ Brassica System

THE CLEANCROP™ BRASSICA SYSTEM IS A CROP AND WEED MANAGEMENT SOLUTION ALL IN ONE.

HOW DOES IT WORK?

Only Cleancrop™ combines the power of broad-spectrum herbicide Telar® and plants bred to tolerate it. Telar® takes care of 23 hard-to-control weeds at the time of sowing, freeing up moisture and nutrients to give your crop the best chance of maximising performance and delivering superior returns on your seed investment.

WHY USE IT?

The Cleancrop™ Brassica System is a simple weed management system that targets a wide range of historically difficult-to-control weeds in brassica crops. Telar® cannot be used with conventional brassicas.

cleancrop® Brassica System =

+

Cleancrop™ brassica seed

Cultivars that have been BRED to be tolerant to the sulfonylurea herbicide Telar®

Telar® herbicide

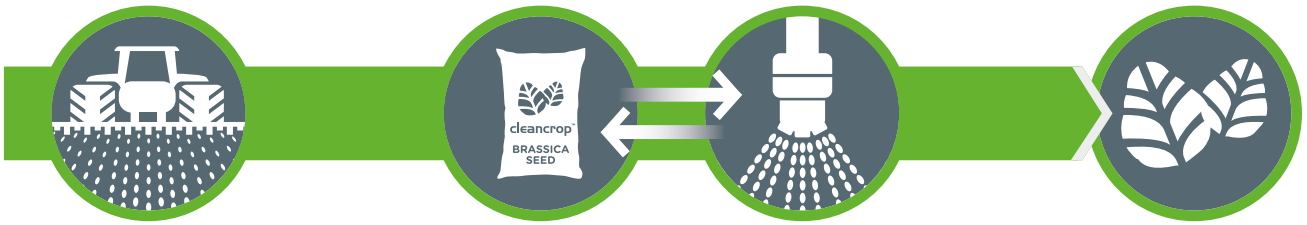
A broad spectrum herbicide that provides EXCELLENT control of broadleaf weeds from the pre-emerge stage

TELAR® HERBICIDE CONTROLS THE FOLLOWING 23 WEEDS:

- Calandrinia
- Californian Thistle*
- Chickweed
- Cornbind
- Dandelions
- Docks
- Fathen
- Hawksbeard
- Nodding Thistle
- Rayless Chamomile
- Redroot
- Scarlet Pimpernel
- Scentless Chamomile
- Scotch Thistle
- Shepherd's Purse
- Spurrey (Yarr)
- Stinking Mayweed
- Twin Cress
- Vetch
- White Clover
- Wild Turnip*
- Willow Weed
- Yellow Gromwell

**Apply Telar® post-emerge when Cleancrop™ brassicas are at the fourth true leaf stage.*

APPLY TELAR® AT THE PRE-EMERGE STAGE WITHIN 48 HOURS OF SOWING.



Prepare paddock | **Plant Cleancrop™** | **Spray with Telar®**

CONTROL WEEDS. INCREASE YIELD.

CLEANCROP™ BENEFITS

The Cleancrop™ Brassica System (seed + herbicide) package enables you to control your weeds at the time of sowing.

Control weeds within 48 hours of sowing*

No moisture required# to activate Telar® herbicide

No soil incorporation required

Adaptable to method of sowing

**For the weeds listed on page 12 that require Telar® applied as a foliar spray at post-emergence, an application can be made when the crop is at the fourth true leaf stage or later.*
#When applied pre-emerge Telar® is taken up through the roots of weeds when conditions promote their growth.

6 CULTIVARS

CLEANCROP™ PACKAGES

The Cleancrop™ Brassica System is available in six cultivars to suit all farm types and stock classes. All Cleancrop™ cultivars are ordered on a per hectare (ha) basis and include the herbicide Telar® applied at 20 g/ha.

Leafy turnip	4 kg/ha
Rape	4 kg/ha
Bulb turnip (Summer)	2 kg/ha
Bulb turnip (Winter)	1 kg/ha
Toto turnip NEW	2 kg/ha
Hawkestone swede	1 kg/ha
Hawkestone swede (Pelleted)	90,000 seeds/ha
Firefly kale	4 kg/ha

Note: The Cleancrop™ Brassica System is unique. PGG Wrightson Seeds sell it as a package, i.e. Seed + Chemical. One item cannot be purchased without the other. Agents/Retailers have to be accredited to sell the Cleancrop™ Brassica System to ensure stewardship is maintained.

GRAZING WITHHOLDING

Take note of grazing withholding periods (WHP) following use of Telar®. The WHP for Cleancrop™ rape and Cleancrop™ leafy turnip is 28 days after application and 42 days after Telar® application for Cleancrop™ bulb turnip, Cleancrop™ Toto turnip and Cleancrop™ Hawkestone swede. The WHP for Cleancrop™ Firefly kale is 98 days after Telar® application.

Farm type

Sowing rate

4 kg/ha

Days to grazing

150-220 days

Firefly KALE
Cleancrop™ Brassica System

- High yielding, intermediate-height kale
- High leaf-to-stem ratio with very good late winter leaf percentage
- Excellent crop utilisation due to selection for soft stems
- Very good winter hardiness and excellent pest and disease tolerance

Firefly kale is a high yielding, intermediate-height kale with a high leaf-to-stem ratio. Excellent crop utilisation by stock due to single plant selection for soft stems during the plant breeding process. Firefly is the first kale cultivar available in the Cleancrop™ Brassica System bred to have a herbicide tolerance trait, which allows the application of Telar® herbicide at both pre- and post-emergence for excellent weed control.

Agronomic performance of Regal® kale relative to Cleancrop™ Firefly kale

Cultivar	Leaf %	Hundredised total yield	Maturity (DAS)
Cleancrop™ Firefly	33	100	150-220
Regal®	32	101	150-220

4 trials: Gore, Hinds, Kimihia and Palmerston North (2015). In these trials conventional herbicides were used on both Firefly and Regal®. Telar® was not applied. Where Telar® was used for Firefly and no herbicide applied to Regal®, we would expect higher yields for Firefly kale.

PGG Wrightson Seeds Sales Agronomist Brian Young and farmer Peter Kane inspecting a paddock of Cleancrop™ Firefly kale on farm in Southland.

Cleancrop™ case study

CLEANCROP™ FIREFLY KALE CASE STUDY

Farm type:	Sheep and beef Dairy support
Hectares:	637
Location:	Gore, Southland
Name:	Andrew and Sarah Currie

Andrew and Sarah Currie are operating a 637 hectare farm near Gore in Southland. Their farm is made up of sheep and beef as well as dairy support. Their current stock numbers on the sheep and beef side are made up of 2,500 breeding ewes, 750 hoggets and 170 beef cattle. The dairy support side currently includes stock of 140 dairy heifers and 700 dairy cows.

Andrew and Sarah have been growing Cleancrop™ Firely kale for their winter feed since they first planted in spring 2017. The decision was made to utilise the benefits of the Cleancrop™ Brassica System through the use of Cleancrop™ Firefly kale after they experienced a failed conventional kale crop. They purchased their Firefly seed that comes with Ultrastrike® brassica seed treatment to support the establishment of the crop in the early stages against insects and fungal diseases.

"We have found that Cleancrop™ Firefly kale provides us with excellent weed control against wild turnip, Shepherd's Purse, Californian thistle and rayless chamomile, which have proven to be issues on our farm in the past", say Andrew and Sarah.

The Firefly was sown late November 2018 and is set to be grazed through winter by their beef calves. They have also found that this crop is a great option to control weeds following fodder beet. Cleancrop™ Hawkestone swede is another variety of the Cleancrop™ Brassica System they use in their rotation. They've found the system performs well for them and they will continue to use Cleancrop™ varieties.

Sarah Currie (left) and Andrew Currie (right) in their Firefly kale crop.

Hawkestone SWEDE

Cleancrop™ Brassica System

Farm type

Sowing rate

CONVENTIONAL SOWING

1 kg/ha

PELLETED

90,000 seeds/ha

Days to grazing

170-250 days

- High yielding, yellow-fleshed swede with medium maturity
- Similar dry rot and clubroot tolerance to Aparima Gold
- Good leaf disease tolerance
- Plant glucosinolate levels similar to Aparima Gold swede[#]
- Pelleted seed available, see pages 58-59 for more information

[#]Three main glucosinolates - progoitrin, glucobrassicin and neoglucobrassicin.

Hawkestone swede is a high yielding, yellow-fleshed, main crop swede with medium maturity. Along with a similar dry rot and clubroot tolerance to Aparima Gold swede, Hawkestone also has a good tolerance to powdery mildew. With the added benefit of the Cleancrop™ Brassica System, Hawkestone swede is tolerant to Telar® herbicide application at both pre- and post-emergence for excellent weed control. It is the first swede cultivar to be single plant selected for lower levels of grazing anti-nutritional glucosinolate compounds (progoitrin, glucobrassicin and neoglucobrassicin levels similar to Aparima Gold Swede).

Agronomic performance of swede cultivars relative to Cleancrop™ Hawkestone swede

Cultivar	Hundredised bulb yield	Hundredised leaf yield	Leaf %	Hundredised total yield	Maturity (DAS)
Cleancrop™ Hawkestone	100	100	24	100	170-250
Aparima Gold	89	118	28	96	170-250
Clutha Gold	104	115	26	106	170-250
Invitation	70	121	35	82	170-250

7 trials: Methven (2013, 2014, 2015), Gore (2013, 2014, 2015) and Palmerston North (2015). In these trials conventional herbicides were used on all cultivars. Telar® was not applied. Where Telar® was used for Hawkestone and no herbicide applied to the other cultivars, we would expect higher yields for Hawkestone swede.

PGG Wrightson Seeds Sales Agronomist Brian Young in a Cleancrop™ Hawkestone swede crop in Southland.

Cleancrop™ case study

PGG Wrightson Seeds Sales Agronomist Brian Young and farmer Scott Stiven standing in a on-farm Firefly kale paddock.

CLEANCROP™ FIREFLY KALE AND CLEANCROP™ HAWKESTONE SWEDE CASE STUDY

Farm type:	Sheep and beef
Hectares:	600
Location:	Otama, Southland
Name:	Scott and Danielle Stiven

Scott and Danielle Stiven manage a 600-hectare sheep and beef farm in Otama, eastern Southland. They run a sheep and beef finishing operation with current stock numbers on farm consisting of 4,700 mixed-age ewes, 1,200 ewe hoggets and 150 drystock beef cattle. All animals are wintered on brassica crops with this energy-dense, high quality feed complementing the overall farm system.

Scott and Danielle have been growing Cleancrop™ brassicas for winter feed since they first planted in 2016. They made the decision to utilise the Cleancrop™ Brassica System to control a few historically difficult-to-control weeds in their brassica crops. Scott has found Cleancrop to be an easy-to-use, simple crop and weed management solution all in one. The system combines the power of broad-spectrum herbicide Telar® and crops bred to tolerate it. Telar® takes care of 23 hard-to-control weeds at the time of sowing, freeing up moisture and nutrients to allow the Stivens' crop the best chance of maximising performance and delivering superior returns on their seed investment.

Cleancrop Hawkestone swede and Cleancrop Firefly kale are used for winter feed, while they sow Cleancrop leafy turnip as summer feed for fattening lambs. The usual cropping rotation is Hawkestone swedes followed by Firefly kale as a second-year brassica crop, due to its tolerance to clubroot and dry rot diseases. Kale is sown as early in November as ground conditions allow. A combination of sowing methods is used, either direct-drilling or a one-pass rotospike with air seeder.

Firefly is grazed through winter by both the twin-bearing MA ewes and beef cattle. "Firefly keeps its forage quality into late winter with good leaf retention and soft stems," Scott has observed. They have achieved high crop utilisation by grazing animals that can be attributed to stem softness and palatability. Scott has been impressed with the weed control, explaining that "the regrassing paddocks are noticeably clean, the Cleancrop system has helped to reduce the weed burden of ex-crop paddocks."

Overall, the Stivens have found the Cleancrop brassicas to be palatable, high yielding cultivars with effective weed control achieved with Telar herbicide. With these high yielding crops and consistent results, Scott will continue to use the Cleancrop Brassica System for all of his brassica requirements.

Brian Young and Scott Stiven inspecting a Hawkestone swede crop.

Bulb Turnip

Cleancrop™ Brassica System

- High yielding bulb turnip
- Suitable for sowing from late spring through to late summer
- Suitable for summer/autumn/winter feed

Farm type

Sowing rate

SUMMER
2 kg/ha

WINTER
1 kg/ha

Days to grazing

80-110 days

Cleancrop™ bulb turnip is a high yielding, globe bulb turnip with medium maturity suitable for sowing from late spring through to early summer to supply feed in summer, autumn and early winter months. The added benefit of the Cleancrop Brassica system is that plants are bred to tolerate Telar® herbicide allowing application at both pre- and post-emergence for excellent weed control.

Agronomic performance of Green Globe turnip relative to Cleancrop™ bulb turnip

Cultivar	Hundredised bulb yield	Hundredised leaf yield	Leaf %	Hundredised total yield	Maturity (DAS)
Cleancrop™ bulb turnip	100	100	54	100	80-110
Green Globe	87	93	55	90	90-120

4 trials: Kimihia (2013, 2016), Lincoln PFR (2013) and Ruakura (2016). In these trials conventional herbicides were used on both Cleancrop™ bulb turnip and Green Globe. Telar® was not applied. Where Telar® was used for Cleancrop™ bulb turnip and no herbicide applied to Green Globe, we would expect higher yields for Cleancrop™ bulb turnip.

Farm type

Sowing rate

2 kg/ha

Days to grazing

55-90 days

Feed planning

Area

Plant 2.5 hectares (ha) of turnips per 100 cows to feed for 60 days. Based on the assumption of a 10.5 tDM/ha yield and feeding 4 kg/cow/day with 90% crop utilisation.

Cultivar choice

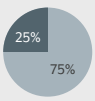
Suggested ratio for hectares of Cleancrop™ Toto turnip and Cleancrop™ bulb turnip for 60 days of feed during summer based on a late October planting.

Cleancrop™ Toto turnip to Cleancrop™ bulb turnip ratio and planned grazing period

Cleancrop™ Toto turnip
Cleancrop™ bulb turnip

Mid Dec–mid Feb

Start Jan–end Feb



Mid Jan–mid Mar

E.g. Based on the area assumption above, if planning to start grazing on 1st January for 400 cows, then plant 5 ha of Cleancrop™ Toto turnip and 5 ha of Cleancrop™ bulb turnip for 60 days of feed.

Toto TURNIP NEW

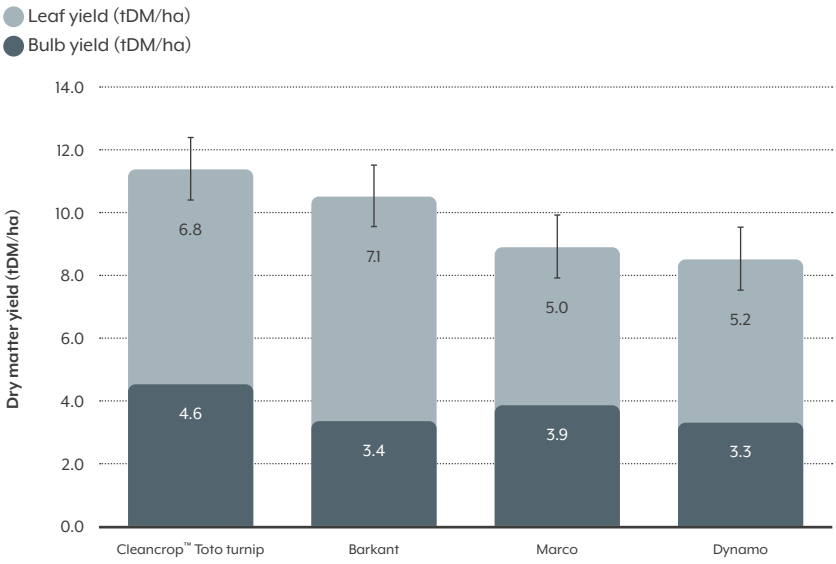
Cleancrop™ Brassica System

NEW ZEALAND BRED

- High yielding, summer bulb turnip
- Improved turnip mosaic virus tolerance
- Tankard bulb shape to increase crop utilisation
- Able to graze from 55 days after sowing (55-90 DAS)
- Suitable for summer and autumn feed

Toto turnip is a high yielding, summer and autumn bulb turnip with early maturity, allowing it to be grazed from 55 days after sowing. A tankard bulb shape alongside great bulb softness promotes excellent crop utilisation by grazing animals. Toto is also part of the Cleancrop™ Brassica System with the added benefit of a herbicide tolerance trait, which allows the application of Telar® herbicide at both pre- and post-emergence for excellent weed control.

Dry matter production of summer bulb turnip cultivars



Combined averages from 2 trials run at Puketaha, Waikato 2018 and 2019. LSD (5%) = 2.00 tDM/ha difference between cultivars must exceed the LSD to be significantly different.

In these trials, conventional herbicides were used on all cultivars. Telar® herbicide was not applied. Where Telar® was used for Toto turnip and no herbicide applied to the other cultivars, we would expect higher yields for Toto turnip.

Leafy Turnip

Cleancrop™ Brassica System

- High yielding - 25% higher than Pasja II
- Multi-graze Pasja type with reduced bolting
- Excellent plant persistence after multiple grazings (moisture dependent)
- Fast-establishing, high quality feed
- Provides a flexible grazing option for all stock classes over summer and autumn
- Minimal ripening required

Farm type

Sowing rate

4 kg/ha

Days to grazing

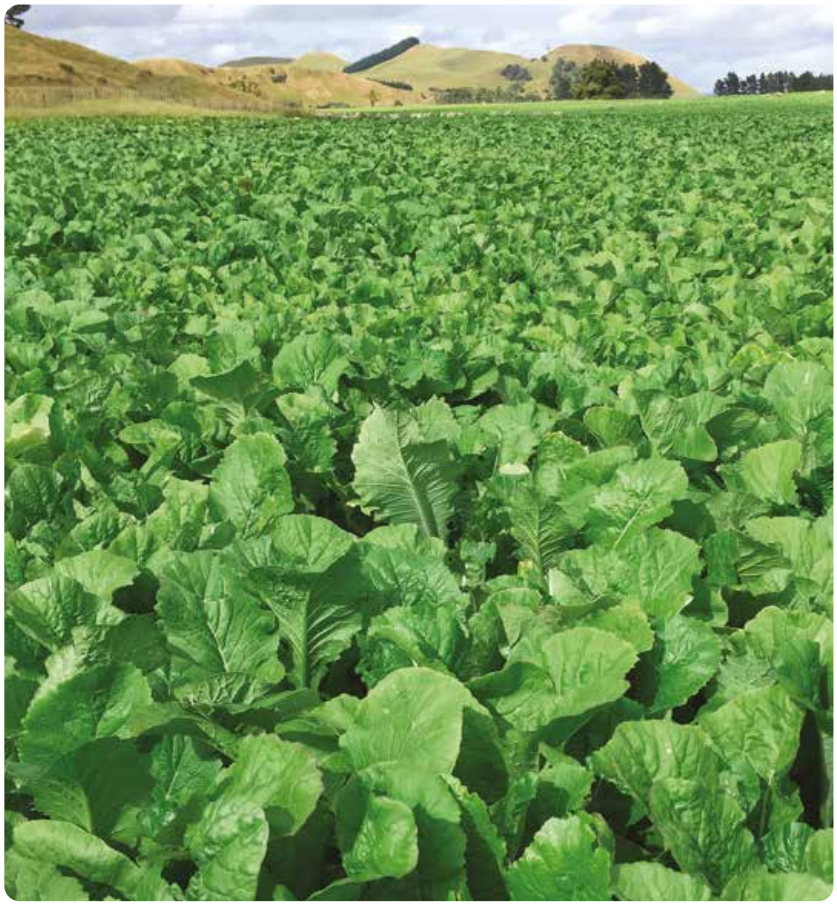
42-70 days

Cleancrop™ leafy turnip is a fast-establishing, multi-graze variety with reduced flower bolting and 25% more total yield from multiple grazings than Pasja II leafy turnip. As part of the Cleancrop Brassica System, it has the added benefit of a herbicide tolerance trait allowing Telar® herbicide to be applied at both pre- and post-emergence for excellent weed control.

Agronomic performance of Pasja II forage brassica relative to Cleancrop™ leafy turnip

Cultivar	Hundredised yield 1	Hundredised regrowth 1	Hundredised regrowth 2	Hundredised total yield	Maturity (DAS)
Cleancrop™ leafy turnip	100	100	100	100	42-70
Pasja II	64	85	82	75	42-70

3 trials: Kimihia (2013, 2014, 2015). In these trials conventional herbicides were used on both Cleancrop™ leafy turnip and Pasja II. Telar® was not applied. Where Telar® was used for Cleancrop™ leafy turnip and no herbicide applied to Pasja II, we would expect higher yields for Cleancrop™ leafy turnip.



Rape

Cleancrop™ Brassica System

- High yielding, multi-graze rape with good leaf percentage and crop utilisation
- Multi-purpose forage rape with excellent summer/autumn/early winter feed
- Similar Aphid tolerance as Goliath®
- Good regrowth potential with excellent winter-keeping ability
- A new generation rape and kale interspecies cross

Farm type

Sowing rate

4 kg/ha

Days to grazing

90-110 days

Cleancrop™ rape is a high yielding, multi-graze forage rape with very good leaf percentage and excellent crop ultilisation by stock. As part of the Cleancrop Brassica System, it has the added benefit of a herbicide tolerance trait. Telar® herbicide can be applied at both pre- and post-emergence for excellent weed control, freeing up moisture and nutrients to give this multi-purpose forage rape the best chance of maximising summer, autumn and winter feed.

Agronomic performance of rape cultivars relative to Cleancrop™ rape

Cultivar	Leaf %	Hundredised total yield	Maturity (DAS)
Cleancrop™ rape	76	100	90-110
Titan®	75	89	70-90
Greenland	70	99	70-84
Goliath®	69	101	90-110
Interval	63	104	90-110

12 Trials: Culverden (2013), Lincoln PFR (2013, 2014), Hawkes Bay (2013), Kimihia Research Centre (2014, 2015, 2016 x2), Gore (2016), Oxford (2016), Taihape (2016) and Ruakura (2016). In these trials conventional herbicides were used on all cultivars. Telar® was not applied. Where Telar® was used for Cleancrop™ rape and no herbicide applied to the other cultivars, we would expect higher yields for Cleancrop™ rape.

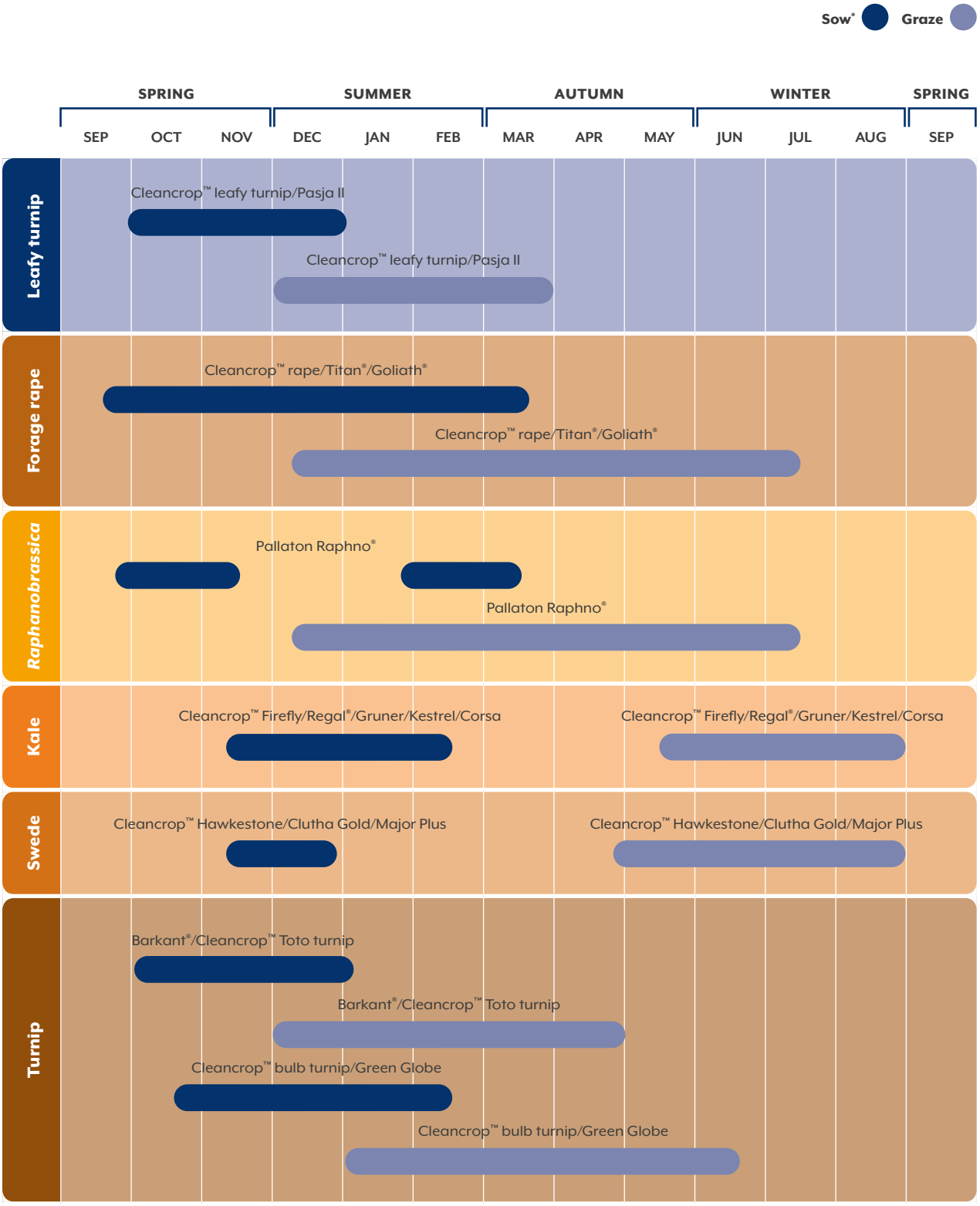
Brassica Options

We're proud to deliver the ultimate brassica range for your business.

Brassica options contents

Lambs grazing Pallaton Raphno® in South Australia.

Growing and grazing guide



Check with your seed retailer for the best time to sow and graze crops in your area.

**Make sure soil temperatures are around 10°C and rising before sowing.*

Brassica selection guide

BRASSICA PLANNING

1. Soil test paddocks at least 6-8 weeks prior to sowing.
2. Apply fertiliser as per specific soil test recommendations.
3. Aim to control all weeds prior to sowing.
4. Sow the most suitable brassica crop for your needs, with seed sown approximately 10 mm deep and a soil temperature of around 10°C and rising.
5. Use Ultrastrike®/Superstrike® treated brassica seed. This is recommended in both cultivated and direct drilling situations to enhance crop establishment and performance.

FACT FILE: CROP ROTATION

Ideally, brassicas should not be planted more than once in a five-year rotation where clubroot or dry rot is a problem, even when using clubroot or dry rot tolerant varieties. Kale and Raphno should be the only brassicas considered for a second crop and should not be sown if clubroot has been observed in the previous crop.

FACT FILE: CROP HUSBANDRY

If brassicas are sown following a crop, consideration should be given to the previous crop's herbicides when making the brassica selection.

WINTER BRASSICA OPTIONS:

SOWING TIME

- **Spring** (November - December)
  - Summer safe
    - First crop: Kale or swede
      - **SWEDE**
      - GRAZE FROM 150-170 DAS
      - Well-suited to both sheep, cattle and deer wintering systems. Good option for farms with snow risk that could cause kale to lodge.
      - Hawkestone® Cleancrop® Brassica System
      - Major Plus SWEDE
      - Clutha Gold SWEDE
    - Second crop: Kale only
  - Summer dry: Kale
    - **KALE**
    - GRAZE FROM 150 DAS
    - Good option for cattle and deer wintering systems. Shorter kale cultivars (e.g. Kestrel) also suitable for sheep wintering systems.
    - Regal® KALE
    - Firefly® KALE Cleancrop® Brassica System
    - Corsa® KALE
    - Kestrel® KALE
- **Late summer/autumn** (February - March)
  - Early winter feed: Rape or bulb turnip
    - **RAPE or BULB TURNIP**
    - GRAZE FROM APPROX. 100-120 DAS
    - Sow earlier for higher yielding crops.
    - Rape® Cleancrop® Brassica System
    - Goliath® FORAGE RAPE
    - Bulb Turnip® Cleancrop® Brassica System
    - Green Globe® CERTIFIED TURNIP
  - Late winter feed: Kale
    - **KALE**
    - GRAZE FROM APPROX. 100-120 DAS
    - Good option for production of high quality winter feed.
    - Regal® KALE
    - Firefly® KALE Cleancrop® Brassica System
    - Corsa® KALE
    - Kestrel® KALE

SUMMER BRASSICA OPTIONS:

SOWING TIME

Spring
(Late September - November)

Number of grazings

1

Bulb turnip

BULB TUNIP

SINGLE GRAZING
GRAZE FROM 55-90 DAS

Good source of summer energy and protein on dairy farms.

Bulb Turnip
Cleancrop™ Brassica System

Toto Turnip
Cleancrop™ Brassica System

Barkant Turnip

2-3

Summer safe

Leafy turnip

LEAFY TURNIP

EARLY MATURING
GRAZE FROM 42 DAS

Suitable for finishing lambs through the summer months.

Leafy Turnip
Cleancrop™ Brassica System

Pasja II Forage Brassica

Summer dry

Rape

RAPE

LATER MATURING
GRAZE FROM 70-90 DAS

Suitable for sheep and beef summer grazing systems.

Rape
Cleancrop™ Brassica System

Titan Forage Rape

4+

Raphno

RAPHNO®

EARLY MATURING
GRAZE FROM 50 DAE

Suitable for sheep and beef systems, providing reliable summer and early winter feed. Excellent in summer dry environments.

pallaton RAPHNO®

***DAS**: Days after sowing*
***DAE**: Days after emergence*

Brassica production and feed quality guide

Summer/autumn feed		Sowing rate (kg/ha)	Days to grazing	Regrowth ability		Crude protein %		Metabolisable energy (MJME/kgDM)	Digestibility	Yield range (kgDM/ha)	Average yield (kgDM/ha)	Utilisation %
				Regrowth	No. of grazings	Stem/bulb	Tops					
Turnip	Cleancrop™ bulb turnip	2	80-110	Nil	1	10-16	12-22	13.6	85	8,000 - 15,000	11,000	85
	Barkant®	1-3	60-90	Nil	1	10-16	12-22	13.6	85	8,000 - 15,000	11,000	90
	Cleancrop™ Toto turnip	2	55-90	Nil	1	10-16	12-22	13.6	85	8,000 - 15,000	11,000	90
Forage rape#	Cleancrop™ rape	4	90-110	Moderate	2	10-14	15-24	12.8	85	8,000 - 14,000	11,000	80
	Titan®	4	70-90	High	2	10-14	15-24	12.8	85	8,000 - 12,000	9,000	90
	Goliath®	4	90-110	Moderate	2	10-14	15-24	12.8	85	8,000 - 14,000	11,000	80
Leafy turnip	Cleancrop™ leafy turnip***	4	42-70	High*	3	-	13-22	13.6	85	6,000 - 11,000	10,000	80
	Pasja II***	4	42-70	High*	3	-	13-22	13.6	85	5,000 - 10,000	8,000	80
Raphanobrassica	Pallaton Raphno®	8	50+	Very high	3-5	10-14	15-24	13.3	85	10,000 - 18,000	12,000	85**

*Moisture dependant.
**Dependant on grazing height.
***Average yield based on 3+ grazings.
#Forage rape can be used as a winter feed option.

Winter feed		Sowing rate (kg/ha)	Days to grazing	Regrowth ability		Crude protein %		Metabolisable energy (MJME/kgDM)	Digestibility	Yield range (kgDM/ha)	Average yield (kgDM/ha)	Utilisation %
				Regrowth	No. of grazings	Stem/bulb	Tops					
Turnip	Cleancrop™ bulb turnip	1	80-110	Nil	1	10-16	12-22	13.6	85	6,000-12,000	11,500	80
	Green Globe#	0.8-2.0	90-120	Nil	1	10-16	12-22	13.6	85	6,000-12,000	11,500	80
Swede	Cleancrop™ Hawkestone swede	0.7-1	170-250	Nil	1	8-12	15-24	13.9	87	10,000-18,000	14,000	80
	Major Plus	0.8-1.5	150-220	Nil	1	8-12	15-24	13.9	87	10,000-16,000	13,000	80
	Clutha Gold	0.8-1.5	170-250	Nil	1	8-12	15-24	13.9	87	10,000-18,000	14,000	80
Kale	Cleancrop™ Firefly kale	4	150-220	Low	1	8-12	15-20	12.8	80	11,000-16,000	14,000	75
	Regal®	4	150-220	Low	1	8-12	15-20	12.8	80	11,000-16,000	14,000	75
	Kestrel	4	150-220	Low	1	8-12	15-20	12.8	80	10,000-14,000	12,000	75
	Corsa	4	150-220	Low	1	8-12	15-20	12.8	75	11,000-17,000	15,000	70
	Gruner	4	150-220	Low	1	8-12	15-20	12.8	75	11,000-17,000	15,000	70

#Green Globe turnip can be used as summer/autumn feed.
These figures are indications that allow you to compare stocking rates achievable on the various brassica options. Remember many factors, aside from dry matter yield, should be considered when choosing your brassica option.
For optimum productivity, stock wintered on brassicas should be offered a proportion of their daily intake as hay or straw in addition to brassica.

Brassica sowing

FACT FILE: FERTILISER

The soil pH level should be at least 5.6 and ideally between 5.8 and 6.2 for most brassicas. Crops should have at least 40-60 kg phosphate/ha available at sowing.

Paddocks should have low soil sulphate levels. After grazing, a light application of nitrogen will greatly increase yields of subsequent growth. Use of nitrogen may increase problems of high crop nitrate content; test levels before grazing.

1. Allow the paddock to get a pasture or weed cover of 2000 kgDM/ha.
2. Spray out with glyphosate at the correct label rate.
3. Three days later, hard graze to remove vegetation prior to cultivation or drilling.
4. If cultivating, use conventional farm practices that result in a fine, firm, residual-free seedbed.
5. In cultivated situations, seed can be broadcast, then harrowed and rolled. (If using Cleancrop™ Brassica System, then apply Telar® post sowing).
6. Best practice for direct drilling is to use a double spray programme. The initial spray out with glyphosate and usually a broadleaf herbicide occurs about 6 weeks before sowing. A second spray with glyphosate occurs prior to sowing to remove germinating seedling weeds (if using Cleancrop™ Brassica System, include Telar® with second spray), usually includes an insecticide and may require slug bait. Seed is sown at approximately 10 mm depth and then rolled. Seek advice for the appropriate use of chemicals.
7. Once the crop is sown, it is important to monitor the crop and apply the appropriate herbicides and insecticides to remove any weed or insect problems.

SWEDE SOWING RECOMMENDATIONS

Swedes should only be used in a first crop situation to prevent dry rot infection. A second crop alternative is kale.

If clubroot is likely to occur, Hawkestone or Clutha Gold are the better alternatives to other swede cultivars. Under high pressure from clubroot, kale should be used.

If there is a high risk of either dry rot or clubroot infection in the second year, it is recommended to sow the paddock in either a pasture or cereal crop.

In environments where brassica crops can be exposed to very cold conditions post-sowing followed by increasing temperatures, swedes should be sown no earlier than 20 November.

Earlier sowing combined with weather conditions can cause 'vernalisation', which means the plant believes it has been through winter and subsequently produces a seed head.

Sales Agronomist Brian Young and farmer Matthew Hough in a paddock of Cleancrop Hawkestone swede in Southland.

NOTE:

For products within the Cleancrop™ Brassica System range (Cleancrop™ Hawkestone swede, Cleancrop™ Firefly kale, Cleancrop™ bulb turnip, Cleancrop™ Toto turnip, Cleancrop™ leafy turnip and Cleancrop™ rape), follow the latest Cleancrop™ Brassica System Guide for best practice management and the stewardship plan.

Winter cropping and the environment

KEY ISSUES

1. Loss of **soil** including **phosphorus** from crop paddocks into waterways.
2. Movement of **nitrate** from animal urine to waterways.
3. **Greenhouse gas** emissions from stock.

WHAT'S BEST FOR THE ENVIRONMENT CAN HAVE OTHER BENEFITS TOO

Keeping stock out of waterways away from critical source areas (CSAs) - key benefits:

Environment

Reduced loss of soil sediment, phosphorus and faecal matter to water.

Animals

Away from muddy CSAs:

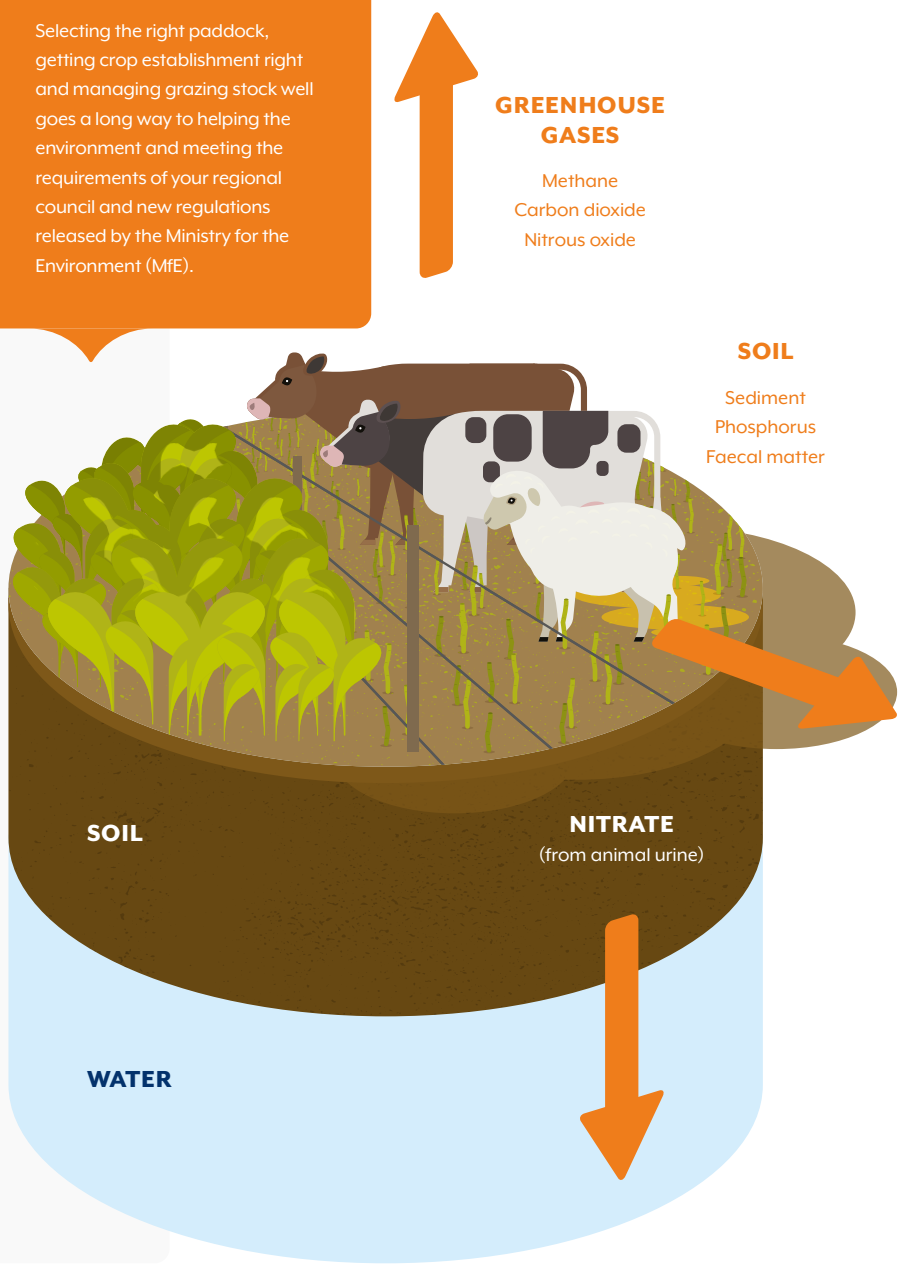
- Able to lie down/rest, more content stock, more likely to meet animal welfare code
- Improved image for international markets

Your farm business

Sustainable farming for future generations.

TIP:

Selecting the right paddock, getting crop establishment right and managing grazing stock well goes a long way to helping the environment and meeting the requirements of your regional council and new regulations released by the Ministry for the Environment (MfE).



TIP:

Stock grazing forage brassicas produce less of the greenhouse gas methane than pasture-fed stock*

**www.pggrc.co.nz/files/1554327577875.pdf*

SMALL CHANGES CAN MAKE BIG DIFFERENCES

What to do today

Depending on the time of year, winter crop planning can start today – paddock selection for next year or grazing management for the crop being grazed today. Review your obligations as required by your local regional council for crop planning, including maximum areas of crop that you can sow and grazing strategies that optimise outcomes for both your animals and the environment.

Farm Environment Plans (FEP) and Freshwater Farm Plans (FWFP)

Winter crop planning is no longer simply part of regular farm planning. Planning for and implementation of crop management now forms a part of the FEP and FWFP, as well as needing to meet expectations of local catchment groups, regional council, and current and future regulations within the National Environment Standards for freshwater (NES-FW). Well planned and implemented winter crop management will help meet current and future environmental components of industry assurance programmes such as the New Zealand Farm Assurance Programme.

More information about FEPs and FWFPs, the NES-FW and industry assurance programmes can be found on the DairyNZ, Beef and Lamb New Zealand, Ministry for Primary Industries (MPI), Ministry for the Environment (MfE) and your local regional council websites.

Local regional council regulations

Find out about local regulations around winter grazing that apply to you at home and/or where your stock may be grazing.

Adopt a team approach

Discuss ideas, concepts and planning strategies around crop and grazing management with friends, family and rural professionals you work with.

TIP:

All winter crop types contribute to nitrate loss to water. Extent of loss depends on soil type, soil drainage properties, stocking rate, animal type and liveweight, nitrogen content of feeds and rainfall.

1. PLANNING

Feed budget: Area of crop needed to meet feed demands and total area that does not exceed MfE regulations
Paddock history: Soil fertility, previous crops, weeds
Soil type: Heavy or free-draining
Paddock location: Location of waterways or critical source areas with crop set back from these areas at least the minimum distance required by your local regional council
Resource consent requirement: You may need a resource consent if you plan to plant more than 50 hectares or 10% of your farm in winter forage crops, or as required by your regional council
Slope of paddock: Consider the risks of water and soil runoff in relation to the paddock slope and ensure regulatory requirements are met
Shelter: Animal welfare during storms
Location: Walking/truck access for stock, distance to truck baleage, straw
Altitude: Southland requirements no higher than 800m
Catch crop: Establish a catch crop (e.g. forage oats) after the winter crop to utilise soil nitrate

2. SOWING

Fertiliser use: Soil test to define nutrient demand of crop, avoiding unnecessary nitrogen and phosphorus application
No-tillage: This can be beneficial due to less soil disturbance, which can reduce soil loss to waterways. Good for first year crops
Baleage placement: Leave sufficient area for bales
Avoid critical source areas (CSAs): Do not cultivate through CSAs
Grass buffer zones: Retain buffer zones between crop area and CSAs to reduce soil runoff. Buffer widths of between 5-20 m may be needed
Grass headland: Leave sufficient area for stock to begin crop transitioning, reduces gate way soil damage from on-off grazing

3. GRAZING

Placing of baleage: Place bales before winter – avoid soil disruption during wet weather. Place away from CSAs
Fence off CSAs: Fencing to be in accordance with regulatory requirements and stock kept off CSA areas
High pasture mass on CSAs: Pasture mass accumulating through summer acts as filter for soil lost from crop ground
Grazing direction: Start furthest away from CSAs, grazing downhill towards CSAs
Extra supplementary feed in bad weather: Fill up stock with extra fibre – animals will be more settled with less walking in bad weather
Stock water: Portable troughs that follow crop face reduces unnecessary walking by stock to find water
Back fencing: Cattle: back fence twice a week (or as frequently as required by your regional council)

BRASSICA OPTIONS

Raphno®

Farm type

Sowing rate

8 kg/ha

Days to grazing

50-70 DAE

DAE: *Days after emergence*

pallaton RAPHNO®

THE SUCCESS OF SCIENCE

Pallaton Raphno® is a hybrid between *Brassica oleracea* (kale) and *Raphanus sativus* (radish). This hybrid has brought a number of impressive agronomic attributes into one cultivar, including high forage yields from multiple grazings, drought tolerance, clubroot tolerance and improved tolerance to a range of key insects.

The first new forage brassica species New Zealand farming has seen since the 1980s. Developed by PGG Wrightson Seeds under the Forage Innovations Limited joint venture with Plant and Food Research.

THE SIX TRAITS INCLUDE:

HIGH FORAGE YIELDS
FROM MULTIPLE GRAZINGS

PLANT PERSISTENCE
UNDER MULTIPLE GRAZINGS

DROUGHT TOLERANCE

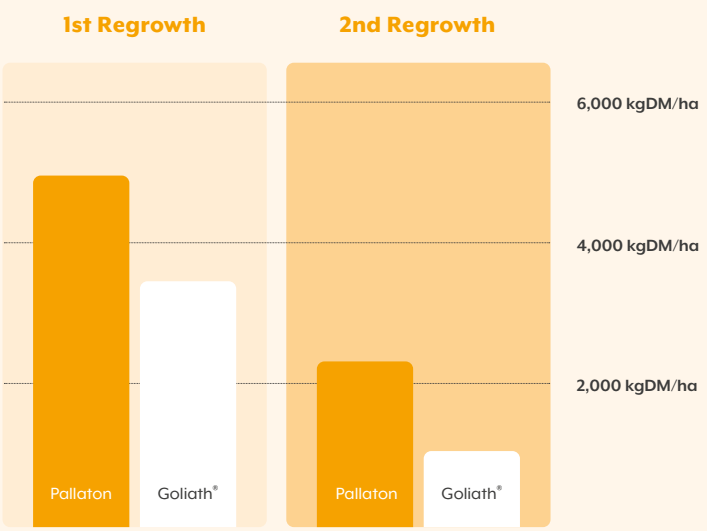
CLUBROOT TOLERANCE

APHID TOLERANCE

GRAZING FLEXIBILITY

HIGH YIELDING

14% increased yield advantage relative to Goliath® forage rape in a multi-graze system (total cumulative dry matter (DM) yield from repeat harvests).



MORE MEAT PER HECTARE

Our trials showed Pallaton delivered 41%* more meat per hectare compared with chicory. **Pallaton Raphno®: total 390 kg/ha** versus **chicory: total 276 kg/ha**.

**Trial completed by PhD student Holly Phillips at Massey University. Meat per hectare data was captured over the period 17/01/2020 to 01/05/2020. For more information, refer to pages 44-45.*

Performance: Agronomic trials

DROUGHT TOLERANCE

38% increase in water use efficiency (WUE) relative to Goliath® forage rape.

Pallaton plots (dark green) amongst forage rape varieties in dryland North Canterbury.

FLEXIBILITY

Graze Pallaton as early as 50 days after emergence (DAE) to maximise crop utilisation and optimise regrowth potential. It can be deferred up to 100 DAE, however crop utilisation, regrowth potential and feed quality will be reduced. Pallaton does not have a specific maturity requirement.

Refer to page 42 for grazing management.

CLUBROOT TOLERANCE

Pallaton Raphno® has a **high tolerance to clubroot**. *In vitro* inoculation pot trials and field trials to date have shown strong tolerance to Pukekohe, Hawke's Bay and Southland strains of clubroot. Although Pallaton is highly tolerant to clubroot it is still susceptible to other brassica diseases.

GRAZING PALATABILITY

Pallaton has shown **increased palatability** relative to forage rape and leafy turnip brassicas.

Lambs preferentially grazed Pallaton over the forage rape in Central Hawke's Bay. There was no fence between the strips of cultivars.

Post-grazing (left) and 15 days after rain (right).

PERSISTENCE UNDER MULTIPLE GRAZINGS

100% increase in plant survival relative to forage rape under dryland sheep grazing management.

Forage rape (left) and Pallaton (right) under Aphid pressure. Both plants have had identical treatment and are in side-by-side plots.

APHID TOLERANCE

32% increase in Aphid tolerance relative to forage rape. Pallaton also has a higher level of tolerance to White Butterfly and Diamondback Moth.

Forage rape (left) and Pallaton (right) under clubroot pressure.

FURTHER INFO: More info on Pallaton Raphno® can be found in the Pallaton Raphno® Guide.

Lamb grazing focus

For the best opportunity to maximise feed quality, increase crop utilisation of lambs and optimise regrowth potential of Pallaton Raphno®, follow these lamb grazing guidelines.

EXAMPLE OF CALCULATING STOCKING RATE FOR LAMB GRAZING

1 ASSESS DRY MATTER YIELD PRIOR TO GRAZING

Take a minimum of four quadrat cuts of 1 m^2 from your crop prior to grazing. Send a sample away for dry matter testing (DM%).

Formula:

Pre-grazing yield (kgDM/ha) =
average fresh weight/m^2 (kg) x DM% x 10,000 m^2

Example:

Quadrat weights:
1) ***3 kg*** *2)* ***4 kg*** *3)* ***3.5 kg*** *4)* ***3.5 kg***

Average = 3.5 kg fresh weight

Dry matter test result = 10%

Pre-grazing yield = 3.5 kg x 10% x 10,000 m^2

= 3,500 kgDM/ha (A)

2 WORK OUT THE DAILY FEED DEMAND OF YOUR LAMBS

Estimate the average liveweight of the lambs over the duration of the grazing period by using the starting weight and target finishing weight. Offer lambs 7% of their average liveweight per day.

Formula:

Daily demand (kgDM offered/head/day) *= average liveweight (kg) x 7%*

Example:

Average lamb starting weight = 30 kg

Planned rotation length = 40 days

Target lamb finishing weight (at the end of the grazing rotation) = 40 kg

Average liveweight (at mid-point of rotation) = 35 kg

Daily demand (kgDM offered/head/day) = 35 kg x 7%

= 2.45 kg (B)

3 CONSIDER ADDITIONAL GROWTH UNDERFOOT

Pallaton continues to grow even while grazing, so you may end up with more feed than you started with. Make the following assumptions to predict how much feed you may grow ahead of lambs in the grazing rotation, or underfoot in set stocking situations, and add this to your yield calculation. Expected Pallaton growth rates underfoot and ahead of lambs are:

Summer dry[#]:
50 kgDM/ha/day.

Summer moist[#]:
100+ kgDM/ha/day.

Winter[#]:
20-50 kgDM/ha/day.

Formula:

Growth underfoot (kgDM/ha) =
Predicted growth rate (kgDM/ha/day) x (Rotation length x 0.5) days

Pick the halfway point in the rotation for your 'growth underfoot' calculation.

Example:

Predicted growth rate = 50 kgDM/ha/day (Summer dry conditions)

Planned rotation length = 40 days

Growth underfoot (kgDM/ha) = 50 kgDM/ha/day x (40 x 0.5) days

= 1,000 kgDM/ha (C)

[#]Crop growth rates are examples only. Actual growth rates will vary depending on soil fertility, plant density, ambient temperature and paddock aspect.

4 CALCULATE YOUR STOCKING RATE

Stocking rate (lambs/ha) =

$$\frac{A + C}{B \times \text{No. days on crop or rotation length}}$$

Example:

Dry matter yield (A) = 3,500 kgDM/ha

Lamb daily demand (B) = 2.45 kgDM offered/head/day

Growth underfoot (C) = 1,000 kgDM/ha

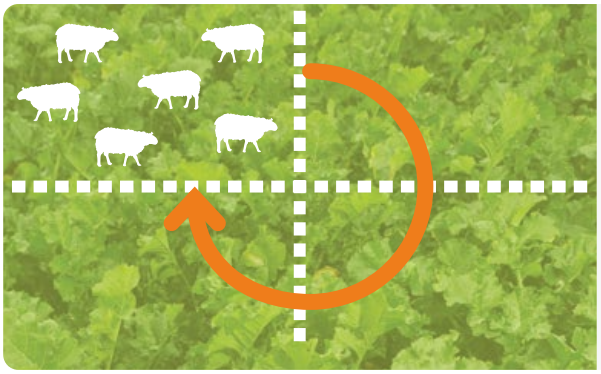
Rotation length = 40 days

Stocking rate (lambs/ha) =

$$\frac{3{,}500 \text{ kgDM/ha} + 1{,}000 \text{ kgDM/ha}}{2.45 \text{ kgDM offered/head/day} \times 40 \text{ days}}$$

= 46 lambs/ha

GRAZING SYSTEM FOR LAMBS



1 ROTATIONAL GRAZING

Take advantage of Pallaton's regrowth ability by setting up a rotation - this is the best way to achieve the highest number of grazings over a season.

Divide the total area of crop into blocks (for instance, 4 blocks) and use a rotation length of 28-40 days, depending on your area and climatic conditions*.

2 SET STOCKING

If it is not practical to subdivide Pallaton paddocks for rotational grazing, lambs can be set stocked on the crop for a fixed period of time.

Take a yield assessment prior to grazing to calculate the stocking rate to ensure the right number of lambs for the required time#.

*Pallaton growth rates will vary depending on environmental conditions.

#See the grazing indicator information on page 39 and example of calculating stocking rate for lamb grazing on pages 36-37.

PALLATON RAPHNO® GRAZING INDICATOR FOR LAMBS

To optimise the multi-graze capabilities of Pallaton Raphno®, we recommend using the grazing indicator road cone to help with lamb grazing management decisions.

1 PLANT, WAIT AND WATCH

Identify a position for your Pallaton cone in an average area of paddock.

Think about what stock classes you have available.

2 GRAZE!

Once Pallaton reaches the reflective strip on the cone, get in and graze. Make sure lambs are full of another feed type at first grazing.

Note: It must be at least 42 days since planting before grazing can commence.

3 YOU ARE MISSING OUT

Once Pallaton exceeds the height of the cone, feed quality and regrowth potential will begin to decline.

TIPS FOR TOP GRAZING MANAGEMENT

- If you don't have lambs on hand when Pallaton is ready to graze, consider another stock class such as ewes. Ewes will help 'open up' the crop, which can be very beneficial for introducing lambs to the crop afterwards
- Stocking rate is very important to get right. Understocking will result in poor crop utilisation and risk losing feed quality, while overstocking may see you run short of feed
- If you are unable to graze early, not all is lost. It may mean you can carry a higher yield forward to a period when you require the feed. However, adjust your expectations and understand your regrowth potential, crop utilisation and/or crop feed quality may be compromised
- A grazing withholding period of 42 days after sowing (DAS) applies to Pallaton due to the Ultrastrike® seed treatment.

IMPORTANT

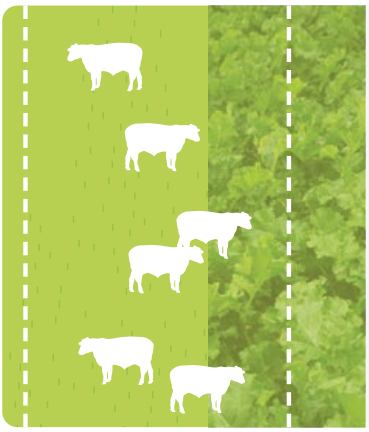
Leaving Pallaton to grow past optimal grazing height and/or not grazing down to optimal post-grazing residuals SIGNIFICANTLY reduces:

- Feed quality - lower metabolisable energy (MJME/kgDM) and crude protein; higher neutral detergent fibre (NDF)
- Regrowth potential
- Potential number of grazings

Cattle grazing focus

For the best opportunity to maximise feed quality, increase crop utilisation of cattle and optimise regrowth potential of Pallaton Raphno®, follow these cattle grazing guidelines.

GRAZING SYSTEM FOR CATTLE

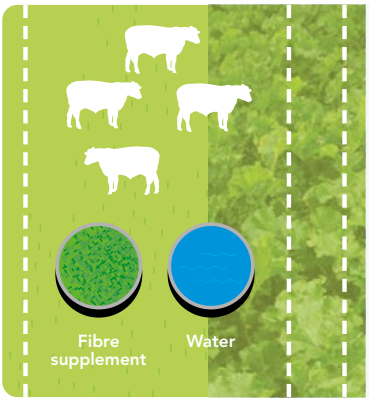


1 STRIP GRAZING

Strip grazing is necessary for cattle grazing Pallaton with daily or every second day break shifts.

Set stocking or grazing large blocks of Pallaton with weekly shifts for instance, is not recommended for cattle.

Back fencing and taking care to not overgraze Pallaton is essential if crop regrowth is required. Avoid post-grazing residuals below 10 cm, as this will compromise regrowth potential. Prior to grazing, it is important to assess the dry matter (DM) yield of the crop, while also accounting for ongoing growth of Pallaton 'underfoot' and in front of cattle to help with feed allocation.

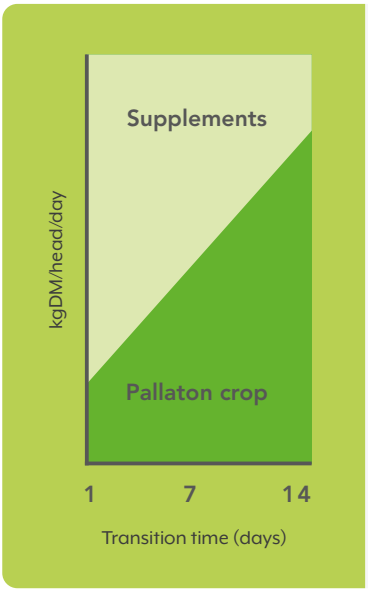


2 FENCING AND FRESH WATER

When transitioning from pasture onto brassica crops, cattle are most at risk of bloat and rumen acidosis. Therefore, it is important to manage a gradual transition onto crop and to monitor animal health.

Double fence the Pallaton crop face and check voltage of electric fences to prevent breakouts.

Crop-fed cattle must have access to fresh water at all times. The use of portable troughs that move with the crop face work best. When back fencing ensure cattle are able to easily access the fresh water.



3 GRADUALLY TRANSITION ONTO PALLATON

A gradual feed transition period from pasture onto brassica crops is required. The amount of Pallaton offered (kgDM/head/day) can be steadily increased until cattle receive their full diet allocation after 10-14 days.

Transitioning allows the rumen time to adjust to a fermentation best suited to the new feed source. However, feed transitioning onto Pallaton from another brassica such as forage rape, kale, swede or turnip is not typically required.

To assist with feed allocation, complete a DM yield assessment before grazing Pallaton crop.

Once transitioned onto Pallaton, limit the diet on a DM basis to no more than 80% of Pallaton crop for beef cattle, dry dairy cows and dairy heifer replacements and 35% for lactating dairy cows.

Feed pasture, baleage, hay and/or silage as the balance of the diet, offering a high fibre supplement helps to stabilise the rumen function for brassica-fed animals.

PALLATON RAPHNO® GRAZING INDICATOR FOR CATTLE

To optimise the multi-graze capabilities of Pallaton Raphno®, we recommend using the grazing indicator road cone to help with cattle grazing management decisions.

1 PLANT, WAIT AND WATCH

Identify a position for your Pallaton cone in an average area of paddock.

Think about what stock classes you have available and how you will transition cattle onto Pallaton.

2 GRAZE!

Once Pallaton reaches the reflective strip on the cone, get in and graze.

Make sure cattle are full of another feed type at first grazing.

Note: It must be at least 42 days since planting before grazing can commence.

3 YOU ARE MISSING OUT

As Pallaton gets taller and appears more like kale, heavier stems reduce feed quality, crop utilisation and overall stock performance.

TIPS FOR TOP GRAZING MANAGEMENT

- A grazing withholding period of 42 days after sowing (DAS) applies to Pallaton due to the Ultrastrike® seed treatment
- Post-grazing residuals below 10 cm can reduce the regrowth potential of the Pallaton crop
- Dry dairy cows, dairy heifers and beef cattle should be limited to 80% of Pallaton in their diet. Feed no more than 35% of the diet as Pallaton for lactating dairy cows. Use a high fibre supplementary feed such as baleage, hay, silage and/or pasture for a balanced diet
- Do not feed Pallaton as a complete diet. Cattle will require a high fibre supplementary feed

IMPORTANT

Leaving Pallaton to grow past optimal grazing height and/or not grazing down to optimal post-grazing residuals SIGNIFICANTLY reduces:

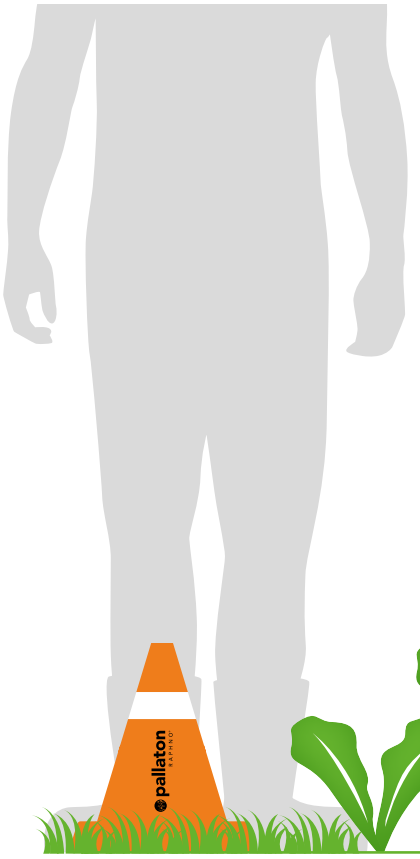
- Feed quality - lower metabolisable energy (MJME/kgDM) and crude protein; higher neutral detergent fibre (NDF)
- Regrowth potential
- Potential number of grazings

Grazing management

TIP:

Check that Pallaton plants are strongly rooted into the ground prior to being grazed by cattle.

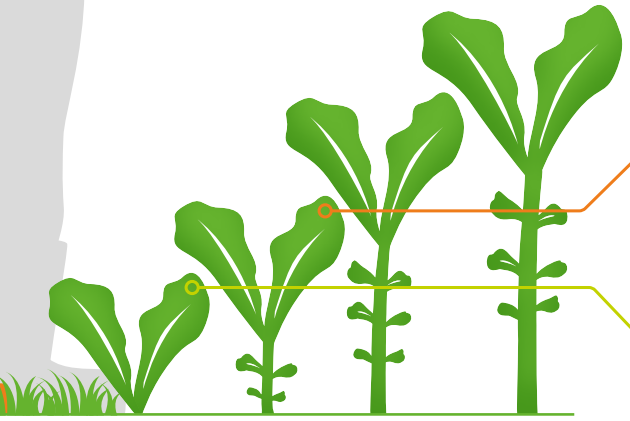
Cattle are a great management tool to control Pallaton crops that have grown too quickly and become too tall for sheep to effectively utilise. Graze tall crops with cattle before shifting sheep onto the crop to graze the short, fresh and better quality regrowth.

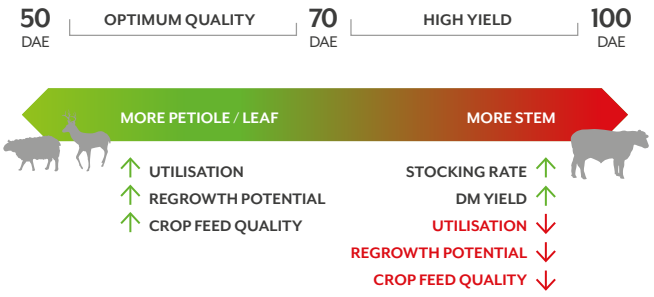


Note: knee and gumboot height in the illustration are indicative for grazing height based on an average height person. Ideal first grazing height for cattle is above 25 cm.

Maximum crop height for good crop utilisation for CATTLE

Maximum crop height for good crop utilisation for SHEEP





DAE: Days after emergence

AUTUMN PLANT COUNTS

The average plant numbers present in early autumn will help determine what the best option will be for your Pallaton crop.

MORE THAN 15 PLANTS/m²

Carry through for winter graze

Consider carrying the crop through to winter as a sole sward if weed burden is low and soil fertility is adequate. Shut the paddock up by early April and apply nitrogen accordingly to boost overall dry matter yield for winter.

10-15 PLANTS/m²

Undersow with winter-active grasses or cereals

Increase the opportunity for extra winter feed by undersowing with a winter-active ryegrass in the autumn. Options include Italian ryegrasses such as Supercruise, Lush AR37 and Feast® II, Winter Star II annual ryegrass or oats.

LESS THAN 10 PLANTS/m²

Spray out and resow

Plant numbers are inadequate to provide sufficient winter feed. Consider spraying out crop followed by a hard/low residual graze with animals to minimise crop residue carryover before planting back into pasture.

Raphno® case study

PALLATON RAPHNO® CASE STUDY

Property:	Smedley Station
Farm type:	Sheep, beef and deer
Hectares:	5,500 (3,600 effective)
Location:	Tikokino, Hawke's Bay
Name:	Rob Evans

Smedley Station is located in Tikokino, Hawke's Bay, spanning 5,500 hectares. Smedley farm sheep, beef and deer as a breeding and finishing operation, including velvet production. The 2019/20 season was the third consecutive season they had used Pallaton Raphno®. The decision to plant Pallaton was made to enhance their lamb finishing operation as well as safe guarding their farm system against possible drought. They are impressed with the drought tolerance of Pallaton as it can persist and regrow in dry summers. Smedley Station have integrated 140 hectares this past year into their farm system, alongside ryegrass pasture and high-performance crops including plantain, lucerne and chicory. Pallaton provides them with summer grazing with the added benefit of winter feed as a 12-month option. The multi-graze, multi-use qualities have led them to rotationally graze lambs in summer, followed by replacement hoggets, in-lamb ewe hoggets, deer and bulls in winter.

This year, Pallaton has enabled Smedley Station to finish their lambs, while taking advantage of high stocking rates as well as sustaining animal performance over an extremely dry summer. To ensure the crop was ready to graze with early-weaned lambs, the crop was sown as early as possible and rotationally grazed. Stocking rates were higher on Pallaton compared to other forage crops and were reassessed between grazings to ensure continued animal growth and crop regrowth.

Business Manager Rob Evans is impressed with the crop and animal performance on this year's Pallaton. Lambs achieved up to 300 grams liveweight gain per day. Rob was very pleased with the final carcass weight dressing percentages, ranging between 46-49% per head over the grazing period.

They have followed the best practice grazing management guidelines by using the summer grazing indicator cone and not allowing the crop to get above knee-height between grazings. Local PGG Wrightson Seeds Sales Agronomist Paul Greenbank says, "Grazing at the cone's reflector strip provides the best opportunity to maximise feed quality, increase utilisation and regrowth potential of Pallaton Raphno®. This encourages more leaf and petiole growth, which helps maintain the quality for lamb liveweight gain."

Smedley Station was one of the first properties to use Pallaton since its release 3 years ago. Smedley have continued to increase the area grown on farm, as they see a suitable fit for Pallaton within their farm system. This past season they grazed the crop to its optimum standard; the Pallaton cone grazing indicator has been a useful tool to ensure the crop is grazed at the right time. Rob and the team have gained the rewards of exceptional liveweight gain, carcass weight yields as well as quality and regrowth of the crop. Rob says, "This year our team have done a great job with grazing management and we're looking to utilise Pallaton Raphno® again next season."

Business Manager Rob Evans in a paddock of Pallaton Raphno® at Smedley Station.

Raphno® farm systems research

As a Forage Agronomist, Holly Phillips is responsible for research and extension relating to PGG Wrightson Seeds pasture and brassica products in the lower North Island. Recently, Holly completed two replicated farmlet trials for her PhD from Massey University, investigating the effect of finishing diet on liveweight gain, meat quality and fat characteristics in lambs. The second trial, near Palmerston North, ran from January to May 2020 and compared the forage yields, stocking rates and red meat yield per hectare (ha) associated with three forage types: Pallaton Raphno®, Puna II chicory and perennial ryegrass/white clover pasture.

The data collected included dry matter yields, stocking rates, lamb growth rates, lamb carcass weights and a meat sample taken for later analysis. This information was used to identify how a forage may be able to deliver meat with favourable attributes while also being profitable, with farmers being paid for meat on a yield basis.

Overall, 436 male lambs were examined with each EID tagged to track individual liveweights and carcass information through the abattoir.

During the trial in summer and autumn 2020, the Manawatu region experienced dry conditions, with 30% lower rainfall than the 10-year average. This lack of moisture placed stress on plant performance, resulting in large differences in regrowth potential and carrying capacity across the three forages.

Forage Agronomist Holly Phillips standing in a Pallaton Raphno paddock, a part of her farm systems research.

Lambs grazing Puna II chicory.

LAMB PERFORMANCE

Lambs on Puna II had the highest liveweight gain per head (301 g/day) compared to Pallaton (202 g/day) and pasture (187 g/day). The lambs transitioned quickly from pasture to chicory, growing well since day 1 of the trial whereas Pallaton lambs required more time to transition before maximising their liveweight gain. When selecting a forage, it is important to consider both per head performance and stocking rate to assess the benefits it could bring to your farm system. In this trial, Pallaton had a significantly higher stocking rate, resulting in a higher liveweight gain per ha over the length of the trial.

STOCKING RATE

For the second year in a row, Pallaton proved impressive with its drought tolerance and persistence, enabling a higher stocking rate of lambs per grazing (refer to Figure 1) and producing more feed into late summer and autumn compared to the other forages.

In comparison, despite low stocking rates, the slow growth of chicory meant that, once grazed down to a low residual, it did not recover well enough to be fed in autumn. It was for this reason that no new lambs were started on chicory in March.

Figure 1: Lamb stocking rates per hectare on forages

Lambs per hectare

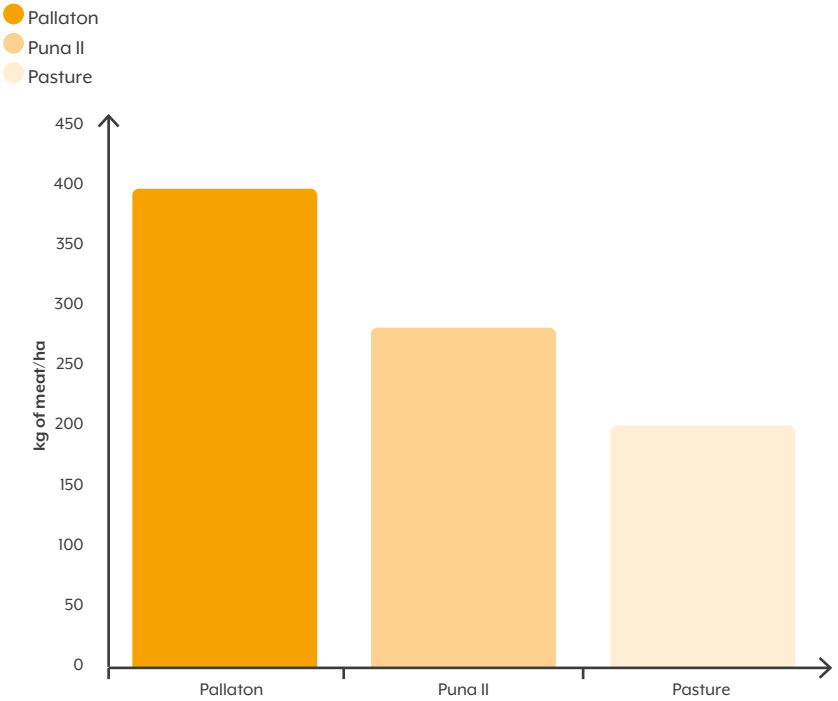
	MID-SUMMER Day 1 – 34 17.01.20 – 20.02.20	LATE SUMMER Day 35 – 68 21.02.20 – 25.03.20	AUTUMN Day 69 – 105 26.03.20 – 01.05.20
pallaton RAPHNO	50 →	32 →	35 →
Pasture	32 →	19 →	18 →
GRASSLANDS Puna II CHICORY	35 →	15 →	

Lamb stocking rates on the forages through mid-summer, late summer and autumn

CARCASS WEIGHT GAINED

Carcass weight gained was used to determine the farm system benefits of the three forages studied. Liveweight can be misleading as it is affected by forage type and time off feed, whereas carcass weight provides a more complete picture. Utilising the lambs' EID tags, the individual carcass weights were recorded at the abattoir. As shown in Figure 2, the total carcass weight gained on Pallaton was 390 kg/ha over the trial period, compared to 276 kg/ha on chicory and 195 kg/ha on pasture. Overall, Pallaton produced 41% more carcass weight per ha compared to chicory and 100% more than on pasture.

Figure 2: Carcass weight gained per hectare



Net carcass weight gained on Pallaton Raphno, Puna II chicory and perennial ryegrass/white clover pasture over the trial period.

TIP:

Choose Puna II chicory for 'A' (heavier) lambs as they will transition quickly and have fast growth rates. Liveweight gain per head will be high but stocking rate will be lower than Pallaton Raphno.

Choose Pallaton Raphno for 'B' (medium) lambs as this gives them time to transition and maximise liveweight gain. Stocking rate will be higher than on Puna II but liveweight gain per head may be lower. Reliable summer performance means that lambs can be kept on quality feed during summer when pasture quality and quantity is declining.

Use both in your farm system for optimal feed supply and to spread your risk.

BRASSICA OPTIONS

Kale

Choosing the best kale

WITH A RANGE OF KALES AVAILABLE, IT'S IMPORTANT TO CHOOSE THE RIGHT ONE FOR YOUR FARM

Stock can and will gain weight on kale, but need plenty of leaf and good forage quality. The days of choosing a kale cultivar based simply on dry matter (DM) yield are well behind us. Results from a Canterbury kale study (Westwood et al 2014)* can help identify the best kale for your property.

The study ran from May to September 2013 and compared the forage yields, leaf percentages and feed quality values associated with four kale cultivars: Regal®, Gruner, Kestrel and Rawera. Kale cultivars were sampled on a monthly basis for nutrition value of plant components (stem and leaf).

TRIAL RESULTS

Dry matter yield: Regal® and Gruner yielded significantly more DM than Kestrel or Rawera kales. A late-winter flush of leaf growth lifted yields of Regal and Kestrel, but not Gruner or Rawera.

For the best of both worlds (yield and leaf), choose Regal.

Leaf percentage: Regal and Kestrel produced more leaf compared with Gruner or Rawera. The difference was very obvious by late winter.

For a leafy crop, particularly in late winter, choose Regal or Kestrel.

Metabolisable energy (MJME) content: Kestrel contained significantly more energy (MJME/kgDM) and less neutral detergent fibre (NDF) than the other kale cultivars. While Kestrel recorded a lower DM yield, its energy density lifted the MJME yield per hectare to levels comparable with other cultivars.

Stem quality: Kestrel had the highest quality stem, with 13.0 MJME/kgDM for top stem and 11.6 MJME for stem base. The results indicated Rawera has a very low quality stem base (8.7 MJME/kgDM), almost a 3.3 reduction in the MJME value recorded for top stem.

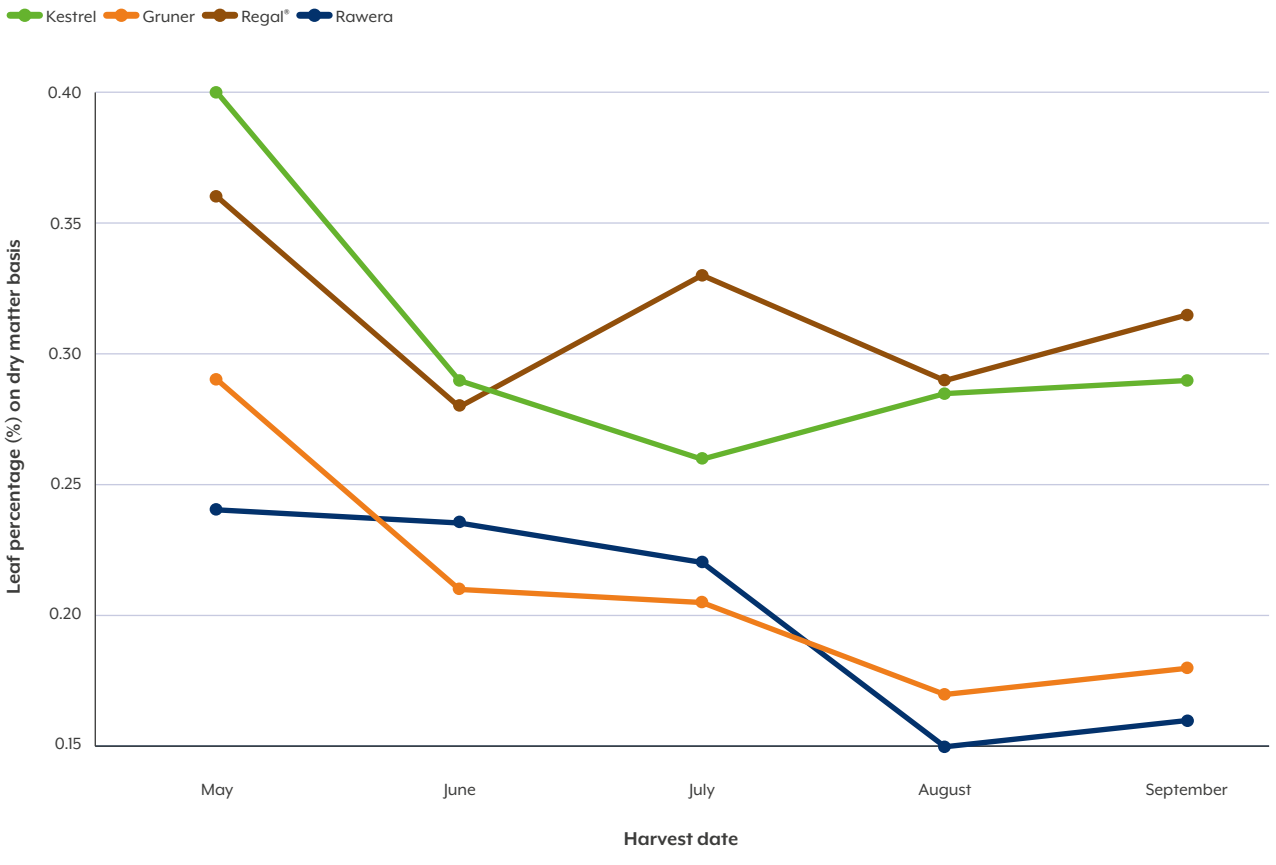
RECOMMENDATIONS

DM yield: If the amount of feed available is your key requirement, choose Regal or Gruner. Both kale cultivars produce a high DM yield; however Regal had a flush of new leaf growth in late winter while Gruner lost leaf. When late-winter leaf and yield is needed, choose Regal over Gruner.

Forage quality: When stock liveweight gain and/or body condition score is your priority, choose Kestrel. A high quality stem and good leaf percentage allows Kestrel to provide a premium feed option. When yield and forage quality are equally important, Regal's high leaf percentage and high DM yield delivers on both, optimising performance of your stock.

*Westwood CT, Cutts M, Russell R, O'Brien K (2014). Effect of timing of harvest on nutritive value, and dry matter yield of four cultivars of kale (Brassica oleracea L. Var. acephala). Proceedings of the New Zealand Grasslands Association (in press).

Leaf percentage of four kale cultivars during winter 2013



TIP 1:

Regal® is the kale of choice for excellent dry matter yields and leaf production, even in late winter.

TIP 2:

Choose Kestrel when high energy feed is needed for top priority stock classes.

Sales Agronomist Brian Young inspecting a Regal® kale paddock in Tapanui, West Otago.

Dairy cows being break fed Cleancrop™ Firefly kale as summer feed in Cambridge, Waikato.

Dairy cow grazing Cleancrop™ Firefly kale.

Montage of one replicate of the trial of each of the four kale cultivars in August 2013.

Regal®

Kestrel

Rawera

Gruner

Farm type

Sowing rate

4 kg/ha

Days to grazing

150-220 days

Regal® KALE

INTERMEDIATE HEIGHT

- High yielding, intermediate height kale with a potential yield of 16,000 kgDM/ha
- High leaf-to-stem ratio, with very good late-winter leaf percentage
- First and second crop option
- Excellent crop utilisation due to selection for soft stems
- Very good winter hardiness and excellent pest and disease tolerance
- New Zealand bred for local conditions

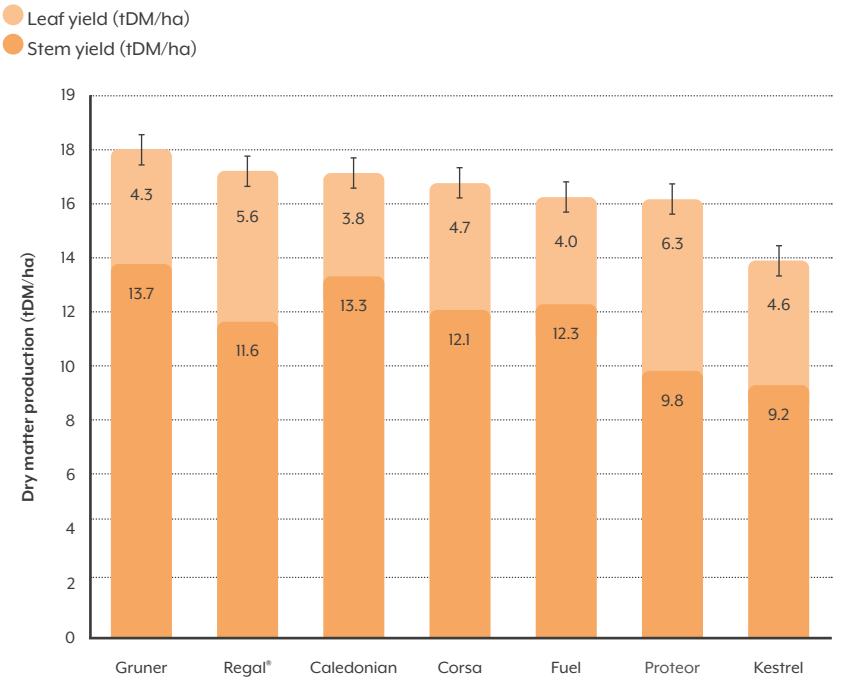
Regal® is an intermediate height kale that has been bred for a high leaf percentage for better utilisation in conjunction with a high total yield in order to maximise stock productivity.

Extensively trialled prior to commercial release, Regal has been proven to perform well against other kales in the market. In addition, field trials have shown Regal to be a very winter-hardy kale with proven yield potential and feed value.

Average nutritive value of the stem or leaf components for eight kale cultivars

Nutrient	Stem	Leaf
Dry matter %	18.9	14.6
Megajoules metabolisable energy/kgDM	10.8	12.0
Crude protein	5.7	17.3

Dry matter production of kale cultivars



Combined averages from 11 trials at Lincoln Plant and Food Research (2016, 2017, 2018), Gore Plant and Food Research (2016, 2017, 2018), Hinds (2016, 2018) and Kimihia Research Centre (2016, 2017, 2018). LSD (5%) =1.35 tDM/ha; differences between cultivars must exceed the LSD to be statistcally significant.

Farm type

Sowing rate

4 kg/ha

Days to grazing

150-220 days

Kestrel KALE

SHORT HEIGHT

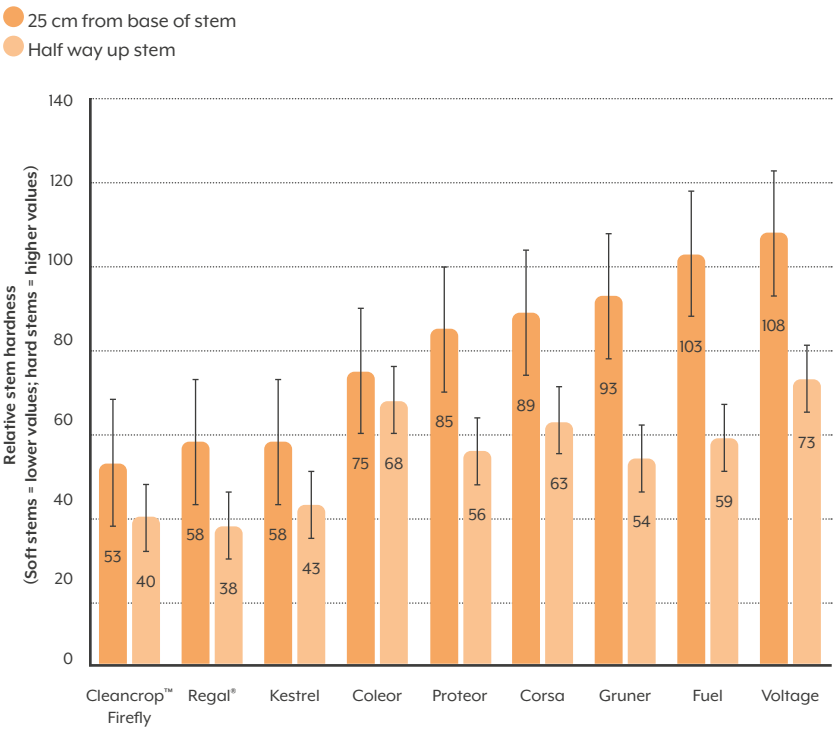
- High leaf-to-stem ratio with very good late-winter leafiness
- Excellent stem softness to promote crop utilisation with very good stem quality to enhance animal performance
- Superior animal production due to enhanced forage quality
- Bred for low levels of S-methyl cysteine sulphoxide (SMCO)
- Good regrowth if lightly grazed during late summer
- First and second crop option

Kestrel kale is an exceptionally high quality winter feed for top animal performance. Kestrel has a high leaf percentage and soft, digestible stems that deliver an energy-dense, easy-to-harvest feed. Soft stems offer excellent crop utilisation, even for young sheep, deer and cattle. Late-winter leafiness means better stock performance throughout the season. Kestrel has the adaptability to fit into a range of farm systems and soil types.

Stem softness of kale cultivars trial results

In stem softness trial results completed by Plant and Food Research, Kestrel, Cleancrop™ Firefly and Regal® kale cultivars demonstrated market-leading stem softness suitable for enhancing crop utilisation. In the graph below, soft stems are indicated by lower relative stem hardness values, while hard stems are indicated by higher stem hardness values.

Relative stem hardness of kale cultivars Plant and Food Research, Lincoln 2016



Average relative stem hardness measured by Instron 1140 tensile tester in Lincoln, Canterbury 2016.
Differences between cultivars must exceed the LSD 5% to be statistically significant. '25 cm from base of stem' LSD 5% = 30; 'Half way up stem' LSD 5% = 16.1

Farm type

Sowing rate

4 kg/ha

Days to grazing

150-220 days

Corsa KALE

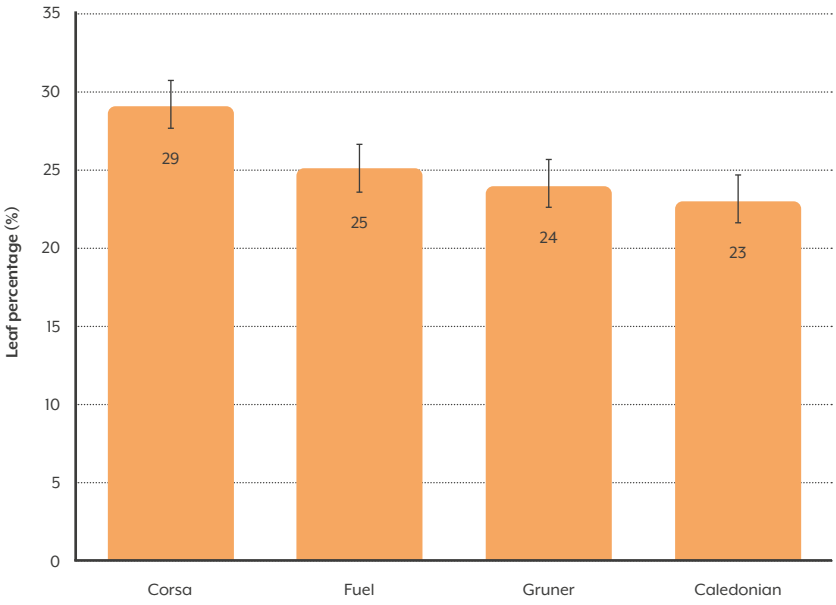
NEW ZEALAND BRED

GIANT TYPE WITH EXCELLENT LEAF PERCENTAGE

- High yielding, giant type kale
- Highest leaf-to-stem ratio of giant kales
- Good winter hardiness
- Softer stem compared to other giant type kales
- Good Aphid tolerance

Corsa is a new generation giant type kale that has been bred to revolutionise the giant kale market. With higher leaf percentage and enhanced stem quality than conventional giant kales, Corsa will deliver a high volume, high quality feed for animals.

Leaf percentage of giant kale cultivars



Combined averages from 11 trials at Lincoln Plant and Food Research (2016, 2017, 2018), Gore Plant and Food Research (2016, 2017, 2018), Hinds (2016, 2018) and Kimihia Research Centre (2016, 2017, 2018). LSD (5%) = 3%; differences between cultivars must exceed the LSD to be statistcally significant.

Farm type

Sowing rate

4 kg/ha

Days to grazing

150-220 days

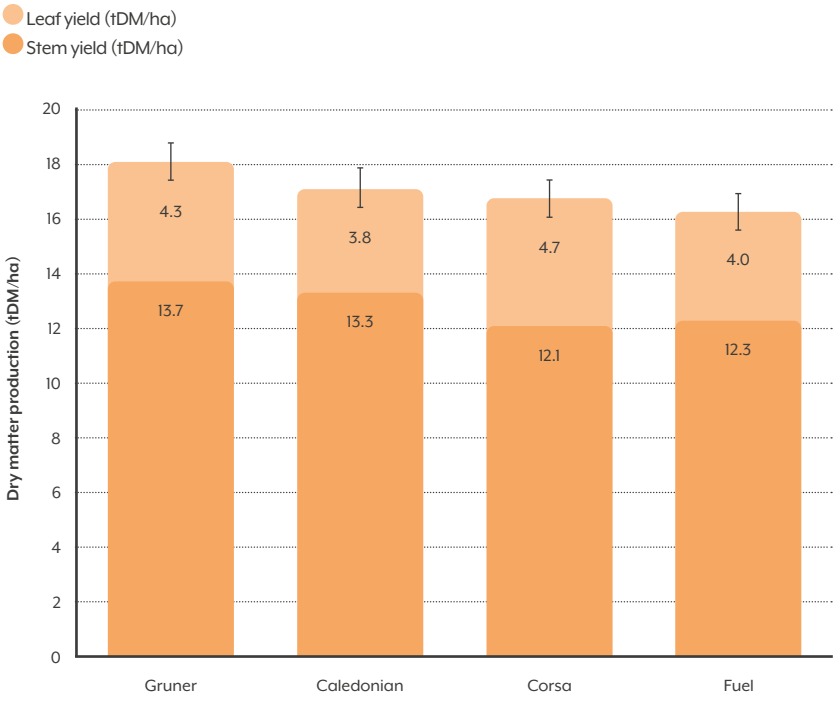
Gruner KALE

GIANT TYPE

- High yielding, giant type kale with potential yield of 17,000 kgDM/ha
- Excellent tolerance to frost
- Good Aphid tolerance
- A proven and reliable kale for New Zealand grazing systems
- First and second crop option

Gruner kale is a high yielding, giant type kale with excellent winter hardiness and good Aphid tolerance. Gruner is a suitable option when high dry matter yield is required to feed and maintain a higher stocking rate.

Dry matter production of giant kale cultivars



Combined averages from 11 trials at Lincoln Plant and Food Research (2016, 2017, 2018), Gore Plant and Food Research (2016, 2017, 2018), Hinds (2016, 2018) and Kimihia Research Centre (2016, 2017, 2018). LSD (5%) = 1.35 tDM/ha; differences between cultivars must exceed the LSD to be statistcally significant.

Farm type

Sowing rate

4 kg/ha

Days to grazing

150-220 days

Firefly KALE

Cleancrop™ Brassica System

- High yielding, intermediate height kale
- High leaf-to-stem ratio with very good late-winter leaf percentage
- Excellent crop utilisation due to selection for soft stems
- Very good winter hardiness and excellent pest and disease tolerance

Firefly kale is a high yielding, intermediate height kale with a high leaf-to-stem ratio. Excellent crop utilisation by stock due to single plant selection for soft stems during the plant breeding process. Firefly is the first kale cultivar available in the Cleancrop™ Brassica System bred to have a herbicide tolerance trait, which allows the application of Telar® herbicide at both pre- and post-emergence for excellent weed control.

Agronomic performance of Regal® kale relative to Cleancrop™ Firefly kale

Cultivar	Leaf %	Hundredised total yield	Maturity (DAS)
Cleancrop™ Firefly	33	100	150-220
Regal®	32	101	150-220

4 trials: Gore, Hinds, Kimihia and Palmerston North (2015). In these trials conventional herbicides were used on both Firefly and Regal®. Telar® was not applied. Where Telar® was used for Firefly and no herbicide applied to Regal®, we would expect higher yields for Firefly kale.

Dairy cow grazing Cleancrop Firefly kale in Cambridge, Waikato.

Kale case study

CLEANCROP™ FIREFLY KALE HELPS OWL FARM EXTEND LACTATION

Property:	Owl Farm
Farm type:	Dairy
Hectares:	147.5
Location:	Cambridge
Name:	Tom Buckley (Farm Manager) and Jo Sheridan (Demonstration Manager)

Cleancrop™ Firefly kale has made a valuable contribution to the summer feed budget for over 400 dairy cows at Owl Farm. After this season's experience, Owl Farm has a better understanding about the importance of having late lactation forage such as kale, particularly when confronted with tough, dry summer conditions.

Owl Farm planted Firefly kale (graze from 98 days after sowing), Cleancrop™ bulb turnip (80-110 days maturity) and Cleancrop™ Toto turnip (55–90 days maturity) for summer feed. Planting two turnip cultivars on the same day allowed Owl Farm to leverage the variation in plant maturity to graze feed over a longer period. Cleancrop Toto turnips are grazed first, followed by Cleancrop bulb turnips during January to February, while Firefly kale, planted two weeks earlier than the turnips, is utilised during March and April. This approach reduces the need to sow turnip cultivars a few weeks apart, since there is almost a 3-week difference in maturity between the cultivars. Moreover, Firefly kale offers flexibility to Owl Farm with a high-quality feed available for grazing anytime between late February to late August.

Without feeding infrastructure, the extra feed supplied from Firefly kale enables Owl Farm to reduce the need for imported feed and associated costs. Owl Farm have previously found it difficult to source supplementary feed with megajoules of metabolisable energy (MJME) and protein levels close to the summer brassicas at that time of year. The crop-fed cows have a higher quality diet resulting in improved milksolids production and dairy cows that maintain better body condition.

Owl Farm are pleased with the results from their summer brassicas. "We wanted to get the best value out of the crop," says Jo Sheridan, Owl Farm's Demonstration Manager. "Producing a good crop is equivalent to costs involved for a poor crop, so it was important we looked after the crops to maximise yield. In summer dry conditions, it is important to have a good feed budget in place with 75 days or more of summer feed from brassica crops." Overall, Owl Farm are able to milk more cows into autumn months to make the most of summer pasture recovery.

"Dry matter yields by the crops were impressive" explains Tom Buckley, Farm Manager at Owl Farm. "Cleancrop Toto yielded on average 15.2 of dry matter per hectare (tDM/ha). Planted on lighter soils, Cleancrop bulb turnip averaged 12 tDM/ha. Similarly, Firefly kale averaged 12 tDM/ha in the first two paddocks, however by the time the third kale paddock was grazed Firefly kale was yielding over 16 tDM/ha. This impressive yield can be attributed to late summer rain and a longer growing period of Firefly kale compared to earlier maturing brassica species. Crop yield is important to dilute the fixed costs (for example, drilling, fertiliser and crop protection). With a higher than expected kale yield, Tom explains "We were able to graze brassicas for an extra 25 days than if we'd not had the kale, which reduced the amount of silage fed out."

Even with the extremely dry conditions this summer, Owl Farm produced a good Firefly kale crop that proved valuable to their feed supply. "We managed to get 13 weeks of feed from our total of 11.4 hectares of Cleancrop turnips and Firefly kale, which was 3 kgDM per cow per day from crops that yielded, on average, around 12 tDM/ha."

Utilising a combination of Cleancrop™ turnips and Firefly kale proved a good choice for Owl Farm, as they were to accumulate a feed bank coming into January, February and March when they require extra feed during the dry summer conditions. The two turnip cultivars allowed Owl Farm to spread crop maturity across a longer period, while leveraging Firefly kale provided an extra few weeks of feed that enabled summer brassicas to be pushed out into March and April, when turnips struggle to hold on into late summer.

As Tom explained "Firefly kale is able to persist into late summer, when turnips struggle to hold on. The extra feed helps to bolster supply leading up to the autumn rains, rather than having a feed shortage after turnips finish in late February to April." Dairy cows were shifted from turnips directly onto Firefly kale, since no transition period is required between crop types. "The use of Firefly kale greatly extended our brassica feeding 'window' with cows staying on brassicas for a longer period of time than if we relied on turnips alone" explains Tom.

Summer brassicas offered a valuable feed source during this extremely dry season, with pasture yields lower than average, Owl Farm we able to ensure dairy cows maintained a satisfactory fat evaluation index (FEI) score. Furthermore, Owl Farm were able to reduce the need for Palm Kernel Extract (PKE) and minimise associated costs from importing feed. "Even if we had contracted PKE at a competitive rate we are limited by the amount we can feed, due to the potential FEI scores and milk quality restrictions. The crops provided good value feed for us," Tom says. "Replacing more of our PKE with home grown crops will help us align with our strategy of meeting Te Tihi Co-operative difference in future years" explains Jo. A guaranteed, reliable feed supply through to the final pregnancy diagnosis in early February gives Owl Farm a known fixed cost to budget for and reduces their exposure to fluctuating feed prices.

After this season's success, Owl Farm are going to continue to add brassica cropping into their summer feed supply mix. Owl Farm feel like they got their feed plan close to ideal this season and will look to replicate the brassica system again this coming year.

BRASSICA OPTIONS

Swede

Ultrastrike® pelleted swede seed

With a weighted build-up coating (pellet), Ultrastrike® pelleted swede seed can be sown using precision drills. Yield is maximised through the even distribution of seed, sown at the correct rate and depth, which allows bulbs to grow more consistently and be protected from sun exposure or being eaten by birds or pests.

For farmers with a focus on outcomes over inputs, Ultrastrike® pelleted swede is a fantastic way to increase yields as long as they're prepared to do the necessary paddock preparation and ongoing monitoring of the crop.

Ultrastrike® pelleted swede has an optimum sowing rate of 90,000 seeds/ha or 22 cm seed spacing in 50 cm rows. The size specification for pelleted swede seed is 3.25-4.00 mm.

KEY BENEFITS

- Maximum bulb yield through evenly-distributed sowing
- Highly cost-effective outputs
- Easy to sow (one bucket/ha)
- Contains trace element molybdenum for enhanced growth

GERMINATION

With the seeds' weighted build-up coating, oxygen and moisture from the soil penetrate the pellet, initiating germination. The pellet then splits open as the seed expands and begins to sprout. The pellet does not require any more soil moisture than a non-pelleted seed and is lightweight yet hardy enough to remain undamaged during transportation and sowing. The pellet does not persist in the soil as it breaks down completely over time.

Ultrastrike® pelleted brassica

PEST AND DISEASE PROTECTION

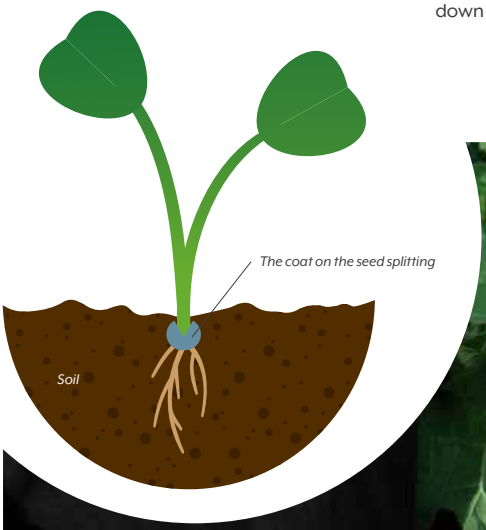
Ultrastrike® pelleted seed also contains a systemic insecticide and two contact fungicides to provide critical insect and disease protection during establishment.

Seedling diseases

Pythium, Fusarium, Rhizoctonia

Insect pests

Springtails, Aphids, Argentine Stem Weevil and *Nysius*

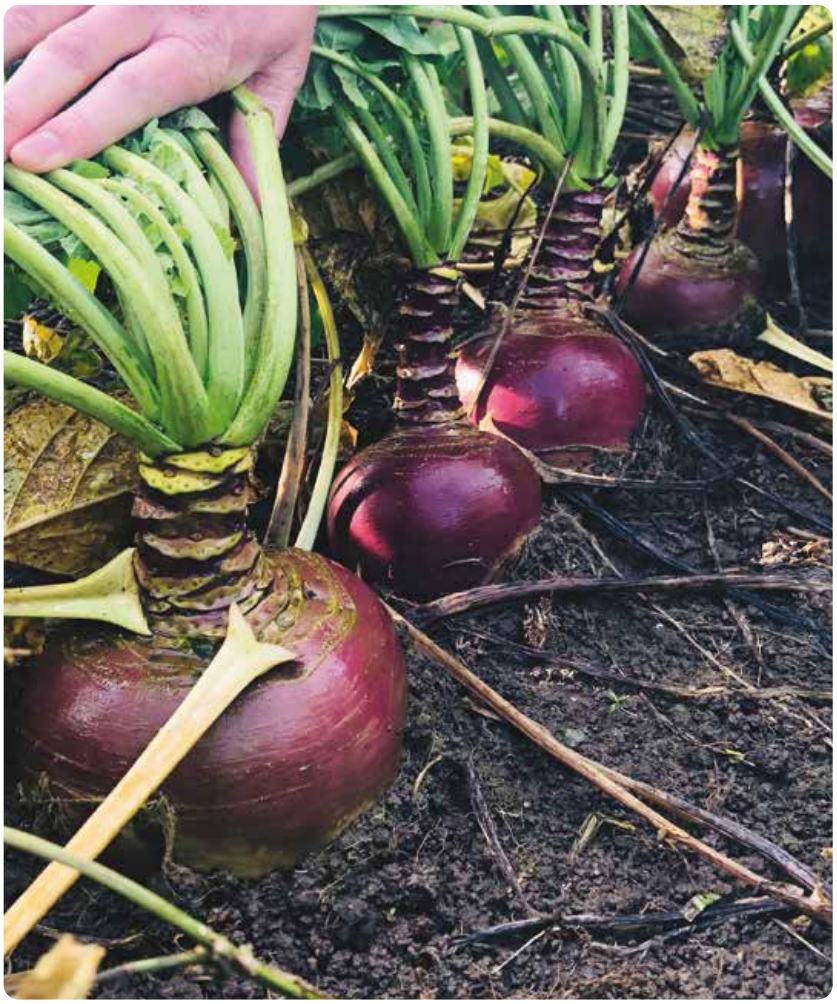


Cleancrop™ Hawkestone swede is available in pelleted form.

Paul and Wendy Stirling on Wether Hill Farm, Ohai, Southland

CASE STUDY: PAUL & WENDY STIRLING WETHER HILL FARM, OHAI

Wether Hill farm of Ohai, Southland is farmed by Paul and Wendy Stirling. In previous years, they achieved 10-12 tonne swede crop yields, but after switching to Cleancrop™ Hawkestone pelleted swede, it dramatically increased. Specifically, they had a 19,000 kgDM/ha crop established for $1,400/ha ultimately providing feed for just 7 c/kgDM! Paul says that along with the large, even bulb size, he is also impressed with how quickly the pelleted seed germinates and gets out of the ground. He says he is getting great payback from the extra investment of precision sowing.



A row of pelleted Major Plus swede.

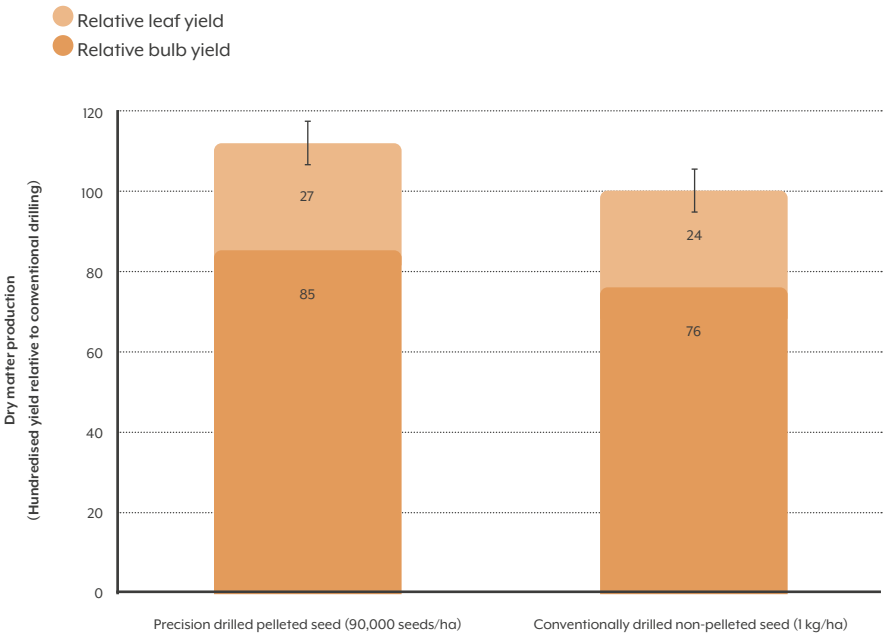
TRIAL RESULTS

A trial evaluating precision planting of Cleancrop™ Hawkestone pelleted swede (90,000 seeds/ha) versus conventional sowing (1 kg/ha) was established in Oxford, Canterbury on 17 November 2018. Prior to grazing on 20 May 2019 (184 days after sowing), yield assessments demonstrated that precision-sown pelleted seed provided a significant 12% increase in yield relative to conventional sowing.

AVAILABLE CULTIVARS

Cleancrop™ Hawkestone, Clutha Gold and Major Plus are all available in pelleted form.

Relative dry matter production of precision planting pelleted swede versus conventional drilling of Cleancrop™ Hawkestone swede



Trial conducted in Oxford, North Canterbury. Sown on 17 November 2018 and harvested on 20 May 2019 (184 DAS), LSD (5%)= 10.7%

Farm type

Sowing rate

CONVENTIONAL SOWING OR DIRECT DRILLING

0.8-1.5 kg/ha

PELLETED

90,000 seeds/ha

Days to grazing

170-250 days

Andy Dumbleton
Brassica breeder
PGG Wrightson Seeds

"Clutha Gold was bred to meet a clear need in the New Zealand swede market for an Aparima Gold replacement. Clutha Gold meets all breeding objectives of Aparima Gold and also offers a significantly higher yield and additional tolerance to the leaf disease powdery mildew. We see great potential for Clutha Gold swede and look forward to seeing it perform on New Zealand farms."

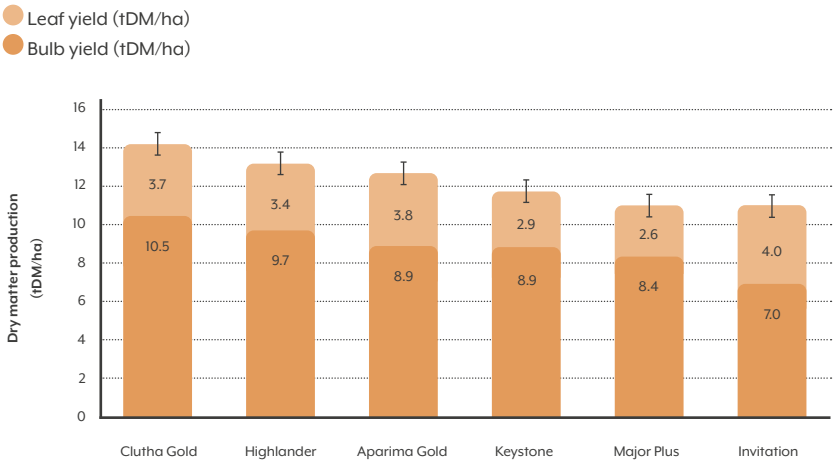
Clutha Gold SWEDE

YELLOW-FLESHED SWEDE

- Very high yielding, main crop swede
- New Zealand bred and evaluated
- Yellow-fleshed bulb with medium maturity
- Disease tolerance to clubroot, dry rot and powdery mildew
- Excellent winter-keeping qualities
- Pelleted seed available, see pages 58-59 for more information

Clutha Gold is the latest swede bred from the Forage Innovations plant breeding joint venture between Plant and Food Research and PGG Wrightson Seeds and has been developed to supersede Aparima Gold swede. Clutha Gold has a significant yield advantage over Aparima Gold while maintaining its disease tolerance to clubroot and dry rot. Clutha Gold can be used for all farm types and is suitable for sheep, cattle and deer grazing.

Dry matter production of swede cultivars



Combined averages from 7 trials at Methven (2013, 2014, 2015) and Gore Plant and Food Research (2013, 2014, 2015, 2016). LSD (5%) = 1.2 t DM/ha; difference between cultivars must exceed the LSD to be statistically different.

PGG Wrightson Seeds Sales Agronomist Brian Young (left) and Farmlands Technical Field Officer Mike Magennity (right) inspecting a crop of pelleted Clutha Gold swede.

Farm type

Sowing rate

CONVENTIONAL SOWING OR DIRECT DRILLING

0.8-1.5 kg/ha

PELLETED

90,000 seeds/ha

Days to grazing

150-220 days

Major Plus SWEDE

NEW ZEALAND BRED

YELLOW-FLESHED SWEDE

- Softest bulb swede on the market
- Good dry matter yields with a potential yield of 16,000 kgDM/ha
- Yellow-fleshed, purple-skinned bulb
- Early maturing, main swede crop
- Pelleted seed available, see pages 58-59 for more information

Major Plus is a traditional yellow-fleshed swede with a early maturity date and soft bulb easily consumed by animals. A suitable option for early winter feed before moving stock onto a later maturing Clutha Gold swede crop for mid- to late-winter grazing.

Hawkestone SWEDE

Cleancrop™ Brassica System

Farm type

Sowing rate

CONVENTIONAL SOWING OR DIRECT DRILLING

1 kg/ha

PELLETED

90,000 seeds/ha

Days to grazing

170-250 days

- High yielding, yellow-fleshed swede with medium maturity
- Similar dry rot and clubroot tolerance to Aparima Gold
- Good leaf disease tolerance
- Plant glucosinolate levels similar to Aparima Gold swede#
- Pelleted seed available, see pages 58-59 for more information

#Three main glucosinolates - progoitrin, glucobrassicin and neoglucobrassicin.

Hawkestone swede is a high yielding, yellow-fleshed, main crop swede with medium maturity. Along with a similar dry rot and clubroot tolerance to Aparima Gold swede, Hawkestone also has a good disease tolerance to powdery mildew. With the added benefit of the Cleancrop™ Brassica System, Hawkestone swede is tolerant to Telar® herbicide application at both pre- and post-emergence for excellent weed control. It is the first swede cultivar to be single plant selected for lower levels of grazing anti-nutritional glucosinolate compounds (progoitrin, glucobrassicin and neoglucobrassicin levels similar to Aparima Gold Swede).

Agronomic performance of swede cultivars relative to Cleancrop™ Hawkestone swede

Cultivar	Hundredised bulb yield	Hundredised leaf yield	Leaf %	Hundredised total yield	Maturity (DAS)
Cleancrop™ Hawkestone	100	100	24	100	170-250
Aparima Gold	89	118	28	96	170-250
Clutha Gold	104	115	26	106	170-250
Invitation	70	121	35	82	170-250

7 trials: Methven (2013, 2014, 2015), Gore (2013, 2014, 2015) and Palmerston North (2015). In these trials conventional herbicides were used on all cultivars. Telar® was not applied. Where Telar® was used for Hawkestone and no herbicide applied to the other cultivars, we would expect higher yields for Hawkestone swede.

Swede case study

Simon Smith, farm owner (left), and Brendon Bain, RB Rural (right), standing in Cleancrop™ Hawkestone swede (pelleted).

CLEANCROP™ HAWKESTONE SWEDE (PELLETED) CASE STUDY

Farm type:	Sheep and beef
Hectares:	240
Location:	Kaiwera, Southland
Name:	Simon and Sandy Smith

Simon and Sandy Smith are farming in Kaiwera, Southland on a 240 hectare sheep and beef farm. They had been using both conventional swede and kale crops for winter supplement, but had experienced issues in the past with producing high-yielding crops due to the prevalent weed burden. Simon decided to plant Cleancrop™ Hawkestone swede for the first time in November 2019, after his local seed supplier Brendon Bain from RB Rural recommended the Cleancrop™ Brassica System for effective weed control. A point raised in their discussion was the ability to have a clean paddock to sow down permanent pasture the following season. Simon has found his weed challenges include Spurrey (yarr), Fathen and both Californian and Nodding Thistles, all of which Telar® was able to control. A spray miss due to his foam marker malfunctioning certainly proved that.

Simon found the Cleancrop™ Brassica System simple to implement, drilling the seed and then pre-emerge spraying with the supplied chemical Telar® within 48 hours after sowing. He felt confident having the option to activate a second spray if needed after the crop was established.

Simon also decided to take advantage of Ultrastrike® treated, pelleted swede seed to allow uniform placement of seed through a precision drill, sowing at 90,000 seeds/ha to maximise potential yield. The combination of Cleancrop™ Hawkestone swede and the evenly-distributed crop enabled bulb yields to be maximised. Simon was impressed that despite the challenging start they got with the cold and wet season, they were able to achieve average yields of 15,000 kg dry matter per hectare (kgDM/ha), where the best paddock was 17,000 kgDM/ha.

Simon and Sandy will most certainly be using the Cleancrop™ Brassica system in the future as a reliable, simple solution to control weeds.

A spray miss in a Cleancrop™ Hawkestone swede paddock, showing the control Telar® has over a wide variety of weeds.

Simon Smith showing the yield difference in Cleancrop™ Hawkestone swede with Telar® applied (left) and without (right).

BRASSICA OPTIONS

Forage Rape

Why sow forage rape?

1. VERSATILE FORAGE

Spring-sown rape fills the summer feed gap. The perfect non-pasture feed for stock when facial eczema spore count or internal parasite larval challenge is high. Finish lambs, feed your ewe lamb replacements or flush ewes late summer. For milking platforms, plant rape as part of your summer brassica feed system, start by grazing Barkant® summer turnip and switch to forage rape in late summer. This means cows spend more time on summer brassicas. Autumn-sown rape delivers high quality winter feed just when you need it.

2. HIGH QUALITY

Forage rape is a high quality feed with nutritional benefits for grazing animals. The excellent leaf percentage of rape (average 68% leaf) and soft stems mean better performance by stock. Rape contains energy levels of 11-13 megajoules of metabolisable energy (MJME)/kgDM and moderate to high crude protein content (Westwood and Mulcock 2012*). The ideal high quality forage to balance summer pastures or silage/straw supplements over winter.

3. MULTI-GRAZE OPTIONS

Single or multi-graze, the choice is yours. Goliath® and Titan® are new generation, multi-graze cultivars that are an interspecies cross between rape and kale parentage. Graze now, close up for a month and regraze later. Expect up to 3.5 tDM/ha regrowth at the first regrazing. Combining Goliath or Titan rape with an Italian or short-rotation ryegrass increases the flexibility of rape as a multi-graze option.

4. VARYING MATURITY DATES

PGG Wrightson Seeds rape cultivars range in maturity dates from 70-110 days after sowing (DAS). Ideal for matching feed supply with stock demand and avoiding crops being ready to graze at the wrong times. Planting two forage rape cultivars on the same day allows you to leverage the variation in plant maturity to graze feed over a longer period. Graze early maturing Titan 70-90 DAS. Later maturing Goliath and Cleancrop™ rape are ready to go 90-110 DAS.

5. PERFORMS OVER A RANGE OF SOIL FERTILITY AND MOISTURE STATUSES

Compared with other brassica species, forage rape tolerates lower soil fertility – a suitable option when soil tests come back with less than ideal results. Like all species, forage rape dry matter yields improve when soil fertility is optimal.

For areas prone to summer or autumn dry, choose forage rape. Rape is more tolerant of drier growing conditions than other summer brassicas such as leafy turnip and bulb turnip. Despite tolerance of dry conditions, rape performs best when irrigated or planted in summer-safe areas.

*Westwood, C.T. and Mulcock, H. Nutritional evaluation of five species of forage brassica. (2012). Proceedings of the New Zealand Grassland Associations Volume 71, Gore. http://www.grassland.org.nz/publications/nzgrassland_publication_2266.pdf

"PGG Wrightson Seeds rape cultivars range in maturities from 70-110 days after sowing. Ideal for matching feed supply with stock demand and avoiding crops being ready to graze at the wrong times."

Farm type

Sowing rate

4 kg/ha

Days to grazing

70-90 days

Titan® FORAGE RAPE

- **Highest animal grazing preference forage rape cultivar available**
- **Excellent Aphid and virus tolerance**
- **A new generation rape and kale interspecies cross**
- **Multi-graze option with good regrowth potential**
- **High yielding, intermediate height rape available with a potential yield of 12,000 kgDM/ha**
- **Suitable for summer, autumn and winter feed**
- **Early maturing**
- **Excellent whole plant quality**

Titan combines early maturity, high dry matter yields and exceptional palatability to deliver a high quality summer, autumn and winter feed option. Strong regrowth potential offers a multi-graze option for all farm systems. Good Aphid and virus tolerance means Titan will last the distance under challenging conditions.

Good animal grazing palatability is an important aspect of developing a new forage rape. The Plant and Food Research and PGG Wrightson Seeds brassica breeding programme (Forage Innovations Limited) develops new cultivars with increased palatability by conducting animal grazing preference trials, comparing a new breeding line's palatability against commercially available cultivars. This breeding programme led to the development of Titan forage rape - a tasty, palatable rape with high grazing preference and rapid acceptance by livestock.

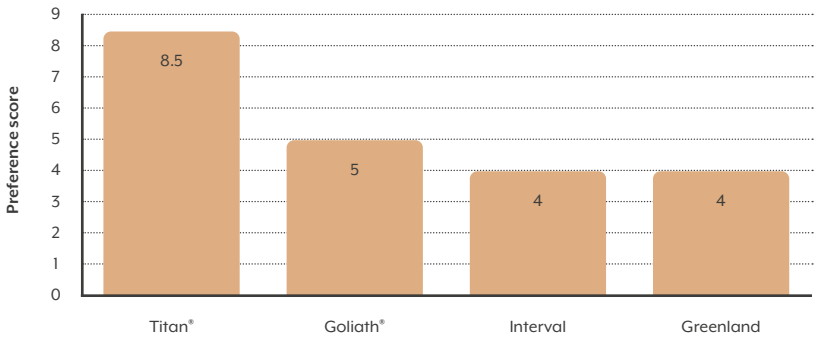
Stock grazing preference of different forage rapes

Preference score

The higher the score the better:

1 = Crop untouched

9 = Crop completely eaten



Trial conducted at the Kimihia Research Centre, Canterbury. Sown on 25 November 2007 and visual preference scores taken after the second harvest on 1 April 2008.

Farm type

Sowing rate

4 kg/ha

Days to grazing

90-110 days

Goliath® FORAGE RAPE

- High yielding forage rape with a potential yield of 14,000 kgDM/ha
- Good Aphid tolerance
- Excellent summer/autumn/early winter feed
- Multi-graze feed option with superior regrowth potential
- Excellent winter-keeping ability
- A new generation rape and kale interspecies cross

Goliath® forage rape – the multi-purpose forage rape that fits all farm systems. Goliath performs well from spring/summer/autumn sowing, offering flexibility to deliver feed when you need it. Graze Goliath once or take advantage of superior regrowth potential for multiple grazings; the perfect versatile feed option for all stock classes. Good Aphid tolerance means Goliath will go the distance.

APHID TOLERANCE

Aphid tolerance is an important part of the breeding programme; Aphid-tolerant rape cultivars like Goliath are developed by plant breeding and then selected under Aphid pressure in the field, with European bred rapes as the comparison.

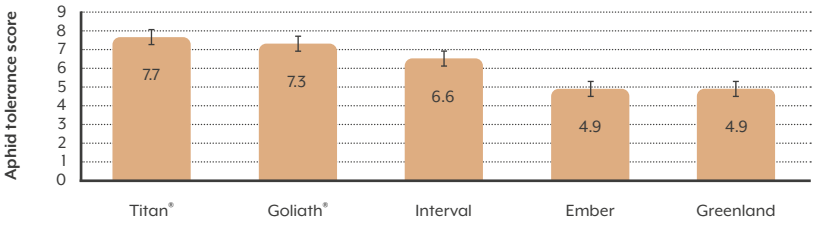
Aphid tolerance score of different forage rapes

Aphid tolerance score

The higher the score the better:

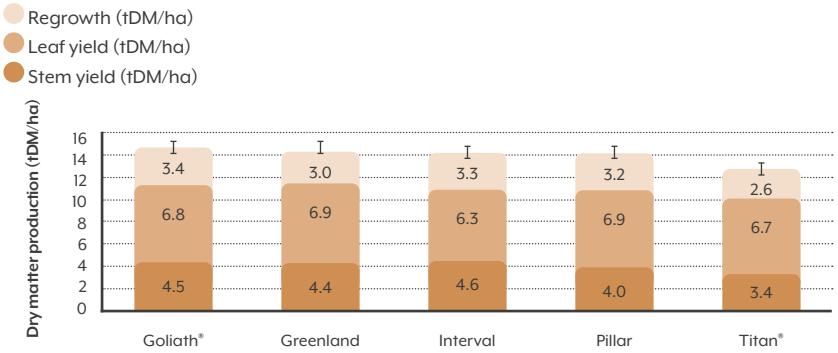
1 = Crop completely covered with Aphids

9 = Crop completely free from Aphids



Combined averages from four trials at Kimihia Research Centre (2011, 2012, 2013) and Hawke's Bay (2011). LSD (5%) = 1.2; difference between cultivars must exceed the LSD to be statistically significant.

Dry matter production of rape cultivars



Combined averages from 6 trials at Lincoln Plant and Food Research (2018) and Kimihia Research Centre (2014, 2016, 2017, 2018, 2019). LSD (5%) = 1.12 tDM/ha; differences between cultivars must exceed the LSD to be statistically significant.

Rape

Cleancrop™ Brassica System

- High yielding, multi-graze rape with good leaf percentage and crop utilisation
- Multi-purpose forage rape with excellent summer/autumn/early winter feed
- Similar Aphid tolerance to Goliath®
- Good regrowth potential with excellent winter-keeping ability
- A new generation rape and kale interspecies cross

Farm type

Sowing rate

4 kg/ha

Days to grazing

90-110 days

Cleancrop™ rape is a high yielding, multi-graze forage rape with very good leaf percentage and excellent crop ultilisation by stock. As part of the Cleancrop Brassica System, it has the added benefit of a herbicide tolerance trait. Telar® herbicide can be applied at both pre- and post-emergence for excellent weed control, freeing up moisture and nutrients to give this multi-purpose forage rape the best chance of maximising summer, autumn and winter feed.

Agronomic performance of rape cultivars relative to Cleancrop™ rape

Cultivar	Leaf %	Hundredised total yield	Maturity (DAS)
Cleancrop™ rape	76	100	90-110
Titan®	75	89	70-90
Greenland	70	99	70-84
Goliath®	69	101	90-110
Interval	63	104	90-110

12 Trials: Culverden (2013), Lincoln PFR (2013, 2014), Hawkes Bay (2013), Kimihia Research Centre (2014, 2015, 2016 x2), Gore (2016), Oxford (2016), Taihape (2016) and Ruakura (2016). In these trials conventional herbicides were used on all cultivars. Telar® was not applied. Where Telar® was used for Cleancrop™ rape and no herbicide applied to the other cultivars, we would expect higher yields for Cleancrop™ rape.

BRASSICA OPTIONS

Turnip

Farm type

Sowing rate

1-3 kg/ha

Days to grazing

60-90 days

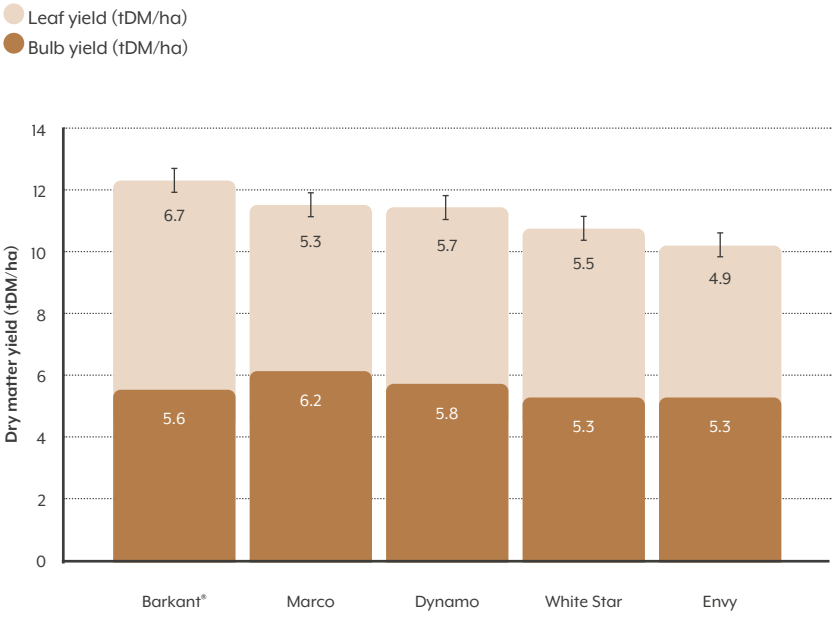
Barkant® TURNIP

SUMMER TURNIP

- High yielding summer bulb turnip with a potential yield 15,000 kgDM/ha
- High leaf-to-bulb ratio resulting in high levels of protein
- Shown in an independent animal trial to increase summer/autumn milksolids production by 25%
- Early maturing for excellent summer feed
- Tankard bulb shape enhances crop utilisation and reduces the risk of choke associated with round bulbs
- High source of metabolisable energy (MJME)

Barkant® bulb turnip is one of the highest yielding summer bulb turnips available in New Zealand. Barkant® turnips produce high quality feed with a high metabolisable energy (ME) value, meaning greater animal performance can be achieved. It is a high-performance feed for lactating dairy cows, supplying the energy required to boost milk production. Barkant delivers supplementary protein within the leaf and water soluble carbohydrates in the bulb, offering an ideal feed to balance summer pastures.

Dry matter production of summer bulb turnip cultivars



Combined averages from 10 trials at Lincoln Plant and Food Research (2013), Kimihia Research Centre (2013, 2016, 2017, 2018, 2019) and Waikato (2016, 2017, 2018, 2019). LSD (5%) = 0.78 tDM/ha; differences between cultivars must exceed the LSD to be statistically significant.

Farm type

Sowing rate

0.8-2 kg/ha

Days to grazing

90-120 days

Green Globe CERTIFIED TURNIP

SUMMER/WINTER TURNIP

- Multi-purpose turnip suitable for summer, autumn and winter feed
- Proven winter hardiness
- Good yield potential (12,000 kgDM/ha)
- Late maturing

SUMMER FEED

Green Globe is a valuable summer feed option on dairy farms to help maximise milk production. Plant 2/3 of the crop area in the early-maturing Barkant® turnip (60-90 days maturity) and 1/3 in late-maturing Green Globe turnip (90-120 days maturity). Planting both turnip cultivars on the same day provides a variation in the spread of maturity, whereby the turnips can be grazed over a longer period from 60-120 days.

Using this system, farmers don't have to worry about the quality of their turnip crop declining because they are trying to maintain an early-maturing cultivar for too long and they don't need to worry about reduced yields by having to graze a later-maturing crop too early. Green Globe and Barkant turnips complement each other very well.

Cultivar	Time of feeding
Barkant®	Early-mid summer
Green Globe	Late summer/autumn

LATE AUTUMN/WINTER FEED

Green Globe turnips are an ideal late autumn/winter feed option in more challenging environments. Sown in late summer it can can be grazed 90-120 days after sowing and does not require a specific ripening period. There is a number of situations where Green Globe could be incorporated, whether as part of a development plan (e.g. breaking in country), lower fertility soils or more challenging topography.

Farm type

Sowing rate

2 kg/ha

Days to grazing

55-90 days

Feed planning

Area

Plant 2.5 hectares (ha) of turnips per 100 cows to feed for 60 days. Based on the assumption of a 10.5 tDM/ha yield and feeding 4 kg/cow/day with 90% crop utilisation.

Cultivar choice

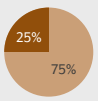
Suggested ratio for hectares of Cleancrop™ Toto turnip and Cleancrop™ bulb turnip for 60 days of feed during summer based on a late October planting.

Cleancrop™ Toto turnip to Cleancrop™ bulb turnip ratio and planned grazing period

- Cleancrop™ Toto turnip
- Cleancrop™ bulb turnip

Mid Dec–mid Feb

Start Jan–end Feb



Mid Jan–mid Mar

E.g. Based on the area assumption above, if planning to start grazing on 1st January for 400 cows, then plant 5 ha of Cleancrop™ Toto turnip and 5 ha of Cleancrop™ bulb turnip for 60 days of feed.

Toto TURNIP

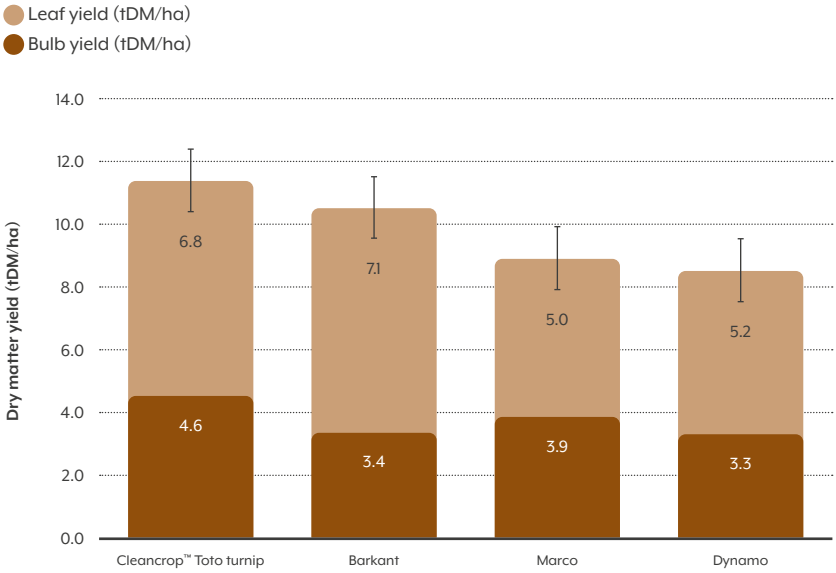
Cleancrop™ Brassica System

NEW ZEALAND BRED

- High yielding, summer bulb turnip
- Improved turnip mosaic virus tolerance
- Tankard bulb shape to increase crop utilisation
- Able to graze from 55 days after sowing (55-90 DAS)
- Suitable for summer and autumn feed

Toto turnip is a high yielding, summer and autumn bulb turnip with early maturity, allowing it to be grazed from 55 days after sowing. A tankard bulb shape alongside great bulb softness promotes excellent crop utilisation by grazing animals. Toto is also part of the Cleancrop™ Brassica System with the added benefit of a herbicide tolerance trait, which allows the application of Telar® herbicide at both pre- and post-emergence for excellent weed control.

Dry matter production of summer bulb turnip cultivars



Combined averages from 2 trials run at Puketaha, Waikato 2018 and 2019. LSD (5%) = 2.00 tDM/ha difference between cultivars must exceed the LSD to be significantly different.

In these trials, conventional herbicides were used on all cultivars. Telar® herbicide was not applied. Where Telar® was used for Toto turnip and no herbicide applied to the other cultivars, we would expect higher yields for Toto turnip.

Turnip case study

CLEANCROP™ BULB TURNIP AND CLEANCROP™ TOTO TURNIP CASE STUDY

Property name:	Owl Farm
Farm type:	Dairy
Hectares:	147.5
Location:	Cambridge
Name:	Tom Buckley (Farm Manager) and Jo Sheridan (Demonstration Manager)

Summer turnips have always made a valuable contribution to pasture renewal programmes. After this season's experience, Owl Farm has a better understanding about how important summer turnips are, particularly in a tough, dry season. Owl Farm planted both early maturing Cleancrop™ Toto turnip (55-90 days maturity) and later maturing Cleancrop™ bulb turnip (80-110 days maturity). Planting both turnip cultivars on the same day gave a variation in the spread of maturity, whereby the turnips could be grazed over a longer period. This reduced the need to drill turnips a few weeks apart, as there was already almost a 3-week difference in maturity.

Owl Farm also planted their first kale crop this season at just under three hectares (ha). Cleancrop™ Firefly kale was planted mid-October 2019, not as a winter feed for dry cows, but rather to provide milkers with a high-quality feed in March after they had finished the turnips.

Dairy cows were moved straight from turnips onto kale, since no transition period is required between crop types. "The use of kale greatly extended our brassica-feeding 'window', with cows staying on brassicas for a longer time than if we relied on turnips alone", says Tom Buckley, Farm Manager at Owl Farm.

Owl Farm are pleased with the results from their summer brassicas. "We wanted to get the best value out of the crop," says Jo Sheridan, Owl Farm's Demonstration Manager. "Producing a good crop costs as much as a poor crop, so it was important we looked after the crops to maximise yield. In this extremely dry year, we have discovered how important it is to select the paddocks that are most suited to the crop, rather than just focusing on the paddocks that we are going to renew."

Maximising yield is important to dilute the fixed costs (for example, drilling, fertiliser and crop protection, etc.). Growing a cultivar that maximises yield in a short timeframe, such as Cleancrop™ Toto turnip, is a great way to reduce the cost per kilogram of dry matter (kg/DM). Owl Farm yielded the crops on the 17th December 2019, 55 days after sowing. Interestingly, Cleancrop™ Toto had yielded just over 10 tDM/ha, while Barkant turnip had only yielded around 8 tDM/ha in the same paddock. They were impressed with these results.

"Even with the extremely dry conditions this summer, the crop was valuable", says Tom. "We managed to get eleven weeks of feed out of our eleven hectares of crop, that was 3 kgDM/cow/day from crops that yielded, on average, 10 tDM/ha."

Sales Agronomist Kyle Gardyne from PGG Wrightson Seeds mentioned that the combination of turnips and kale proved a good choice for Owl Farm. "You can use brassicas to build a feed bank coming into January/February/March when you require extra feed. Using the two turnip cultivars to spread maturity, then getting an extra few weeks of feed from the kale, has been a great way to push summer brassicas out into mid-March. Other crops, such as chicory, can be a little more reliant on moisture for post-grazing regrowth, so even though the turnip and kale yields were a couple of tonnes DM/ha less than Owl Farm's previous season average for turnips, and our expectations for yield from the kale, this crop combination still proved to be better off in terms of bulk feed during this extremely dry season."

Owl Farm calculated the cost to grow the turnip and kale crops at 15.9 c/kgDM. They were unable to source other supplementary feed with the same megajoules of metabolisable energy (MJME) and protein levels close to that price.

"Even if we had contracted Palm Kernel Extract (PKE) in at that rate, we were limited by the amount we could feed use due to the potential fat evaluation index (FEI) milk quality restrictions. The crops provided good value feed for us," Tom explained.

After this season's success, Owl Farm are definitely going to continue to add brassica cropping into their summer feed supply mix. However, they will make a few adjustments to improve their approach. "We have learned that paddock selection is key," says Tom.

"Next season we will select paddocks with characteristics best suited to summer crops, rather than solely focussing on our pasture renewal strategy, in order to achieve the best results."

Yield difference between Cleancrop™ Toto turnip (left) and Barkant® turnip (right).

Bulb Turnip

Cleancrop™ Brassica System

- High yielding bulb turnip
- Suitable for sowing from late spring through to late summer
- Suitable for summer/autumn/winter feed

Farm type

Sowing rate

SUMMER
2 kg/ha

WINTER
1 kg/ha

Days to grazing

80-110 days

Cleancrop™ bulb turnip is a high yielding, globe bulb turnip with medium maturity suitable for sowing from late spring through to early summer to supply feed in summer, autumn and early winter months. With the added benefit of the Cleancrop Brassica System, plants are bred to tolerate Telar® herbicide allowing application at both pre- and post-emergence for excellent weed control.

Agronomic performance of Green Globe turnip relative to Cleancrop™ bulb turnip

Cultivar	Hundredised bulb yield	Hundredised leaf yield	Leaf %	Hundredised total yield	Maturity (DAS)
Cleancrop™ bulb turnip	100	100	54	100	80-110
Green Globe	87	93	55	90	90-120

4 trials: Kimihia (2013, 2016), Lincoln PFR (2013) and Ruakura (2016). In these trials conventional herbicides were used on both Cleancrop™ bulb turnip and Green Globe. Telar® was not applied. Where Telar® was used for Cleancrop™ bulb turnip and no herbicide applied to Green Globe, we would expect higher yields for Cleancrop™ bulb turnip.

Turnip case study

PGG Wrightson Seeds Sales Agronomist Paul Greenbank (left) and farmer Troy Hughes (right) discussing the benefits of the Cleancrop™ Brassica System for Generation Farms' regrassing programme.

CLEANCROP™ BULB TURNIP CASE STUDY

Property name:	Generation Farms Limited
Farm type:	Dairy
Hectares:	150
Location:	Pahiatua, Manawatu
Name:	Troy Hughes

Troy Hughes is sharemilking on an 150 hectare (ha) milking platform in Pahiatua. The farm operates a pasture-based system with turnips used as summer feed and as a lead into their regrassing programme.

Troy used Cleancrop™ bulb turnip for the first time in the 2018/19 season and says, "I will use the Cleancrop™ system again as it is simple, robust and performs well." He found that the bulbs had good utilisation by grazing animals and did not lose quality in dry conditions, especially given the dry summer and early autumn experienced by Pahiatua in 2018/19. Along with sowing the Cleancrop™ bulb turnips, Troy also planted conventional turnips in order to make a comparison between the two cultivars. The Cleancrop™ paddock had a pre-emerge spray application of Telar® herbicide as per guidelines and no post-emergence herbicide or insecticide was required in comparison to the conventional turnips, which required a herbicide spray. When examining yield, the Cleancrop™ bulb turnip yielded 12 tonnes of dry matter (DM) per ha and produced a more even crop compared to 9 tDM/ha on the conventional turnip crop, which had massive variability within the crop. "When comparing Cleancrop™ to conventional cultivars, Cleancrop™ clearly outperforms conventional due to yield, simplicity, less spraying and organisation required" says Troy. The other clear advantage Troy found Cleancrop™ bulb turnips had over conventional turnips was producing a cleaner seedbed with a reduced weed burden, which will require minimal work to get back into permanent pasture. In Pahiatua, Troy has found his weed challenges include redroot, buttercup and Shepherd's Purse, all of which Telar® herbicide had fantastic control over.

Farm type

Sowing rate

4 kg/ha

Days to grazing

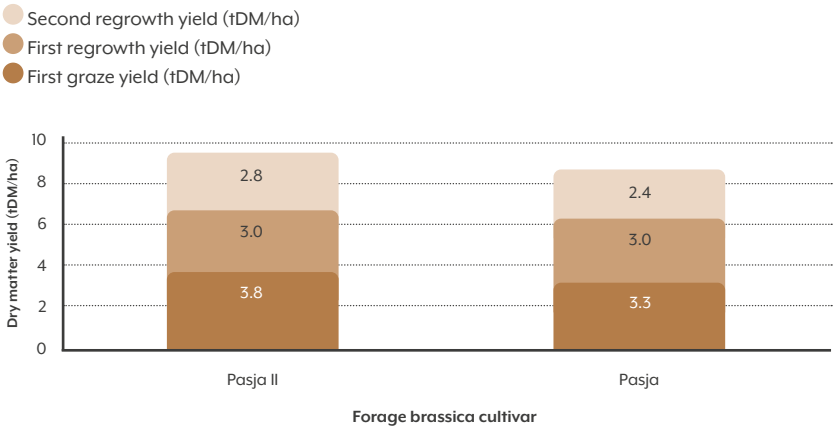
42-70 days

Pasja II FORAGE BRASSICA

- High dry matter yields from successive grazings (potential yield of 10,000 kgDM/ha over multiple grazings)
- Reduced bolting
- Excellent plant persistence
- Fast establishing with the first grazing possible at 42-70 days of sowing
- A flexible grazing option for summer/autumn feed
- Minimal ripening required
- Multi-graze option with excellent regrowth potential (moisture dependent)

Pasja II – the brassica to choose when fast, high quality summer/autumn feed is needed for your stock. Pasja II combines early maturity with yield and the option for multiple grazings, providing quality, fast feed you can rely on.

Dry matter production of multi-graze forage brassica



Both sets of results come from a trial conducted at the Kimihia Research Centre, Canterbury, sown on the 2 November 2006 and harvested on 18 December 2006, 29 January and 21 March 2007.

Number of bolting plants per plot (9 m^2) over time

Cultivar	Bolters per plot	
	16 January 2007	6 March 2007
Pasja II	0	0
Pasja	17	64

Bolting describes the number of yellow flowers each cultivar develops over time. The lower the number the better, as a high number of bolters adversely affects the plant population and regrowth potential.

Farm type

Sowing rate

4 kg/ha

Days to grazing

42-70 days

Leafy Turnip

Cleancrop™ Brassica System

- High yielding - 25% higher than Pasja II
- Multi-graze Pasja type with reduced bolting
- Excellent plant persistence after multiple grazings (moisture dependent)
- Fast-establishing, high quality feed
- Provides a flexible grazing option for all stock classes over summer and autumn
- Minimal ripening required

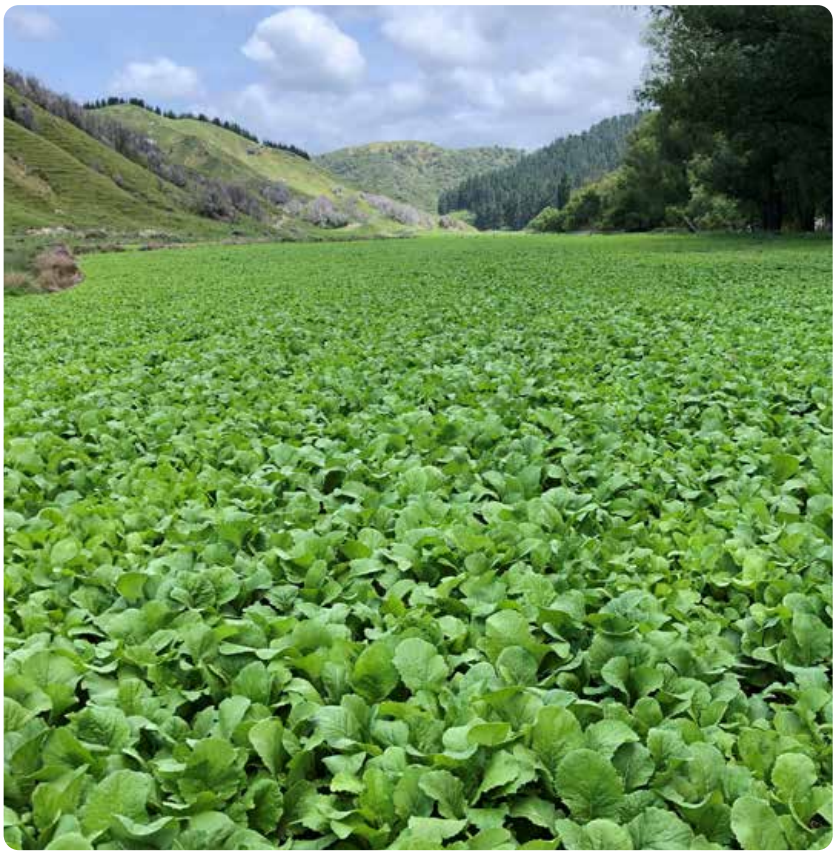
Cleancrop™ leafy turnip is a fast establishing, multi-graze variety with reduced flower bolting and 25% more total yield from multiple grazings than Pasja II leafy turnip. As part of the Cleancrop Brassica System, it has the added benefit of an herbicide tolerance trait allowing Telar® herbicide to be applied at both pre- and post-emergence for excellent weed control.

Agronomic performance of Pasja II forage brassica relative to Cleancrop™ leafy turnip

Cultivar	Hundredised yield 1	Hundredised regrowth 1	Hundredised regrowth 2	Hundredised total yield	Maturity (DAS)
Cleancrop™ leafy turnip	100	100	100	100	42-70
Pasja II	64	85	82	75	42-70

3 trials: Kimihia (2013, 2014, 2015). In these trials conventional herbicides were used on both Cleancrop™ leafy turnip and Pasja II. Telar® was not applied. Where Telar® was used for Cleancrop™ leafy turnip and no herbicide applied to Pasja II, we would expect higher yields for Cleancrop™ leafy turnip.

DAS: Days after sowing



BRASSICA OPTIONS

Animal Health and Nutrition

Benefits of brassicas

WHY SOW BRASSICAS?

Brassica forage crops provide farmers with a large amount of high quality feed (high in energy and protein) for their stock and should be considered in any situation where pasture quantity or quality is limiting the potential of livestock.

WHEN TO USE BRASSICAS

- During periods of feed shortage through the summer, autumn and winter
- To supplement periods of low pasture quality
- To finish stock
- When a summer-safe feed is required
- Prior to pasture renewal

WHY CHOOSE PGG WRIGHTSON SEEDS BRASSICAS?

- We are New Zealand's market-leading supplier of brassica seed
- Our joint forage brassica breeding programme (Forage Innovations Ltd) combines our expertise with Plant and Food Research (NZ)
- The result is a range of class-leading brassicas

We are committed to providing forage crop seed that not only produces high quantities of feed, but also leads to improved animal performance through feed quality, thereby providing positive benefits to the New Zealand farmer.

THE IMPORTANCE OF QUANTITY AND QUALITY OF FORAGE BRASSICAS

Yield assessment and dry matter testing

Allocating the right quantity of feed is essential for achieving target animal performance. Underfeeding is the major cause of animals failing to perform well on brassica crops.

A correct yield and dry matter percentage assessment in combination with correct break size or allocation is critical when feeding brassica crops. Yield cuts provide an assessment of the amount of fresh weight of the crop in the paddock.

FACT FILE:

Brassicas provide a bulk amount of high quality feed to maximise growth rates and increase the number of stock finished or maintained per hectare.

A brassica crop provides a break from pasture, decreasing pest levels, eliminating weed problems and with fertiliser helps correct soil fertility problems, resulting in cleaner, higher-producing pasture.

Using brassicas helps avoid internal parasites and pathogens that cause animal health problems, such as facial eczema and ryegrass staggers.

Brassica crops can increase stock productivity and therefore increase farm profitability.

Planning for grazing brassica crops

PRESOWING

- Choose paddocks well away from waterways; maintain pasture buffer strips between crop and critical source areas (CSA) as required by your local regional council
- Plan sustainable crop rotations, minimising risk of build up of soil-borne plant diseases
- Use conservation tillage techniques, slow runoff and reduce downhill slope loss
- Direct drill first year crops
- Soil test to identify nutrient levels and define fertiliser requirements
- Refer to winter cropping and the environment on pages 30-31 for more information on planting crops to reduce loss of sediment, phosphorus and nitrogen

FEED PLANNING AND PADDOCK SET UP

- Feed budget planning is needed well before crops are grazed
- Place baleage on crop paddocks before winter, away from CSAs
- Check stock water supplies; portable troughs that follow the crop face work well
- Match crop type with stock class (e.g. calves and hoggets need crops that contain more protein); young animals may do less well on bulb crops
- Match supplement type with stock class. Cereal straws are unsuitable for young stock classes if fed as the only supplement type offered alongside brassica crops
- Plan for adverse weather events; allow for nearby standoff areas with extra supplements and good shelter from wind

GRAZING MANAGEMENT

- Utilisation of crop and equal access to crop by all animals is best achieved when long, narrow breaks are offered rather than short, wide breaks
- Move the break fence at least once or twice daily to reduce trampling and crop wastage
- Minimise breakout risk with hot fencing standards and sufficient voltage
- Double fence the crop break to stop access to full crop area if breakouts occur
- Graze downhill towards CSAs
- Offer extra crop area and more high fibre supplementary feed when cold weather is forecast
- Back fencing planning – as required by your local regional council

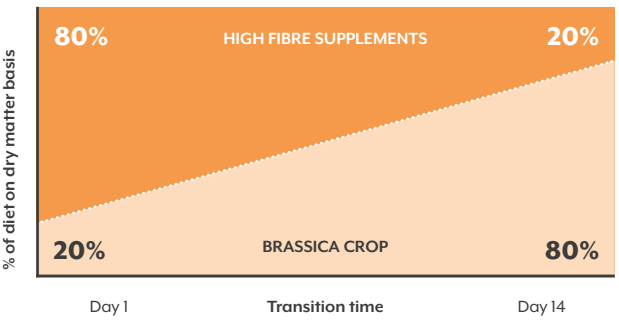
FURTHER INFO about winter cropping and the environment on pages 30-31.

Key risks of transitioning onto brassicas

- Time is needed (up to 10-14 days) for sheep, cattle and deer to transition from pasture to brassica crops
- Livestock learning to graze a new type of feed takes time
- The rumen needs time (up to 14 days) to change from a pasture-based fermentation to one best able to effectively digest brassicas
- Cattle need extra care during transition; they are more likely than sheep to have bloat and/or rumen acidosis challenges
- The first 14 days on brassica crops is when most animal health challenges occur

Transitioning = gradual increase in percentage of brassica crop in the diet

Once fully transitioned onto brassica crop, livestock should continue to receive at least 20% of the diet as high fibre supplements. NOTE: Feed no more than 35% of the diet on a dry matter basis as brassica crop for lactating dairy cows, due to risk of brassica milk taint.



Animal wellbeing on brassica crops

FIT, HAPPY, HEALTHY STOCK ON CROP

- Ensuring animals are well fed on crop and fibre supplements helps to maximise animal performance and improve profitability of the farm operation
- Make us feel proud to be part of the New Zealand farming industry
- Will more likely meet animal welfare requirements of the Ministry for Primary Industries (MPI)

PLANNING AHEAD: STOCK DOING WELL ON CROP

- Plan feed budgets well in advance of stock going onto crop, allowing for wastage of brassica crop and supplements under different conditions
- Adequate nutrition – not just total dry matter (DM) yield on offer, but also the correct balance of energy, protein, macrominerals and trace minerals to match animal requirements
- Plan to increase animal body condition and/or liveweight while on crop
- Prepare contingency plans for keeping animals safe and comfortable during adverse weather events; shelter and ample non-brassica feed if standing off crop

MINIMISING RISK OF ANIMAL HEALTH CHALLENGES ON CROP

- Freedom from preventative animal health disorders – working with your veterinarian to prepare and put in place a full animal health plan for stock while they are on brassica crops

Sometimes things don't go to plan and animals become unwell on crops. Aspects of disease challenges for brassica-fed animals are discussed on pages 89-95.

TIPS:

- Most health challenges happen in animals within 14 days of first grazing on brassica crops (during the 'transition period')
- Monitoring animals on crop for signs of illness is important at any time, but is ESPECIALLY important during the first 14 days of crop grazing

Benefits derived from trees and shelterbelts providing shelter for animals* grazing winter and summer brassicas

- Animal welfare – better comfort for animals on crop
- Productivity – more milk, better body condition and liveweight gains
- Environmental – water management (fencing and riparian plant), soil erosion and biodiversity
- External market demands (from consumer of animal products)
- Aesthetics (of natural plantings of shelter trees)

**Adapted from 'Expectations of pastoral animal shelter among farmers, stakeholders and the general public'. MPI Technical paper No: 2019/08*

Brassica feed quality

FEED QUALITY AND FEED TESTING

New Zealand feed testing laboratories have a wide array of tests available to describe the quality of our feeds. Brassicas are routinely tested by laboratories. Feed test results vary depending on:

- **Brassica species**. Bulb crops (e.g. swedes, turnips) usually have the highest megajoules of metabolisable energy (MJME) and water soluble carbohydrate (WSC; sugar) content
- **Ratio of leafy tops to bulbs for swedes and turnips**. Bulbs contain less protein than tops; variable top to bulb ratios change the delivery of nutrients to animals. Therefore when assessing the dry matter (DM) yield for bulb crops, it is important to measure the leafy tops and bulb yields separately
- **Brassica cultivar**. Feed quality of kale cultivars can vary greatly. Giant type kales contain less MJME and more neutral detergent fibre (NDF) than Kestrel marrowstem kale
- **Sowing date relative to plant maturity**. Plant quality may change as plants near maturity. Pre-reproductive and reproductive plants are of poorer feed quality than rapidly-growing, vegetative (leafy) plants. Reproductive plants may also contain compounds that can make animals unwell (more information on page 89)
- **Fertiliser use**. The type of fertiliser, amount used and timing of application (i.e. at sowing or later) will have an effect on the feed quality of brassicas. Nitrogen (N) fertiliser application increases levels of crude protein (CP) in brassicas. If plant available N is limiting, crop yields may be compromised and CP levels in brassicas may be too low to meet the nutritional requirements of young, growing and/or heavily pregnant animals

FEED REQUIREMENTS OF VARIOUS STOCK CLASSES

Knowing the feed quality of the brassica crops and supplements you plan to feed to animals helps determine if the planned diet will meet the nutritional requirements of your animals.

Nutrient requirements of various stock classes grazing a brassica crop on flat ground

Fill in your brassica crop feed test result plus supplements to compare with livestock requirements.

		STOCK CLASS				
		In-lamb ewe hogget	In-lamb mixed age ewe	Rising 1 steer	In-calf mixed age dairy cow	
		50 kg liveweight, 6 weeks pre-lamb (single), gaining 100 g liveweight/day	60 kg liveweight, 6 weeks pre-lamb (twins), no liveweight gain	250 kg liveweight, gaining 700 g liveweight/day	500 kg liveweight, gaining 0.5 kg liveweight/day, 8 weeks pre-calving	Your test result
NUTRIENT REQUIREMENTS	**Daily ME requirement[1] (MJME eaten/head/day)**	16.3	13.0	74.3	94.0	(MJME from feed test x kgDM eaten)
	Minimum[1] CP % DM	12	12	11	11	
	Minimum[1] NDF % DM	27-30	27-30	32-35	32-35	
	Maximum[2] WSC plus starch % DM	45-50	45-50	35-40	35-40	

[1]Minimum amounts suggested for optimum animal productivity.
[2]Maximum amounts suggested to support optimum animal productivity (once adjusted to the crop; actual target level varies depending on level of fibre in diet).

FEED TEST RESULTS AT A GLANCE

DM% Dry matter percentage; the amount of dry matter in the brassica plant expressed as a percentage of wet weight.

MJME Megajoules of metabolisable energy, expressed as a percentage of dry matter, is calculated from the digestibility of the brassica.

CP Crude protein, expressed as a percentage of dry matter. CP is calculated by multiplying the N content of brassicas x 6.25.

WSC Water soluble carbohydrates (sugars), expressed as a percentage of dry matter.

NDF Neutral detergent fibre, expressed as a percentage of dry matter. NDF is a measure of the cellulose, hemicellulose and lignin in brassica plants.

ADF Acid detergent fibre, expressed as a percentage of dry matter is, like NDF, a measure of the fibre content of brassicas and includes just cellulose and lignin.

These notes are provided as a guide only. For more specific crop review and recommendations relevant to your crop, contact your PGG Wrightson Seeds Sales Agronomist (page 261). For more animal health advice, contact your veterinarian.

Interpretation of common forage brassica feed quality tests

METABOLISABLE ENERGY (MJME)

Metabolisable energy (MJME) is the energy value of the feed expressed as megajoules (MJ) of metabolisable energy (ME) per kilogram (kg) of dry matter (DM). The energy value of forage brassicas is typically very high. Knowing the MJME value of feed helps to align energy supply from brassica-based diets with energy demand of animals. Both DairyNZ and Beef and Lamb New Zealand have publications on the energy requirements of various stock classes.

CRUDE PROTEIN (CP)

Crude protein (CP) is an estimate of the protein content based on the amount of nitrogen in a feed sample. High performing stock classes will require more protein for milk production or liveweight gain. In most cases, the CP content of forage brassicas meets livestock requirements. Exceptions include when the leafy top is lost from turnips or swedes, leaving only bulb. CP levels in the bulb are low compared to the leaves. Supplementing brassicas with low CP supplements increases the risk of protein deficiency.

NEUTRAL DETERGENT FIBRE (NDF)

Neutral detergent fibre (NDF) is a measure of the structural fibre in the feed. Risk of ruminal acidosis is increased when NDF levels are lower than what an animal requires. Brassicas almost always contain inadequate NDF for cattle and in most cases, insufficient NDF for sheep. Forage brassicas should always be fed with a supplementary feed source of extra NDF (e.g. standing pasture, hay, silage or straw).

WATER SOLUBLE CARBOHYDRATES (WSC)

Water soluble carbohydrates (WSC) are a measure of non-structural carbohydrates that are rapidly and extensively degraded in the rumen. Once the rumen has adjusted to crop over 10-14 days, animals can typically digest the higher levels of WSC found in forage brassicas. Exceptions include the bulbs of swede or turnip crops when few or no leafy tops are present; levels of WSC may exceed 50% of DM.

TIP:

When you send samples of a brassica crop away for dry matter percentage (DM%) testing, it's always worthwhile to request a full feed test.

For more information on the feed quality of different forage brassicas, refer to the following resource:

Westwood CT and Mulcock H. (2012). Nutritional evaluation of five species for forage brassica. In Proceedings of the NZ Grasslands Association 74: 31-38.

Available online: www.grassland.org.nz/publications/nzgrassland_publication_2266.pdf

Transitioning livestock onto brassica crops

DRYSTOCK TRANSITIONING TO BRASSICAS

The first two weeks:

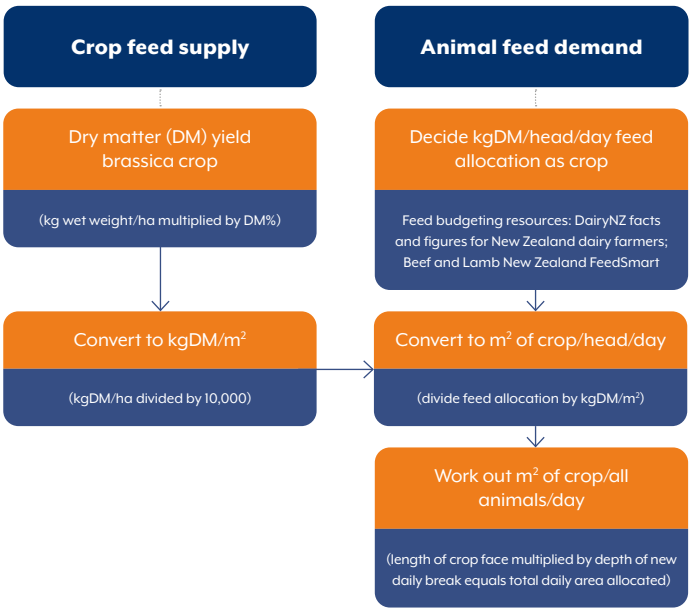
- A full rumen is required before animals are shifted onto crops - especially cattle. Fill up with pasture and/or baleage, silage, hay and/or straw
- Remove animals from crop after 1-2 hours during the first few days and return to pasture
- Ensure plenty of long-stem fibre supplements (baleage, silage, hay and/or straw) are available to stock when off crop
- During transitioning, increase feed allocation of brassica crops in small 15-20% increments every two days, building up to a maximum allowance over at least 10-14 days
- Once feed transition is complete, offer no more than 80% of the diet as crop for drystock
- Feed at least 20% of the diet as good quality fibrous supplement or runoff pasture for non-lactating dairy cattle, beef cattle and sheep. Runoff pasture may not provide adequate fibre intake for cattle, therefore it is recommended that a quality fibre supplement is offered
- Sheep and deer ideally need access to long-stem fibre at 10-20% of the diet once fully transitioned to crop
- The first 14 days while transitioning onto brassica crops is when most animal health challenges occur

Clean, fresh stock water must be available for brassica-fed animals at ALL times.

TIPS:

- ALWAYS dry matter (DM) yield brassica crops pre-grazing
- Unknown DM yields = very difficult and risky transitioning
- Feed testing labs give best crop DM% results; don't use 'book values'
- Nitrate test sample at same time as DM% testing

CROP AREA ALLOCATION

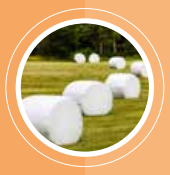


LACTATING DAIRY COWS TRANSITIONING TO BRASSICAS

The first two weeks:

- A full rumen is required before lactating dairy cows are shifted onto crops. Fill up with pasture and/or baleage, silage, hay and/or straw after milking. Once all cows have consumed pasture/supplements THEN start cows onto brassica crop
- Start by grazing the crop for no more than 1-2 hours per day during the first few days, returning cows to a diet of pasture plus high fibre supplementary feeds
- During the transitioning period, ensure plenty of long-stem fibre supplements (baleage, silage, hay and/or straw) are available to cows when off crop
- Pasture plus brassica crop is a suitable complete diet for cows once fully transitioned onto brassica. Feed extra supplementary fibre during the transition period
- During transitioning, increase feed allocation of brassica crops in small 15-20% increments every two days, building up to a maximum allowance over at least 10-14 days
- Once feed transition is complete, offer no more than 35% of the diet as crop for lactating cows, due to risk of brassica milk taint

Supplementary feeds for brassica-fed livestock

		OPPORTUNITIES	CHALLENGES
Standing pasture		• Cost-effective; no ensiling/baling/transport costs • Good energy, protein content, suitable for all stock classes as a diet-balancer for brassicas • Well-accepted by stock	• Pasture use impacts on pasture feed budget/ reduces pasture cover • Soil and gateway compaction during winter and high rainfall events • Transfer of soil-borne brassica disease between paddocks • Fibre content is sometimes too low for balancing low-fibre brassica diets
Baleage and silage		• Good source of dietary fibre • Variable energy, protein content, usually a good dietary balancer with brassicas • Well-accepted by stock (usually) • Place in brassica crop before winter • Homemade or purchase as needed • Move around farm, sell if not required	• Variable quality (need feed test) • Feed out challenging, wet conditions • If short-chop length, high wastage on wet ground; longer chop length baleage is better-suited • Feed out cost
Hay		• Very good source of dietary fibre; better at preventing acidosis, nitrate toxicity than baleage (provided hay is tasty and well-accepted by animals) • Can be great dietary balancer for brassicas, however energy and protein content of hay is variable • Well-accepted by stock (usually) • Homemade or purchase as needed • Cheaper to transport (higher DM% so less water to cart) than baleage	• Variable quality (need feed test) • Needs dry storage facilities • Deteriorates/rots if water damaged • Can't place in paddock pre-winter • Utilisation reduced if leaf shatters at feed out • Feed out cost
Straw		• Very good dietary fibre source • Cheaper to purchase than baleage, hay • Cheaper to transport (higher DM%) than baleage • Useful if locally-produced byproduct from cropping farmers	• Low feed value, brassica and straw-based diets can be inappropriate, young growing stock, late pregnant stock • Large quality difference between straws. Ryegrass straw better quality than barley. Wheat, oat straw least useful (sharp, not well-accepted by stock; variable intakes; wastage) • Needs dry storage facilities • Deteriorates/rots if water damaged • Feed out cost

Reproductive brassica crops and animal wellbeing

All ruminant stock classes may become unwell eating reproductive brassicas. Pregnant and lactating stock are most at risk.

Brassica plants sometimes produce reproductive plant parts when:

- Plants have reached/passed maturity AND/OR
- Vernalisation* has occurred after exposure of young plants to hard frost

Reproductive development changes vegetative/leafy plants to those undergoing stem elongation, formation of flower buds, flowers and finally seed pods.

Which parts of the reproductive brassica plant are potentially toxic to grazing animals?

All parts of the reproductive brassica plant are potentially toxic if eaten by grazing animals. The reproductive parts of a plant are:

- Elongating top third of the plant – even if buds or flowers are not yet evident
- Flower buds (look similar to a small broccoli head)
- Flowers
- Seed pods and seeds

As a rule, reproductive parts of brassica plants should NOT be grazed by animals. Animal health risk is influenced by many factors including the number of reproductive plants present relative to non-reproductive (vegetative) plants.

Animal health problems sometimes occur when animals graze reproductive brassica plants. Plants may contain sulphur and nitrogen-containing secondary plant compounds such as progoitrin or other glucosinolates and s-methyl cysteine sulphoxide (SMCO) – these compounds may cause animal health problems.

- Different brassica species accumulate varying amounts and ratios of unwanted secondary plant compounds
- The percentage of flowering plants alters risk. Risk to animals is greatest when every brassica plant is undergoing reproductive development. A low percentage of flowering plants with remaining plants being vegetative/leafy is less risky, but not entirely safe
- Levels of secondary plant compounds vary with many factors, such as fertiliser use, plant available nitrogen/sulphur and environmental/climatic conditions
- Risks to animals vary, but may include SMCO toxicity (refer to page 94) and/or brassica-associated liver disease (BALD) (see page 90)

NOT grazing reproductive brassicas is the ONLY way to fully avoid toxicity risks to animals. Destroy unwanted surplus crop by dicing/mulching/slashing plant material into the ground.

How do we manage for risk of animal toxicity on reproductive brassicas?

We do NOT advise any stock class grazing reproductive brassicas at any time.

If, against this advice, reproductive brassica crops are grazed, consider:

- Follow best practice advice on brassica crop grazing including transitioning onto brassica crops (see page 87)
- Sheep are relatively more tolerant than cattle to SMCO toxicity and BALD. Farmers can substitute cattle with sheep on reproductive brassica crops. Care is still needed with sheep as dry matter intake and well being may be compromised on crops containing a high total concentration of glucosinolates and/or SMCO
- Graze reproductive crops with non-pregnant, non-lactating stock classes. These animals will be at slightly lesser risk than pregnant and lactating stock, but some risk will still remain
- Feed non-brassica supplements with crops to dilute intake of reproductive brassica
- Break feed crops to encourage stock to eat reproductive plant parts combined with leaf and stem, diluting total intake of reproductive plant parts

Factors that influence onset of reproductive development in brassicas

Brassica species

Early maturing species (e.g. Pasja II forage brassica) may become reproductive earlier than late-maturing species (e.g. kale cultivars).

Cultivar

Within brassica species, cultivars vary with different vernalisation* requirements and early, mid- or late maturity, therefore influencing onset of reproductive development.

Other factors

- Sowing date
- Sowing rate (therefore plant density)
- Ambient temperature
- Day length
- Cold temperatures causing vernalisation*

**Vernalisation means the exposure of young brassica plants to cold temperatures (typically a cold frost) that triggers reproductive development in the plant. Different brassica species and even different cultivars have different requirements for vernalisation. Vernalisation can result in spring-sown brassicas initiating reproductive development earlier than at expected plant maturity.*

These notes are provided as a guide only. For more specific crop review and recommendations relevant to your crop, contact your PGG Wrightson Seeds Sales Agronomist (page 261). For more animal health advice, contact your veterinarian.

Photosensitisation in brassica-fed livestock

PHOTOSENSITISATION

Photosensitisation is a sunburn-like condition sometimes seen in animals grazing brassica crops. There are two types of photosensitisation; primary and secondary photosensitisation.

Cattle

- Sunburn-like reddening appears on white areas of skin, as well as hairless areas on the udder and teats of dairy cows. The coronary band of feet can appear reddened
- Skin, particularly white areas, is thickened, red and inflamed. Affected cattle seek shade. Lactating dairy cows resist being milked and milk production can be reduced. Cows may need to be dried off

Lambs

- Signs of photosensitisation appear within 24-72 hours following lambs starting crop. Face, ears and/or midline of the back may be affected.
- Ears are droopy and thickened, and swelling of the face is sometimes seen. Lambs shake their heads and seek shade. Ears are no longer droopy after the first week, but may appear scabby and deformed. The midline of the back appears reddened with skin damage and wool loss. Risk of fly strike and dermatophilus may increase

BRASSICA-ASSOCIATED LIVER DISEASE (BALD)

Only cattle are affected by BALD

- Cattle are affected by BALD
- Photosensitisation occurs secondary to liver damage in a similar manner to facial eczema (sporidesmin toxicity)
- Progoitrin, a glucosinolate found in all brassicas, is broken down in the rumen to form compounds that sometimes cause liver damage. Bile ducts become blocked, preventing excretion of the breakdown product of chlorophyll metabolism, phytoporphyrin. Increased levels of phytoporphyrin build up in the blood, causing photosensitisation
- Rumen acidosis increases risk of BALD because progoitrin is converted into more toxic compounds when rumen pH is low
- BALD is most commonly reported in cattle grazing swedes, bulb turnips and forage rape

REMEMBER:

- Many other non-brassica factors cause photosensitisation, including facial eczema and when stock consume some types of weeds. Talk with your veterinarian for more information
- The only way to know if photosensitisation is primary or secondary is through your veterinarian collecting blood tests from affected animals

RISK FACTORS FOR BALD

- **Swedes, bulb turnips and forage rape** are a higher risk feed source for BALD than kale and *Raphanobrassica*
- **Agronomic factors** that increase concentration of progoitrin, the compound responsible for BALD, include plant stress due to nutrient deficiency (phosphorus, nitrogen, boron), pest or disease stress or moisture stress
- **Reproductive brassicas** including ones that that have started to elongate pre-flowering. Progoitrin accumulates in higher concentrations in reproductive plant parts
- **Grazing management practices that increase risk of BALD**:
  - Feeding brassicas as a very high proportion of the diet
  - Practices that increase risk of rumen acidosis (refer to page 93)
  - Practices that allow individual cattle to eat too much brassica/not enough supplementary feed (e.g. short crop face, not enough bale feeders)

PREVENTING BALD

- Avoid grazing swedes, turnips and forage rape undergoing reproductive development (refer to page 89)
- Pregnant or lactating dairy cows are at particular risk of BALD
- BALD has not previously been reported in sheep. Sheep are at lesser risk of BALD than cattle and may be used if necessary to graze crops considered high risk for BALD. However, accumulation of other anti-nutritional compounds in reproductive brassicas may cause sheep to become unwell (see page 89 for more information on risks around grazing reproductive brassicas)
- Actively minimise the risk of rumen acidosis in brassica-fed stock (see page 93)

Animal health notes are provided as a guide only. For animal health recommendations specific to your animals, contact your veterinarian.

BRASSICA-ASSOCIATED PRIMARY PHOTOSENSITISATION (BAPP or 'RAPE SCALD')

Lambs are affected by BAPP; cattle occasionally.

- Most commonly seen in lambs grazing very healthy, immature and rapidly-growing brassica crops. Cattle may occasionally be affected
- Cause of BAPP remains unknown; it is most likely an unidentified compound in the green part of leaf (but not petiole, stem or bulbs) of brassicas
- BAPP acute cases (swollen ears, reddening of skin) are usually seen during the first 1-3 days after lambs start onto brassica

Leaf margins nibbled by lambs in a lightly-stocked Pallaton Raphno® crop.

Watch for lambs nibbling leaf margins of brassicas during transition onto crop. Lambs that eat just green leaf but not petiole (centre part of leaf) may be at increased risk of BAPP 'rape scald'. High stocking rates during transition to crop can encourage lambs to eat both green leaf and petiole, potentially reducing the risk of BAPP.

RISK FACTORS FOR BAPP ('RAPE SCALD')

- **Dark green**, healthy, strongly growing brassica plants
- **Grazing management** that allows hungry individual animals to eat just brassica leaf but not petiole, stem or bulb
- **Poor transition** onto crop with limited or no transition period onto crop
- **Leafy brassicas** that don't have much stem (or bulb)
- **Immature crops** with limited leaf drop/yellowing of lower leaves
- **Late spring to early autumn** when sun intensity/solar radiation is high
- **Regrowth** that follows rain after a dry spell
- **Dull overcast** weather conditions for prolonged periods
- **Paddock history** of lucerne or clovers grown previously

PREVENTING BAPP ('RAPE SCALD')

- Understand the risk factors for BAPP
- Manage for risk, e.g. avoid planting brassicas into ex-lucerne/clover dominant paddocks likely to contain high soil levels of plant-available nitrogen
- Transition carefully onto brassicas (more information on page 87)
- Develop strategies that reduce risk of lambs nibbling leaf edges. BAPP risk is lower when lambs eat more petiole and less leaf (Box et al, unpublished)
- **High stocking rate**. For crops that do not stop growing at maturity (that is, crops that keep accumulating DM, such as *Raphanobrassica*), correct stocking rate is a very important management strategy to reduce risk of BAPP
- **Focus on the first week of transitioning onto brassica crop**. Stock high numbers of transitioning lambs on the first block or paddock of a brassica grazing rotation. Add extra lambs, ewes and/or subdivide the first paddock or block to achieve a high stocking rate. After the first few days of lambs at a higher stocking rate, return to a more typical grazing management strategy
- **Mechanical topping** of brassica crops ahead of lambs during the transition period greatly reduces risk of BAPP (Box et al, unpublished), likely because lambs eat more petiole and less green leaf
- **Pre-grazing ewes ahead of lambs** on a brassica crop similarly aims to remove leaf, leaving relatively less leaf/more petiole for lambs during the first week that lambs are on crop. Once transitioned, graze lambs normally on crop, with no ongoing leaf removal required

TIPS:

- Stocking rates that correctly match animal feed demand with kgDM/ha yield of brassica may help reduce risk of BAPP ('rape scald')
- **Liver damage:**
  - Is **NOT** present in animals with BAPP
  - IS present in animals affected by brassica-associated liver disease (BALD)

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Nitrate toxicity in animals on forage crops

All ruminant stock classes may become unwell with nitrate toxicity. Cattle are most at risk, especially when animals are transitioning onto high quality forage crops.

NITRATE TOXICITY

- Nitrate toxicity occurs on all forage types, but is more commonly seen on rapidly-growing annual pastures and forage crops
- Plants accumulate too much nitrate instead of plant proteins
- In the rumen, nitrate converts to nitrite. Nitrite leaves the rumen and enters the blood stream, where it damages haemoglobin within the red blood cells. The blood's ability to carry oxygen is reduced. Toxicity risk is greatest when plants stop growing then restart again suddenly, e.g. growth following a drought-breaking rain or plant growth following a frost
- Recent application of nitrogen (N) fertiliser increases risk for nitrate toxicity
- Nitrate toxicity has been reported in animals grazing forage brassicas, greenfeed winter cereals and newly established Italian and annual grasses

NITRATE TOXICITY RISK IN DIFFERENT STOCK CLASSES

Cattle: Cattle are most susceptible to nitrate toxicity. Pregnant and lactating cattle are at greater risk than empty/dry cows, replacement heifers or beef cattle.

Sheep: Nitrate toxicity occurs less frequently in sheep, but certainly can occur.

Deer: Nitrate toxicity is not commonly-diagnosed in deer grazing high quality forage crops.

Young, pregnant and lactating animals are more likely to become unwell from nitrate toxicity than drystock.

REDUCING RISK OF NITRATE TOXICITY

- **Test levels of nitrate in forage**. Rapid test using a nitrate kit or (preferably) send a sample away to a laboratory to quantify nitrate levels. High nitrate levels identify extent of risk to animals. Do not graze high-level nitrate crops; leave for a few days and retest to see if levels have dropped
- **Do not put hungry animals onto high quality forages**. Hungry animals eat more forage, faster. This increases risk of nitrate toxicity. Feed out non-nitrate containing feeds to animals before moving them onto forage that may be risky for nitrate
- **Feed tasty, long-stem, high fibre supplements**. Fibrous supplements fill animals up, slowing down the rate at which animals can eat high nitrate feeds. Fibre helps rumen microbes more effectively convert nitrite to ammonia, reducing the transfer of nitrite to the blood
- During the transition of animals from pasture to forages that are a high risk for nitrate, leave animals on high nitrate forages for no more than 1 hour each day. Increase time on forage gradually over following days. With time, rumen microbes adapt to exposure to high levels of nitrate, more safely and completely converting nitrite to ammonia

SIGNS OF NITRATE TOXICITY

Acute (fast-onset) nitrate toxicity:

- Signs seen as quickly as 1 hour after animals eat high nitrate forages
- Animals are wobbly on their legs
- Gasping for breath
- Colic (gut ache)
- Nervous signs – animals very excitable/overreactive
- Scouring
- Brown-coloured gums
- "Milk fever" in dairy cattle

Chronic signs (seen over a few days to weeks):

- Laminitis (lameness)
- Cows aborting
- Foetal abnormalities in unborn lambs

DIAGNOSIS: NITRATE TOXICITY

- Your veterinarian will help diagnose nitrate toxicity and treat animals affected by nitrate
- Diagnosis involves post-mortem examination of dead animals and/or clinical examination of live animals
- History of a sudden dietary change onto fresh green forage, recent N fertiliser application particularly at relatively high rates of N/hectare, recent 'stop start' growing conditions and/or a feed test showing high levels of nitrate in forage helps conclude that nitrate toxicity was likely responsible for animal ill-health or death

These notes are provided as a guide only. For more specific crop review and recommendations relevant to your crop, contact your PGG Wrightson Seeds Agronomist. For more animal health advice specific to your animal health and wellbeing, contact your veterinarian.

Rumen acidosis in animals on forage crops

All ruminant stock classes may become unwell with rumen acidosis. Cattle are most at risk, especially when animals are transitioning onto high quality forage crops.

RUMEN ACIDOSIS

- Animals transitioning from pasture to high quality forage crops occasionally become unwell with rumen acidosis
- 'Ruminal acidosis' means too much acid has accumulated in the rumen
- Acidosis is more commonly seen when animals transition onto fodder beet crops, but can occur on any high quality forage
- Animals that graze forage brassicas, greenfeed winter cereals, herbs and lush pastures, particularly at the first grazing of newly-established Italian and annual grasses, are also at risk of rumen acidosis

ACIDOSIS RISK IN DIFFERENT STOCK CLASSES

Cattle: Cattle are most susceptible to ruminal acidosis. Dairy cattle are at greater risk than beef cattle due to their greater 'drive' to rapidly consume feed.

Sheep: Ruminal acidosis is less common in sheep than cattle. Despite this, care is required when transitioning sheep onto very high quality forage.

Deer: Rumen acidosis is not commonly diagnosed in deer grazing high quality forage crops.

REDUCING RISK OF RUMEN ACIDOSIS

- **Careful transition of animals** onto high quality forages is the single most important way to reduce risk of rumen acidosis. Transition recommendations are on page 87
- **Do not put hungry animals onto high quality forages**. Hungry animals eat more forage, faster. This increases risk of rumen acidosis. Feed high fibre feeds to animals before moving them onto forage that may be risky for rumen acidosis
- **Feed tasty, long stem, high fibre supplements**. High quality forage often does not contain enough fibre to maintain good rumen function. Long stem, high fibre supplementary feeds help balance the diet
- **No breakouts over electric fences**. The most common cause of rumen acidosis is when animals break out onto large areas of forage crops
- Other feeds like cereal grains increase risk of rumen acidosis in animals consuming high quality forages. Ask your nutritionist or veterinarian for advice around risks of feeding grain and high quality forages together

SIGNS OF RUMEN ACIDOSIS

Animals unwell with rumen acidosis show one or more of the following signs:

- Scouring/diarrhoea with undigested fibre and bubbles present in the dung
- Slab-sided/hollow-gutted appearance
- Bloat
- No or reduced cud chewing
- Dehydration with sunken eyes (in severe cases)
- Recumbency/downer cattle with signs similar to those of milk fever in dairy cattle
- Sudden death is sometimes the only sign of rumen acidosis

If rumen acidosis is suspected, immediately call your veterinarian for further advice

DIAGNOSIS: RUMEN ACIDOSIS

- Your veterinarian will help diagnose and treat cases of rumen acidosis
- Diagnosis involves post-mortem examination of dead animals and/or clinical examination of live animals
- A history of animals recently transitioning from poor quality feeds onto high quality crops and/or breakouts by animals onto large areas of crops and/or insufficient fibre in the diet of crop-fed animals increases the likelihood of rumen acidosis being present

Animal health notes are provided as a guide only. For animal health recommendations specific to your animals, contact your veterinarian.

SMCO toxicity in brassica-fed animals

All ruminant stock classes may become unwell with SMCO toxicity. Heavily-pregnant, lactating and young cattle are most at risk.

S-METHYL CYSTEINE SULPHOXIDE (SMCO) TOXICITY

- Haemolytic anaemia ('kale anaemia' or 'red water') occurs when animals eat brassica plants that contain high levels of SMCO
- The rumen converts SMCO to toxic dimethyl disulphide (DMDS)
- Red blood cells damaged by DMDS are less effective at carrying oxygen around the body

High levels of plant-available nitrogen (N) and sulphur (S) are major risk factors for SMCO accumulation in brassica plants. Talk with your agronomist about soil testing before planting brassicas, avoiding paddocks with high soil sulphate-S content. Avoid use of S-containing fertilisers on brassica crops.

Which brassica species produce the most SMCO?

- **Kale and *Raphanobrassica*** are more likely to accumulate more SMCO than other brassica species
- **All** brassicas can accumulate SMCO under the right conditions, particularly in the presence of too much plant available N and S
- **Reproductive** brassica plant parts accumulate more SMCO than vegetative (leafy) brassicas (refer to page 89)

Which animals are at greatest risk of SMCO toxicity?

- All ruminant animals are affected to some degree by SMCO toxicity
- Lactating and pregnant animals are most at risk of clinical disease
- Cattle are affected more than sheep, but sheep are occasionally affected

KEEPING SMCO LEVELS LOW IN THE PLANT

- **Soil test** before planting brassicas and avoid paddocks with high soil sulphate-S levels (risk of SMCO toxicity increases with soil sulphate-S levels greater than 10 mg/kg)
- **Use DAP** as a starter fertiliser. Do not use S-containing fertilisers on brassicas
- **Late winter grazing** of kale and *Raphanobrassica* is risky when plants are starting to undergo reproductive development. Plant SMCO levels increase gradually from time of sowing through into early spring, even if plants remain vegetative with no visible signs of reproductive development

SIGNS OF SMCO TOXICITY

- Occur as early as 1 week, but usually 3-5 weeks after animals start on brassicas
- Animals look unwell, lose body condition/liveweight, are off their feed, stand away from other animals and may be reluctant to walk
- Urine from affected cattle may appear red-coloured
- Occasionally animals are simply found dead

If SMCO toxicity is suspected, immediately call your veterinarian for further advice

KEEPING ANIMAL RISK OF SMCO TOXICITY LOW

- **Dilute SMCO intake.** Do not feed brassicas as a high percentage of the overall diet. Including other non-brassica feeds (pasture, baleage, silage and hay) as part of the diet will dilute total daily intake of SMCO
- **Avoid grazing brassicas undergoing reproductive development.** The occasional flowering plant within a crop is of relatively low risk to animals. However, a high percentage or all plants flowering greatly increases the risk of SMCO toxicity
- **Trace mineral status of animals.** Talk with your veterinarian about checking copper, selenium and iodine status of your animals; deficiencies of these minerals increase the risk of SMCO damaging a greater proportion of red blood cells

Animal health notes are provided as a guide only. For animal health recommendations specific to your animals, contact your veterinarian.

Animal health challenges in brassica-fed livestock

The following table summarises other animal health challenges sometimes seen in brassica-fed livestock.

	WHAT WE SEE	HOW TO PREVENT
Clostridial disease **Including Pulpy kidney, Blackleg, Tetanus, Malignant oedema, Blacks disease**	• Young calves, lambs and hoggets (often the larger animals within a group) are found dead • Carcase bloats and rots quickly • Live animals affected with clostridial disease are very unwell, unwilling to move, have a high temperature and are difficult to save once unwell • A grazing history of a recent change from pasture to very high quality forage (i.e. brassica crops) • A health history showing either no or an incomplete clostridial vaccination programme	• Obtain veterinary advice about diagnosis of clostridial disease and for assistance with a full clostridial vaccination programme • Allow 7-10 days following the second vaccination before animals are shifted onto high quality pasture or forage crop • Transition carefully onto high quality forage (refer to page 87)
Vitamin B1 deficiency **Also called Thiamine deficiency, Polioencephalomalacia, 'Polio', PE or PEM**	• Usually young calves, lambs and hoggets, but occasionally adult livestock are affected • Animals are found dead; or • Live affected animals show neurological signs including stumbling, staggering, an arched neck/back and blindness. Fatal if animals are left untreated • A grazing history of a recent diet change from pasture to a very high quality forage, typically forage crops or high quality pasture (e.g. silage regrowth)	• Cases of vitamin B1 deficiency can be treated if caught early. Obtain veterinary advice about a full treatment and prevention programme to protect animals against the effects of vitamin B1 deficiency and to rule out other causes of neurological disease • Gradually transition animals onto high quality forage (refer to page 87) • Feed palatable, long-stem fibrous supplements as part of the diet for brassica-fed animals to stabilise rumen function
Brassica bloat	• Rumen bloat, but not necessarily a 'frothy' clover or lucerne type bloat; possibly linked to rumen acidosis • Most often it affects cattle; rarely sheep or deer • Animals are found dead or alive but severely bloated • Risk factors include hungry cattle with insufficient fibre in the diet suddenly accessing brassica crops, usually in the early stages of transitioning from pasture onto a brassica crop. Moving animals onto a fresh break of frosted crop or a crop covered in heavy dew increases the risk of brassica bloat	• Transition animals carefully onto high quality forage (more information on page 87) • Refer to more information about rumen acidosis prevention on page 93. The risk factors are similar for brassica bloat and rumen acidosis • Feed palatable, long-stem fibrous supplements as part of the diet for brassica-fed animals to stabilise rumen function • Wait until frost or dew on brassica crops has lifted before shifting animals onto a new break • Bloat oil benefits are unknown for the prevention of brassica bloat
Goitre	• Enlarged thyroid gland in neck of a newborn lamb or calf born to ewe or cow grazed on brassica crops during pregnancy • Increased risk of dystocia (problems giving birth) and/or the lamb/calf will be at greater risk of hypothermia and death • Caused by low iodine content and/or a high glucosinolate content in forage brassicas • Common in ewes; occasionally reported in cattle	• Work with your veterinarian to confirm a diagnosis of goitre and to develop a control programme • Prevention of goitre in lambs involves treating ewes by either: - Injecting ewes with an iodised oil product 1 month before mating or at least 2 months prior to feeding brassicas; or - Drenching ewes with potassium iodide twice, 8 and 4 weeks before lambing

Other important animal health challenges for brassica-fed stock covered in this section:

- Photosensitisation (pages 90-91)
- Nitrate toxicity (page 92)
- Rumen acidosis (page 93)
- S-methyl cysteine sulphoxide (SMCO) toxicity (page 94)

These notes are provided as a guide only. For more information on these animal health conditions and other diseases affecting brassica-fed stock, contact your veterinarian.

ALWAYS DISCUSS ANIMAL HEALTH PLANNING AND ANY CONCERNS WITH YOUR VETERINARIAN

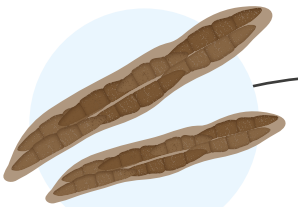
BRASSICA OPTIONS

Brassica Pests and Diseases

Preventing the spread of brassica diseases

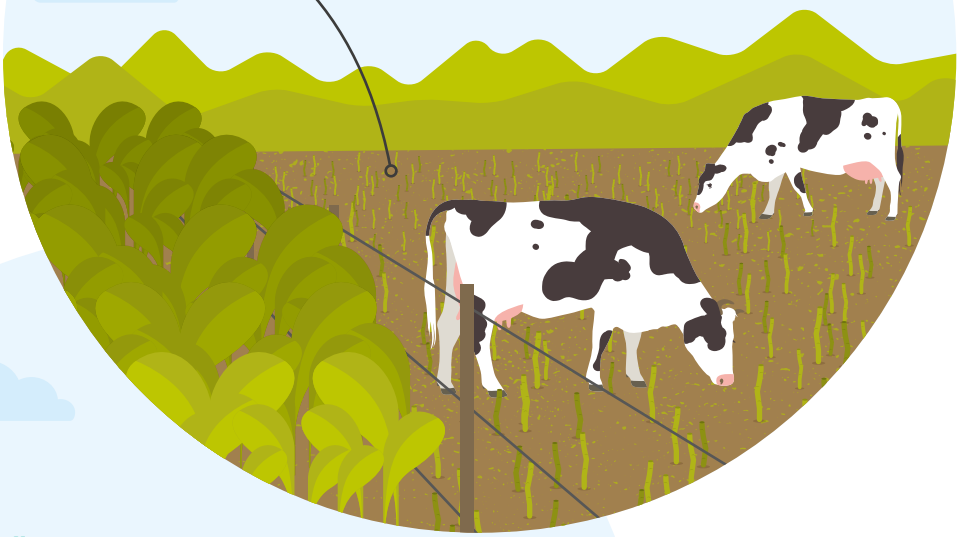
Airborne ascospores released from fungi overwintering in crop residues or soil.

Ascospores are airborne spores that reinfect next year's crop and neighbouring farms or paddocks.



Crop residues host and allow many fungi to overwinter before producing spores in the spring.

Minimising residues and deep ploughing is a good strategy to minimise the transfer of most fungal diseases from one season to the next.



Mechanical spreading of diseases with soil on machinery or stock.

Thoroughly clean machinery between infected paddocks if any signs of clubroot, black rot or bacterial leaf spot are present.

TIP:

Repeated brassica cropping should be avoided to minimise the build up of disease and break down in varietal resistance. Swede should be considered a first crop only with kale, fodder beet or Pallaton Raphno® possible options for second year brassica cropping when required.

Brassica pests

PEST	SYMPTOMS	IMPACT	CONTROL
Aphids			
 Aphids are a pest to all brassica types, and found throughout New Zealand.	Aphids feed on brassica plants by sucking plant juices, causing curling, wilting and distortion of leaves.	High populations of aphids can cause yield reduction and may also cause crops to become unpalatable to stock. Aphids transmit a number of viruses, including turnip mosaic virus which can reduce yield and/or cause plant death.	Use of Ultrastrike® brassica seed treatment for seedling protection. Use of Aphid tolerant varieties or species, including Raphno®. Application of insecticide at early stages. Recognise flight periods and control infestations early.
Grass Grub			
 Grass Grubs are found throughout New Zealand and can cause severe damage to brassica crops.	Grass Grub larvae feed on the roots of a range of plants. Plants will wilt and may eventually die due to the roots being eaten away.	Reduced seedling emergence and plant loss.	Cultivation in spring prior to sowing brassica crop. Sowing crop with granular insecticide. Heavy grazing.
Leaf Miner			
 Leaf Miner is a pest to brassicas and is found throughout New Zealand. The Leaf Miner fly lays larvae which causes the damage to plants.	Leaf Miner flies will lay eggs on plant tissue, then larvae that hatch will damage plants by mining tunnels throughout the leaves of brassica plants, feeding on the green tissue in the leaf. Leaf Miner larvae can be identified by holding the affected leaf up to the sun. It can effect both young and mature plants.	If left uncontrolled, large populations of Leaf Miner can decimate brassica leaves and limit crop yield, and overall feed quality in the leaf.	Early identification and spray with the appropriate insecticide. Removal of alternative hosts, such as fathen and sow thistle, to prevent build-up of numbers.
Diamondback Moth (DBM)			
 A pest of all brassica crops, Diamondback Moth can be found throughout New Zealand. Caterpillars do the damage by feeding on leaves of brassica plants.	DBM caterpillars are typically found on the lower leaf surface, and feed on tissue causing small holes in the leaf. They can be distinguished from White Butterfly caterpillars as they are comparatively smaller, and when touched they are extremely wriggly.	High populations can significantly reduce crop yield if left untreated. Damage is often in conjunction with White Butterfly caterpillars.	Application of an appropriate insecticide. Removal of old brassica plants which may act as a carryover host.
White Butterfly			
 White Butterfly are found throughout New Zealand and are a common pest to all brassica crops. The White Butterfly caterpillar feeds on all brassica crops.	White Butterfly caterpillar consume leaf tissue, and tend to eat around the leaf vein leaving a skeleton leaf in severe cases. In comparison to DBM, they are larger and more docile when touched.	High populations can significantly reduce crop yield if left untreated. Damage is often in conjunction with DBM.	Application of an appropriate insecticide.

PEST		SYMPTOMS	IMPORTANCE	CONTROL
Wheat Bug (*Nysius*)				
	A common pest throughout New Zealand that is more common in warm and dry areas. It can be very damaging to germinating brassica crops if left untreated.	*Nysius* damages plants by feeding around the base of the stem creating a "ring bark" effect.	This damage may kill the plant, or make them susceptible to damage from wind or stock movement. The damage may also provide an entry point for brassica diseases.	Ultrastrike® brassica seed treatment helps protect seedlings. Apply an appropriate insecticide before or after sowing.
Springtail				
	A common pest throughout New Zealand, causing damage to germinating and newly emerged seedlings. Can be identified by tapping the ground around a sheet of white A4 paper and observing the jumping of pin head sized insects.	Damage can be identified as small pin-prick sized holes in emerging brassica cotyledons. In high populations, springtail can cause damage to seedlings before they even emerge from the soil.	Poor establishment or crop loss.	Use of Ultrastrike® or Superstrike® brassica seed treatment for seedling protection. When establishing forage brassica out of old pasture, it is strongly recommended to apply an appropriate contact insecticide before or after sowing to reduce the adult population.
White Fringed Weevil				
	Relatively minor pest in pasture and crops. It can be found throughout the North Island and much of the South Island.	Adults feed on leaves of broadleaf plants, leaving notches in the foliage. Larvae feed on the roots of many plants and are the most damaging.	Larval feeding will damage roots which weakens the plants and can cause wilting and eventually plant death.	Thorough cultivation should be carried out through late spring and summer prior to sowing in infested areas. Clean fallow reduces numbers.
Greasy Cutworm				
	Found throughout New Zealand, and although it is usually considered a minor pest, some years it can have significant impacts on establishing crops.	Caterpillars are the most damaging and feed by cutting the seedlings off at the base of the stem, and dragging them under the soil surface. During windy periods, the eggs tend to be laid on the leeward side of shelter. Damage will therefore be most obvious in those areas initially.	Poor crop establishment or crop loss.	Good seed bed cultivation and compaction. Application of an appropriate insecticide as soon as damage is recognised.
Slugs				
	A very common and significant pest in all crops. Slugs are present all year round but are most damaging in spring and autumn.	Direct drilled crops are typically most at risk as the thatch and direct drill slits provide food and a refuge for slugs. Slugs will feed on germinating seedlings.	High populations can be devastating to crop establishment.	Always use slug bait in direct drill situation. Closely monitor ALL crops for slug presence during establishment, and treat accordingly.
Argentine Stem Weevil (ASW)				
	ASW is a common pasture pest that occasionally affects brassica seedlings throughout New Zealand.	Adult ASW damage is characterised by narrow rectangular holes in brassica seedlings.	Damage, particularly from adult feeding on emerging brassica crops.	Use of Ultrastrike® brassica seed treatment for seedling protection. Cultivation to destroy larval weevil population.

Brassica diseases

DISEASE		SYMPTOMS	IMPORTANCE	CONTROL
Dry rot (Black leg)				
	Fungal disease (*Leptosphaeria maculans*; asexual phase – Phoma lingam) initially spread by airborne spores originating from crop residues. Once established in crops, disease spreads via rain splashed spores.	Initial symptoms include pale brown leaf lesions dotted with small black spots (pycnidia) on the leaves and stem or bulb. Infection then develops into brown cracked cankers that eventually collapse the bulb or stem.	Yield reductions, reduced palatability of crops and severe crop loss in some instances.	Selection of cultivars with improved resistance (e.g. Clutha Gold) or less susceptible species (e.g. kale). Cultivation (deep ploughing) that buries crop residuals before any second year crop. Do not plant second year crops in paddocks with dry rot problems in first year.
Watery soft rot *(Sclerotinia)*				
	Fungal disease (*Sclerotinia sclerotilorum, S. minor*) that overwinters in soil and/or in plant residues producing airborne spores infecting plants.	In moist conditions plants collapse, often with a white cottony growth (mycelium) and black resting bodies known as sclerotia. Infected roots will often cause plants to wilt and die.	Widespread fungal disease causing crop losses and reduced palatability.	Practice good crop rotations as *sclerotinia* can persist in soil for up to 10 years. Deep cultivation to minimise crop residuals for any second year crops. Lower plant densities/wider rows can reduce the spread within crops.
Ring spot				
	Fungal disease (*Mycosphaerella brassicicola*) that overwinters in crop residues followed by production of airborne spores.	Lesions start as small dark spots on leaves/stem that develop in size forming a dark ring shape.	Leaf senescence.	Clean crop rotations and placing crops away from paddocks where this disease has been identified in previous seasons.
Clubroot				
	Soil-borne pathogen (*Plasmodiophora brassicae*) spread by machinery, stock, people and flooding.	Galls forming on roots/bulbs of brassica crops. Plants appear stunted or wilted when galls reduce transport of nutrients and water to leaves.	One of the most economically damaging brassica diseases with severe infections reported in Southland and Pukekohe.	Long crop rotations (5-7 years) and maintenance of high soil pH will limit build up in soils. Use of species with higher clubroot tolerance (e.g. kale or Raphno®). Remove soil and clean machinery between paddocks with infection history.
Damping off				
	Fungal disease caused by *Rhizotonia solani, Fusarium spp.* or *Pythium spp.* Typically soil-borne and more common in autumn sown situations where slower growth rates favour establishment of disease on seedlings.	Narrow constricted base to seedling stem that is often dark brown in colour. During germination fungal diseases can rot seed resulting in 'patchy' field germination.	Reduced germination and increased seedling mortality.	Use of Ultrastrike® or Superstrike® brassica seed treatment to provide seedling protection. Good seedbed preparation to allow rapid establishment.

DISEASE		SYMPTOMS	IMPORTANCE	CONTROL
Alternaria				
	Fungal diseases (*A. brassicae* and *A. brassicicola*) survives on crop debris producing airborne spores.	Small dark brown/black circular lesions that develop to have a yellow halo/margin of leaf tissue.	Leaf senescence.	Cultivation (ploughing) to minimise crop residuals for any second year crops. Planting high quality certified seed.
Downy mildew				
	Fungal disease (*Peronospora parasitica*) that persists in soil on crop debris producing spores in spring that infect crops.	Sporulation on the underside of leaves which develops into a white/grey fungus. As the disease advances leaves will senesce.	Leaf senescence.	Planting high quality certified seed. Minimising brassica weeds (e.g. Shepherd's Purse) that can host the disease.
Black rot				
	Bacterial infection (*Xanthamonas campestris pv.campestris / X.campestris pv.armoraciae*) that can survive in soil and spread via machinery, stock, flooding and occasionally seed.	Yellow/brown wilting of leaf margins that progresses towards the leaf centre. Eventually the vascular system in leaves and stem turns black from infection.	Leaf senescence and crop loss in severe cases.	Practice wide crop rotations to minimise infection from crop residues. Planting high quality certified seed.
Bacterial leaf spot				
	Bacterial infection (*Pseudomonas syringae pv. maculicola*) spread by similar means as Black Rot.	Small to large black lesions on leaves and stem.	Yield reductions, notably reduced leaf yield due to leaf senescence.	As with Black Rot above.
Viruses				
	Beet Western Yellows Virus (BWYV), Cauliflower Mosaic Virus (CuMV) and Turnip Mosaic Virus (TuMV) are all spread via aphids (cabbage aphid or peach aphid), either within or between crops.	BWYV often results in stunted purple/red leaf discoloration with leaves eventually senescing. TuMV and CuMV produces mottled, stunted and distorted (twisted/curled) leaves. Laboratory tests are required to differentiate.	Reduced yield, particularly leaf yield.	Superstrike®/Ultrastrike® provides initial Aphid protection during establishment. Control of Aphid vectors that spread virus, however, complete control requires multiple insecticide applications making control uneconomic.

Evenly-distributed Cleancrop™ bulb turnip seedlings achieved with Ultrastrike® treated, pelleted swede seed placed through a precision drill, sowing at 90,000 seeds per hectare.

Pasture Options

The complete pasture range for dairy, sheep, beef and deer.

Pasture options contents

INTRODUCTION

PERENNIAL GRASSES

SHORT ROTATION/ITALIAN/ANNUAL RYEGRASS

CLOVERS AND HERBS

PGG Wrightson Seeds Sales Agronomist Greg Zeuren and farmer Neil Fagan inspecting Platform perennial ryegrass on farm in Te Kuiti.

[#]Platform has been bred, selected and successfully tested as a perennial and will function as a perennial ryegrass. Due to a small number of tip awns, Platform is certified as Lolium boucheanum.

An established paddock of Platform perennial ryegrass in the Waikato region.

LUCERNE

REGENERATIVE AGRICULTURE

PESTS AND DISEASES

CORSON MAIZE HYBRIDS

Plant breeding perspectives

RYEGRASS BREEDING: A BREEDER'S PERSPECTIVE

For PGG Wrightson Seeds Plant Breeder Richard George, a multidisciplinary team working together across numerous New Zealand research sites is key to successful plant breeding.

With a background growing up in rural Waikato, agricultural science and plant breeding was a natural path for Richard. Initially completing a Bachelor of Agricultural Science at Lincoln University, Richard further specialised in genetics and breeding through postgraduate study at both Massey and Lincoln University. After kickstarting his career in 2009 based out of the seed industry hub of Canterbury, Richard relocated to the Waikato to lead the regional PGG Wrightson Seeds breeding team in 2017. This transition recognised the importance of northern North Island research sites in the PGG Wrightson Seeds breeding programme.

PGG Wrightson Seeds operates a national multi-site breeding programme with plant breeders based at regional research hubs working collaboratively. Having plant breeders based in Waikato, Manawatu and Canterbury allows different environmental and breeding selection pressures to be applied. The advantage of a multi-site testing approach is selecting robust varieties that perform for the New Zealand market. Richard has a specific passion for breeding pasture species that perform and add value to the often-challenging northern New Zealand farming systems.

According to Richard, there are two critical stages in the plant breeding: creating or capturing genetic diversity and the second is agronomic testing. Following plant breeding, product development agronomists intensively screen and test new breeding lines in an Australasian evaluation programme to ensure that only the best forages are commercialised.

The entire breeding, evaluation and commercialisation process can take over 10 years to produce the forage varieties that are currently available. For Richard, a major challenge is anticipating what the market will require in the next 10-15 years and delivering this to farmers. To enable this, Richard and his colleagues at PGG Wrightson Seeds work with expert teams both nationally and internationally, including Crown Research Institutes like AgResearch, to identify added-value traits and technology to incorporate into the commercial breeding programme.

Plant Breeder Richard George inspecting ryegrass trials.

WHERE IT ALL BEGINS: LEGUME BREEDING

PGG Wrightson Seeds legume breeder John Ford shares an insight into breeding legumes and explains the development of the PGG Wrightson Seeds clovers. Forage breeding is a career rewarding those who have a vision for the needs of the end user, an understanding of morphology and ecology, a great deal of patience and a little bit of luck too!

Plant breeding is an accumulation of knowledge, experience and innovation (science and genetics) in formulating crossing combinations. No breeder can do this alone; there is an active team involved with agronomic evaluation through to seed production, all key to the release of a new cultivar into the market.

John personally likes to explore the large pool of genetic diversity available across the globe. White and red clovers have been used by farmers in various geographical locations and have adapted to a wide range of environmental conditions. These populations can offer numerous key traits to a breeder's crossing programme.

A controlled environment is then created to test various breeding lines. Trials are run for a minimum of three years, and often longer, to assess a plant's persistence and seasonal yield. Clovers specific to intensive dairy farming systems have to withstand a heavier animal, higher soil fertility levels (including high nitrogen (N) application rates), shorter grazing rotations and compete in a grass bias management system.

Conversely, a cultivar intended for use on moist hill country (extensive farming) is quite different. Less fertile and generally poor-structured soils with drainage issues and different grass species, for example browntop, require a different type of clover cultivar.

Legume Breeder John Ford presenting at our Seeds in Action® site in Waikato.

Pasture planner - grasses

PERENNIAL RYEGRASS

Excellent base for permanent pasture mix. Good palatability to stock and establishes readily.
Sowing rate: Diploid - 15-25 kg/ha; Tetraploid - 22-28 kg/ha due to larger seed size.

VARIETY	PLOIDY	HEADING DATE (NUI=0)	ENDOPHYTE OPTIONS	COMMENTS
Mid-season heading; -6 to +7 days				**Mid-season varieties provide an early spring flush of feed suited to meeting early spring feed demands.**
RELY	Diploid	0	AR37, AR1	A versatile diploid with fine leaves and dense tillers bred to cater for a range of environments. Rely is a resilient option that can tolerate lower soil fertility and periods of set stocking.
EXCESS	Diploid	+7	AR37, AR1	Excess is a medium-leaved, diploid perennial ryegrass bred specifically for tougher environments. It produces exceptionally high dry matter yields and the mid-season heading date provides an earlier flush of spring growth which makes it ideal for lambing and calving.
Late heading; +8 to +21 days				**Better suited to paddocks with good soil fertility in reliable high rainfall areas or under irrigation. Better late-season quality than earlier maturing cultivars.**
PLATFORM[#]	Diploid	+12	AR37, AR1	Platform[#] is a persistent diploid perennial ryegrass offering high yields of quality feed and year-round dry matter production. Outstanding quality is achieved through low aftermath seed head production and fine dense tillers making it a versatile option for productive environments.
EXPO	Diploid	+21	AR37, AR1	Densely-tillered, late-flowering diploid bred to deliver high quality feed throughout the year, with strong cool season growth. Best suited to rotational grazing but can tolerate periods of set stocking.
Very late heading; +22 to +35 days				**Perform best in areas with good soil fertility and summer rain or irrigation. Better late-season quality than earlier maturing cultivars.**
BASE	Tetraploid	+22	AR37, AR1	Ideal for high performance farm systems with a focus on pasture management and quality. Base tetraploid perennial ryegrass offers top production with increased animal preference meaning higher animal intakes and easier management of post-grazing residuals.

SHORT ROTATION (HYBRID) RYEGRASS

Rapid-growing varieties lasting from 1-5 years or longer, depending on summer conditions and endophyte status.
Sowing rate: Diploid - 15-25 kg/ha; Tetraploid - 22-28 kg/ha due to larger seed size.

VARIETY	PLOIDY	HEADING DATE (NUI=0)	ENDOPHYTE OPTIONS	COMMENTS
DELISH®	Tetraploid	+9	AR1	High yielding, fine-leaved and densely-tillered tetraploid short rotation (hybrid) ryegrass. A highly palatable medium term pasture with improved disease resistance and persistence, as well as low aftermath heading.
MAVERICK GII	Diploid	+17	Without	Maverick GII short rotation ryegrass produces winter yields up to 50% greater than many perennial ryegrasses and almost as much as top-producing Italian ryegrass cultivars. Maverick GII contains both Italian and perennial ryegrass genetics and can persist as well as some low-endophyte perennial ryegrasses.

[#]Platform has been bred, selected and successfully tested as a perennial and will function as a perennial ryegrass. Due to a small number of tip awns, Platform is certified as Lolium boucheanum.

ITALIAN RYEGRASS

Very rapid growing varieties lasting from 1-2 years or longer, depending on summer conditions and endophyte status.
Sowing rate: Diploid - 15-25 kg/ha; Tetraploid - 22-28 kg/ha due to larger seed size.

VARIETY	PLOIDY	HEADING DATE (NUI=0)	ENDOPHYTE OPTIONS	COMMENTS
LUSH	Tetraploid	+17	AR37	Exceptional summer yield and quality (low aftermath heading). Undersowing option for those challenging, opened up, thinned out pastures.
FEAST® II	Tetraploid	+17	Without	High yielding, fine-leaved and persistent with excellent winter production, summer quality and disease resistance.
SUPERCRUISE	Diploid	+20	Without	A fast-establishing robust diploid Italian ryegrass offering high yields, good persistence, disease resistance and summer quality.

ANNUAL RYEGRASS

Similar to an Italian ryegrass with the same fast establishment, good winter growth and feed value.
From an autumn sowing, annual ryegrasses rarely persist past mid-November in northern regions.
Sowing rate: 25-30 kg/ha

VARIETY	PLOIDY	HEADING DATE (NUI=0)	ENDOPHYTE OPTIONS	COMMENTS
WINTER STAR II	Tetraploid	+9	Without	Winter Star II tetraploid annual ryegrass is suitable for quick winter feed, with improved spring quality making it ideal for silage and hay production. Winter Star II is high yielding with fast establishment, giving excellent autumn growth.

TALL FESCUE

Deep-rooted perennial grass. Prefers heavier soils. Tolerant of waterlogging, moderate soil salinity and drought.
All tall fescues should be kept well-grazed (less than 10 cm post-grazing residuals) to maximise animal production. Should not be sown in a pasture mix with ryegrass.
Sowing rate: Sole grass 22-32 kg/ha

VARIETY	TYPE	HEADING DATE	ENDOPHYTE OPTIONS	COMMENTS
QUANTICA	Summer active	Early	MaxP®	Quantica is a soft, finely-leaved tall fescue selected for improved animal palatability and rust resistance. Bred for New Zealand conditions, providing excellent dryland and overall production.

COCKSFOOT

Range of characteristics with uses in different situations. A persistent perennial grass that tolerates moisture stress and lower soil fertility, is slow to establish, but high yielding and with good summer growth.
Sowing rate: Sole grass 6-10 kg/ha

VARIETY	TYPE	COMMENTS
AURUS	Upright	Upright, medium-leaved cocksfoot with improved winter activity and overall performance. Excellent disease tolerance has been observed in New Zealand trials. Suitable for set stocking and hard rotational grazing by sheep.

Pasture planner - legumes

WHITE CLOVER

Sowing rate: 4-6 kg/ha (Superstrike®).

VARIETY	LEAF SIZE	COMMENTS
GRASSLANDS LEGACY	Large	A high performing, large leaf white clover well-suited to rotational grazing in both dairy and drystock cattle systems. Dry matter yield strengthens over time.
GRASSLANDS QUARTZ	Medium	A persistent white clover with broad adaptability across environments and farm systems, Quartz performs well under both sheep, deer and cattle grazing management.
GRASSLANDS HILLTOP	Small-Medium	Bred to cope with more challenging environments from variable soil fertility to variable moisture availability, Hilltop is a very robust and persistent small leaf white clover suitable for set stocking.

BALANSA CLOVER

Sowing rate: 4-6 kg/ha (Superstrike®).

VARIETY	LEAF HARDINESS	PERENNIALITY	COMMENTS
TAIPAN	High	Annual	Taipan is a mid-maturing balansa clover with high levels of hard seed, allowing for flexibility when seasons are dry.

RED CLOVER

Sowing rate: 4-6 kg/ha (Superstrike®) in permanent pasture mixes; 6-8 kg/ha (Superstrike) in short-term pasture mixes and 10-12 kg/ha (Superstrike) as a pure sward.

VARIETY	GROWTH HABIT	OESTROGEN CONTENT	COMMENTS
AMIGAIN NEW	Semi-prostrate	Low	Amigain is the latest generation red clover bred in New Zealand for increased persistence and performance in permanent pastures, high performance short-term pastures, silage mixes and pure sward red clover stands. Ideal for increased animal performance, enhancing pasture management and fixing nitrogen.

SUBTERRANEAN CLOVER

Sowing rate: 4-6 kg/ha. Sowing rates are the same for Superstrike® treated seed as for untreated seed.

VARIETY	LEAF HARDINESS	PERENNIALITY	COMMENTS
BINDOON	Moderate	Annual	Bindoon is recognised for its cool season productivity, due to its high seed production and dense seedling regeneration. Suited for set stocked or rotational sheep grazing.

Pasture planner - lucerne

LUCERNE

Deep-rooted perennial legume suited to a wide range of well-drained soils. Does not host Clover Root Weevil. Requires rotational grazing for best persistence.
Sowing rate: Bare seed 8-10 kg/ha or Superstrike® treated 10-14 kg/ha.
Always sow Superstrike treated seed.

VARIETY	TYPE	COMMENTS
STAMINA™ 5	Semi-winter dormant	Bred for improved grazing tolerance, outstanding persistence, high dry matter yields especially under dryland conditions, with good quality for grazing or hay.
GRASSLANDS KAITUNA	Semi-winter dormant	High producing cultivar with excellent quality (fine stems) and outstanding persistence. A high resistance to common lucerne pests and diseases. Excellent spring and summer growth for hay production or grazing.

Pasture planner - herbs

CHICORY

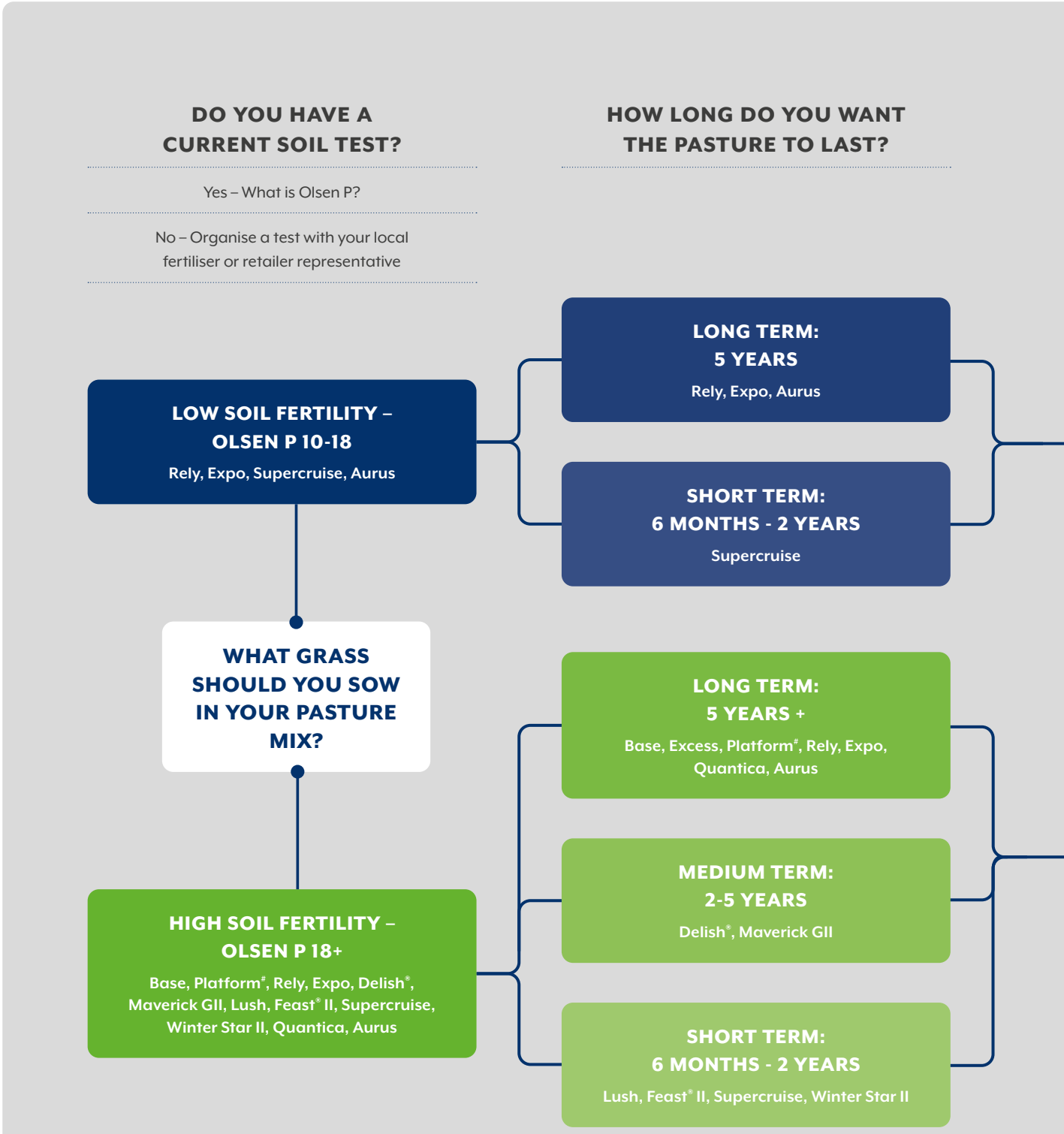
Chicory is a taprooted perennial herb with excellent animal production potential. It produces a leafy, high quality feed over spring, summer and autumn when pastures lack quality. Chicory can either be sown as a specialist crop (with or without clover) or sown as part of a permanent pasture mix. It has high mineral content, particularly zinc, potassium and copper. Best suited to rotational grazing.
Sowing rate: As a specialist crop, 5-7 kg/ha with companion clover. In a pasture blend, 0.5-2 kg/ha. Sowing rates are the same for Superstrike® treated seed as for untreated seed.

VARIETY	COMMENTS
GRASSLANDS PUNA II	New Zealand bred, broad-leaved herb of high nutritional quality. Semi-erect for better crop utilisation by grazing animals than Puna. High dry matter yields from spring to late autumn. Deep taproot allows excellent drought tolerance. Very high summer productivity and outstanding animal performance.
ROCKET FUEL®	High quality forage mix including chicory, red clover and white clover with excellent summer production. Suitable for finishing stock and maintaining summer production in dairy cows.

Lambs grazing Puna II chicory.

Grass selection guide

This diagram is intended as a guide only. For specific recommendations on the grasses best suited to your farming system, contact your local seed retailer, one of your local PGG Wrightson Seeds Sales Agronomists (page 261), call **0800 805 505** or visit **www.pggwrightsonseeds.com**



Sowing new grass species into low fertility soils (Olsen P 10-18) is not recommended unless 40-50 units of phosphorus are applied annually.

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WHAT GRAZING MANAGEMENT DO YOU INTEND TO USE?	WHAT ENDOPHYTE TYPE CAN YOU HAVE WITH SELECTED PASTURE OPTION?
HARD GRAZED/SET STOCKED LONG TERM: Rely, Expo, Aurus SHORT TERM: Supercruise	**AR37 ENDOPHYTE** Base, Excess, Platform#, Rely, Expo, Lush
ROTATIONAL GRAZED LONG TERM: Rely, Expo, Aurus SHORT TERM: Supercruise	**AR1 ENDOPHYTE** Base, Excess, Rely, Expo, Delish®
HARD GRAZED/SET STOCKED LONG TERM: Rely, Expo, Aurus SHORT TERM: Supercruise	**MAXP® ENDOPHYTE** Quantica
ROTATIONAL GRAZED LONG TERM: Base, Excess, Platform#, Rely, Expo, Quantica MEDIUM TERM: Delish®, Maverick GII SHORT TERM: Lush, Feast® II, Supercruise, Winter Star II	**WITHOUT ENDOPHYTE** Maverick GII, Feast® II, Supercruise, Winter Star II, Aurus

Understanding ryegrass and heading dates

RYEGRASS TYPES

- Five broad ryegrass classifications allow farmers to categorise ryegrasses as annual, Italian, short rotation, long rotation or perennial
- The classifications cross freely with each other and are best described as a continuum, from extreme annual to extreme perennial (see diagram below)
- Across a farm, paddocks of shorter-lived annual and Italian ryegrasses can complement longer-lived long rotation and perennial ryegrasses, delivering a range of pasture longevity, winter activity and summer quality options

RYEGRASS CONTINUUM

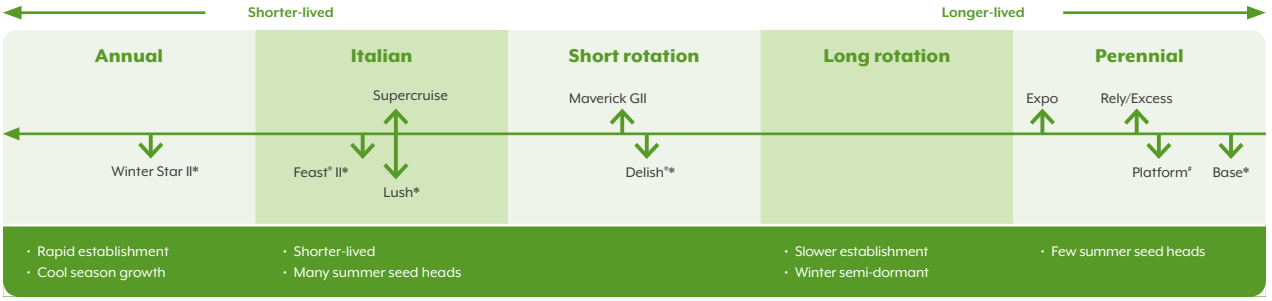

Figure notes:

- Cultivars are placed on the continuum according to their estimated proportion of short-and long-lived genes. Agronomic performance of some cultivars is better than their position on the continuum might suggest, due to their genetic improvement in the plant breeding process
- Endophyte presence/absence can have a big effect on persistence of the ryegrasses
- Substantial differences in heading date are now available in the longer-lived ryegrasses

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**Tetraploid.*

HEADING DATE

- A cultivars heading or maturity date is the time in spring when 50% of plants have emerged seed heads in a typical year. Heading date precedes flowering date by about four weeks
- The heading date of a cultivar is defined relative to well-known cultivar Nui, heading at day zero
- Cultivars with different heading dates give farmers a range of production and forage quality options during late winter, spring and early summer
- Until recently, heading dates of perennial ryegrass cultivars were similar. Now, perennial and long rotation ryegrasses with a wide range of heading dates are available
- A standardised system adopted by the major seed companies allows farmers to compare heading dates of different cultivars. Actual heading dates vary with geographic location, weather and grazing management; however, the ranking order of cultivars will not change
- For the heading date of individual PGG Wrightson Seeds cultivars, refer to the product page for each cultivar's heading date relative to Nui

AFTERMATH HEADING (AMH)

- Aftermath Heading (AMH) is the ongoing production of seed heads produced by a grass plant that occurs after the main flush of seed head production
- Seed head reduces pasture quality (and therefore animal performance), causing grazing management headaches in spring and summer. No seed head would be ideal; however, seed yield is necessary because seed producers need seed to allow farmers to sow new pastures
- Low AMH cultivars aim to optimise animal performance while yielding enough seed to establish new pastures. Low AMH cultivars deliver a short, sharp peak of seed heads, followed by a leafy, high quality sward that favours good animal performance

Early	Mid-season	Late	Very late	Extremely late
Heading 8 days or more before Nui	Heading from 7 days before Nui to 7 days after Nui	Heading from 8-21 days after Nui	Heading from 22-35 days after Nui	Heading more than 35 days after Nui

Heading date continuum

PGG WRIGHTSON SEEDS CULTIVARS WITH LOW AFTERMATH HEADING (AMH) INCLUDE:

- Base tetraploid perennial ryegrass
- Platform perennial ryegrass
- Rely perennial ryegrass
- Expo perennial ryegrass
- Delish® tetraploid short rotation ryegrass
- Maverick GII short rotation ryegrass
- Lush tetraploid Italian ryegrass
- Feast® II tetraploid Italian ryegrass

Approximate heading dates of long rotation and perennial ryegrasses relative to Nui at day 0 (approximately 22 October).

Mid-season	Late	Very late
-7 to +7 Days	+8 to +21 Days	+22 to +35 Days
Rely 0	Ohau* +8	**Base* +22**
Nui 0	Hustle +8	Avatar* +22
Moxie 0	Maxsyn +8	Matrix +23
Request 0	Governor +8	AberGain* +24
Samson +3	Viscount* +9	Halo* +25
Reason +3	**Platform# +12**	
Excess +7	Prospect +12	
	Legion +13	
	Trojan +13	
	4front* +15	
	Rohan +16	
	AberGreen +17	
	Raider +18	
	AberMagic +19	
	Kai* +20	
	ONE[50] +20	
	Sequel +20	
	Ultra +20	
	Expo +21	

< Earlier heading

- Often earlier flush of spring growth in the six weeks prior to heading
- Earlier seed heads
- Poorer late spring quality
- Better early summer quality if aftermath heading is low

Later heading >

- Can be later flush of spring growth
- Later seed heads
- Better late spring quality
- Poorer early summer quality

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**Tetraploid.*

KEY RECOMMENDATIONS

- Sow a range of ryegrass cultivars with different heading dates to spread timing of heading and reduce loss of summer quality
- Sow ryegrasses with different heading dates in separate paddocks
- Sow no more than 50% of the farm in late or very late cultivars to reduce early spring feed pinches

Endophyte insect control

RYEGRASS AND CONTINENTAL TALL FESCUE

PGG Wrightson Seeds partners with AgResearch on the development and testing of endophytes for ryegrass and tall fescue pastures. AR1 and A37 endophytes have been key to improved insect control and ryegrass persistence in New Zealand.

New and existing endophyte strains are extensively tested to determine the spectrum of chemical compounds produced and what impact these have on insect pests.

The following tables 1-4 have been approved by the New Zealand Plant Breeding and Research Association (NZPBRA) and provide an impartial overview of the insect control and animal safety of commercially-available endophytes.

Table 1 – Diploid perennial ryegrass

Insect	AR1	NEA2	NEA4	AR37	Standard endophyte	Without endophyte
Argentine Stem Weevil	♦♦♦♦	♦♦♦	♦♦♦	♦♦♦♦[1]	♦♦♦♦	-
Pasture Mealy Bug	♦♦♦♦	(♦♦♦♦)	(♦♦♦♦)	♦♦♦♦	♦♦♦♦	-
Black Beetle Adult	♦	♦♦♦	♦♦♦	♦♦♦	♦♦♦	-
Root Aphid	-[2]	♦♦	♦♦	♦♦♦♦	♦♦	-
Porina	-	Not tested	Not tested	♦♦♦	♦	-
Grass Grub	-	-	Not tested	♦	-	-
Field Cricket	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested

Table 2 – Tetraploid perennial ryegrass

Insect	AR1	AR37	Without endophyte
Argentine Stem Weevil	(♦♦♦)	(♦♦♦)[1]	-
Pasture Mealy Bug	(♦♦♦♦)	(♦♦♦♦)	-
Black Beetle Adult	♦	♦♦♦	-
Root Aphid	-[2]	♦♦♦♦	-
Porina	-	(♦♦♦)	-
Grass Grub	-	♦	-
Field Cricket	Not tested	Not tested	Not tested

A ryegrass plant with endophyte protection (left) versus no endophyte (right) under Argentine Stem Weevil pressure.

Table 3 – Italian and short term (hybrid) ryegrass

Insect	AR1	NEA	AR37	Without endophyte
Argentine Stem Weevil	♦♦	Not tested	♦♦♦[1]	-
Pasture Mealy Bug	(♦♦♦♦)	(♦♦♦♦)	(♦♦♦♦)	-
Black Beetle Adult	♦	♦♦♦	♦♦♦	-
Root Aphid	-[2]	Not tested	Not tested	-
Porina	Not tested	Not tested	Not tested	-
Grass Grub	-	-	-	-
Field Cricket	Not tested	Not tested	Not tested	Not tested

Argentine Stem Weevil larvae within a perennial ryegrass tiller.

Key to Tables 1-3

- \- ***No control***
- ♦ ***Low level control**: Endophyte may provide a measureable effect, but is unlikely to give any practical control.*
- ♦♦ ***Moderate control**: Endophyte may provide some practical protection, with a low to moderate reduction in insect population.*
- ♦♦♦ ***Good control**: Endophyte markedly reduces insect damage under low to moderate insect pressures. Damage may still occur when insect pressure is high.*
- ♦♦♦♦ ***Very good control**: Endophyte consistently reduces insect populations and keeps pasture damage to low levels, even under high insect pressure.*
- ( ) ***Provisional result**: Further results needed to support the rating. Testing is ongoing.*

Notes on Tables 1-3

1 *AR37 endophyte controls Argentine Stem Weevil larvae, but not adults. While larvae cause most damage to pastures, adults can damage emerging grass seedlings. In Argentine Stem Weevil prone areas, it is recommended to use treated seed for all cultivars with novel endophyte.*

2 *AR1 plants are more susceptible to Root Aphid than plants without endophyte.*

3 *Active against Black Beetle Adults and larvae.*

**Data correct at time of print August 2021. For latest data see http://www.grasslanz.com/understandingthe-science/18-novel-endophyte-technologies*

Endophyte animal safety

RYEGRASS, FESTULOLIUM AND CONTINENTAL TALL FESCUE

These ratings are indicative. Animal performance and health can vary under different management systems and between seasons.

PGG Wrightson Seeds partners with AgResearch to ensure extensive animal safety testing is completed on each ryegrass and endophyte combination. Testing includes laboratory measurements and grazing trials completed under careful supervision and strict animal ethic standards. This standard of testing ensures that each endophyte is throughly understood prior to commercial use on farm.

The information in Table 4 is based on animal safety trialling protocols designed to expose animals to simulated worst-case scenario management. This involves forcing them to graze deep into the base of pure perennial ryegrass pastures that have been allowed to grow for several weeks over late spring/summer (similar to a hay crop), where they will encounter the highest concentrations of harmful endophyte chemicals if these are present.

This management does not represent normal farm practice, although similar situations may arise on farms in rare circumstances. Under normal farm grazing practices, the contribution of basal pasture material to total animal dry matter intake is relatively low, and therefore the intake of harmful chemicals (if they are present) is diluted. Thus, the likelihood of adverse effects on animals is reduced, but the potential for problems to occur may still exist if the endophyte brand is rated less than 4-star for 'freedom from staggers' and/or there are comments on animal performance that flag potential issues.

Comments on animal performance have been moderated based on information from other trials (in addition to the formal animal safety testing protocols), consideration of the 'normal' grazing management practices implemented on farm (see previous paragraph) and recognition that animal diets are very seldom pure ryegrass. Other dietary components such as clovers or non-ryegrass grass species, crops or supplements will dilute the intake of endophyte alkaloids.

Table 4 – Animal safety

Endophyte brand	FREEDOM FROM STAGGERS: Sheep and lambs	FREEDOM FROM STAGGERS: Dairy cows and beef cattle	Effects on animal performance
AR1	♦♦♦♦	♦♦♦♦	High level of animal performance.
AR37	♦♦♦	♦♦♦♦	Typically provides a high level of animal performance. Can cause ryegrass staggers in sheep and lambs in extreme circumstances. Lamb liveweight gain can be reduced during periods of severe staggers. While ryegrass staggers has not been observed in cattle and dairy cows, it could occur on rare occasions.
NEA	♦♦♦♦	♦♦♦♦	High level of animal performance.
NEA2	♦♦♦♦	♦♦♦♦	Typically provides a high level of animal performance. Lamb liveweight gain could be reduced in extreme circumstances. While no effects have been observed in cattle and dairy cows, body temperature could be elevated on rare occasions.
NEA4	♦♦♦♦	♦♦♦♦	Typically provides a high level of animal performance. Lamb liveweight gain could be reduced in extreme circumstances. While no effects have been observed in cattle and dairy cows, body temperature could be elevated on rare occasions.
U2	♦♦♦♦	♦♦♦♦	High level of animal performance.
MaxP (AR584)	♦♦♦♦	♦♦♦♦	High level of animal performance.
Standard endophyte	♦	♦♦	Can cause ryegrass staggers in sheep and lambs, and significantly decrease lamb growth rates in summer and autumn, and significantly increase dag. In dairy cows, it has been shown to depress milksolids production through summer and autumn.
Without endophyte	♦♦♦♦	♦♦♦♦	High level of animal performance.

Key to Table 4

♦ *Likely to cause severe staggers in most years.*
♦♦ *Can cause severe staggers in some years.*
♦♦♦ *Can cause severe staggers occasionally.*
♦♦♦♦ *Very unlikely to cause staggers.*

This table has been approved by the New Zealand Plant Breeding and Research Association (NZPBRA).

**Data correct at time of print August 2021. For latest data see http://www.grasslanz.com/understanding-the-science/18-novel-endophyte-technologies*

AR37 endophyte

AR37 is a novel endophyte developed by AgResearch.

ENDOPHYTE AGRONOMIC PERFORMANCE

Perennial ryegrass with AR37 endophyte produces higher levels of dry matter (on average 12% more per year nationally) than the same variety with standard endophyte.

PERSISTENCE

Perennial ryegrass with AR37 endophyte is more persistent and has higher tiller densities over time compared to ryegrass without endophyte (nil), AR1 endophyte or with standard endophyte.

INSECT PROTECTION

Perennial ryegrasses with AR37 provide control of more insect pests than pastures containing standard endophyte or AR1 endophyte.

Argentine Stem Weevil (ASW) - AR37 in diploid perennial ryegrass provides very good control of the more damaging larvae growth stage. In tetraploid, Italian and hybrid cultivars AR37 provides good protection under low to medium ASW populations.

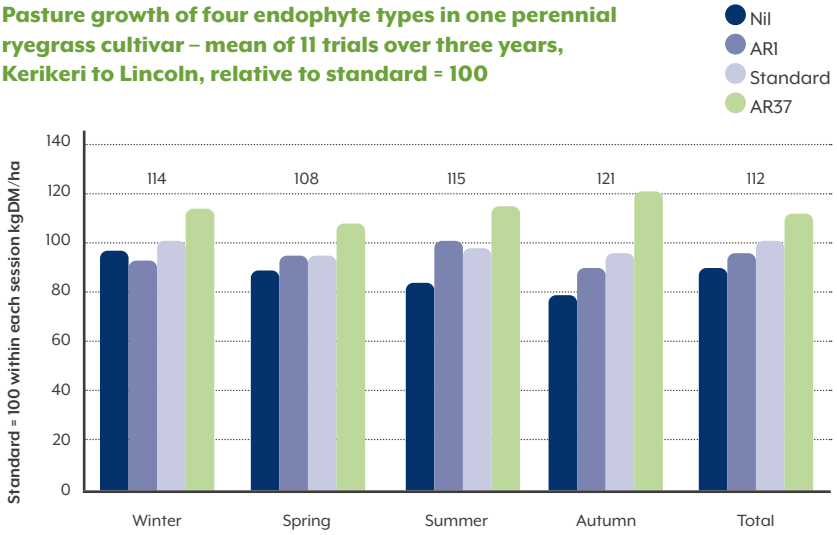
Pasture Mealy Bug (PMB) - Similar to other commercial endophytes, AR37 provides very good control of PMB found throughout New Zealand.

Black Beetle Adults - AR37 provides good protection to low to moderate populations of Black Beetle versus low-level control provided by AR1.

Root Aphid - AR37 provides very good protection from Root Aphid compared to NEA2 and NEA4, which only provide moderate control of low to medium populations.

Porina - AR37 is the only endophyte to provide good control of moderate populations of porina. When porina populations are high, chemical control may also be needed to prevent significant pasture damage.

Pasture growth of four endophyte types in one perennial ryegrass cultivar – mean of 11 trials over three years, Kerikeri to Lincoln, relative to standard = 100



ANIMAL HEALTH

Although AR37 does not produce Lolitrem B, it can cause ryegrass staggers. Trials have shown that on average the frequency, duration and severity of ryegrass staggers is less than for standard endophyte. However, on occasion, sheep (and potentially other animals) grazing AR37 ryegrass may be severely affected.

After many years of use, ryegrass staggers on perennial ryegrass with AR37 have not been observed in dairy cows on-farm to date. AR37 varieties should not be used on properties grazing either deer or horses.

For more information on animal health and performance, see table 4 on page 119.

ANIMAL PERFORMANCE

Perennial ryegrass with AR37 has been tested by AgResearch for liveweight gain in sheep, and animal performance was the same as ryegrass without endophyte and AR1 ryegrass (see table 4 on page 119). Sheep performance is considerably better with AR37 than standard endophyte. The incidence of dags is low as with AR1.

Lamb growth rates (grams/day) grazing on ryegrass containing three endophyte types (mean of four years)

Standard endophyte	AR37 endophyte	Nil endophyte
44	129	131

DAIRYNZ TRIAL RESULTS

A four year DairyNZ trial run on Scott Farm (Waikato) measured perennial ryegrass persistence and pasture yields and assessed effects of AR37 endophyte on cow health and milk production. One perennial ryegrass variety infected with AR37, AR1, standard (SE) or without endophyte (Nil) formed the basis of four pastures.

In the fourth and final milking season, white clover was removed to test the effect of endophyte/ryegrass association in isolation from any effect on clover content of pastures. The following bullet points summarise these results from the four seasons:

- AR37 perennial ryegrass was clearly more persistent than either AR1 or standard (SE) ryegrass. This supports findings from previous work
- The greater persistency translated into a reduced need for renovation of AR37 pastures after the 2008 drought, but in the three years before that time there was no difference in total pasture yield
- There was no sign of ryegrass staggers or any other animal health issues in cows grazing AR1 or AR37 pastures, even at times when cows grazing SE were affected by ryegrass staggers

SOURCE: DairyNZ.

MaxP® tall fescue endophyte

WHAT IS MAXP®?

MaxP® is a novel tall fescue endophyte that improves the ability of tall fescue pastures to handle pest attack and possibly moisture stress. MaxP® endophyte is available in Quantica tall fescue (refer to page 146). Tall fescue with MaxP® endophyte offers improved persistence compared with tall fescue without endophyte.

Unlike ryegrass endophyte, MaxP® endophyte produces loline compounds. These compounds, along with peramine, are likely to be a key factor in providing protection against Black Beetle and Root Aphid. MaxP® can improve the drought tolerance of tall fescue. In areas where there are few insect pests and little moisture stress, MaxP® may not be essential, but may still improve pasture production.

PERSISTENCE

The persistence of tall fescues with MaxP® endophyte has been very good, out-yielding perennial ryegrass three years after sowing and having considerably higher plant density than the same fescue without endophyte.

DRY MATTER PRODUCTION

Tall fescue cultivars with MaxP® endophyte have been tested throughout New Zealand since 1997. In areas with insect pests, trials consistently show significant yield and persistence advantages of tall fescues with MaxP® endophyte. In Kerikeri, Northland, MaxP® tall fescue produced 21-81% more dry matter per year than the same cultivar without endophyte. This benefit is more pronounced through late summer and autumn, when yield increases of up to 180% have been measured.

Much of the increased performance is due to the resistance MaxP® provides against the destructive insects Black Beetle and Argentine Stem Weevil. These insects reduce the growth and persistence of tall fescue without endophyte.

Table 5 – Endophyte insect control – continental tall fescue

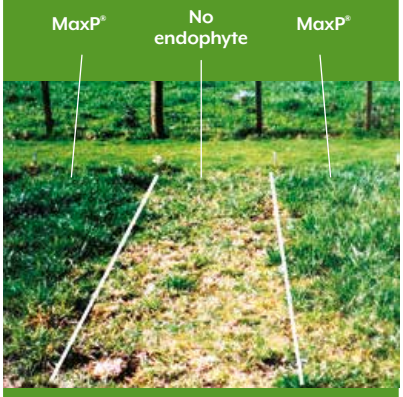
Insect	MaxP® (AR584)	Without endophyte
Argentine Stem Weevil	Not tested	-
Pasture Mealy Bug	Not tested	-
Black Beetle Adult	♦♦♦	-
Root Aphid	(♦♦♦♦)	-
Porina	Not tested	-
Grass Grub	(♦♦)	-
Field Cricket	♦♦♦	-

Key to Table 5

- \- ***No control***.
- ♦ ***Low level control***: *Endophyte may provide a measureable effect, but is unlikely to give any practical control.*
- ♦♦ ***Moderate control***: *Endophyte may provide some practical protection, with a low to moderate reduction in insect population.*
- ♦♦♦ ***Good control***: *Endophyte markedly reduces insect damage under low to moderate insect pressures. Damage may still occur when insect pressure is high.*
- ♦♦♦♦ ***Very good control***: *Endophyte consistently reduces insect populations and keeps pasture damage to low levels, even under high insect pressure.*
- () ***Provisional result***: *Further results needed to support the rating. Testing is ongoing.*

ANIMAL PRODUCTION

MaxP® novel endophyte has been used extensively on sheep and cattle farms and has shown no negative effects on animal health and production of these species.



Endophyte alkaloids

The key to understanding endophytes is understanding the alkaloids, or chemicals, produced by the endophyte in the ryegrass or tall fescue plant. The table below provides a summary of endophytes and their alkaloid production.

Endophyte strains and their alkaloids

Endophyte	Peramine	Lolitrem B	Ergovaline	Janthitrems	Lolines
Without endophyte (WE)	-	-	-	-	-
Standard endophyte (SE)	High	High	High	-	-
AR37	-	-	-	High	-
AR1	High	-	-	-	-
NEA, NEA2 or NEA4	Low	Low*	Low – Medium*	-	-
MaxP®	Medium	-	-	-	Medium - High

Source: Pasture and Forage Plants for New Zealand (Jan 2014)
- none produced
**Depending on the specific endophyte strain(s) and ratio of strains in the mixture. Ergovaline low in Viscount and Shogun, medium in Trojan and Rohan*

Significant improvement has been made on the old standard endophyte (SE); however, there is no 'perfect' endophyte. The main known alkaloids involved in insect protection and animal health are peramine, lolitrem B, ergovaline, janthitrems and lolines.

TIP:

Avoid endophytes containing high levels of lolitrem B or ergovaline as these compounds are associated with ryegrass staggers and heat stress (see page 119).

TYPES OF ALKALOID

Peramine

Peramine provides control of Argentine Stem Weevil, probably also Pasture Mealy Bug and possibly other insects. It has no known effect on the grazing animal.

Lolitrem B

Lolitrem B is the alkaloid responsible for ryegrass staggers in grazing animals during summer and early autumn, when concentrations are highest, particularly if stock are grazing hard into the crown. Lolitrem B has some insecticidal properties on Argentine Stem Weevil, but endophytes with peramine also provide this protection. Lolitrem B may provide some increase in pasture persistence by reducing grazing pressure due to increased crown toxicity.

Ergovaline

Ergovaline can cause sub-clinical or clinical health problems in grazing animals, including reduced animal performance and heat stress. Ergovaline also provides some control of certain insects, including Black Beetle. Ergovaline may also provide some increase in pasture persistence, by reducing grazing pressure due to increased crown toxicity.

Janthitrems (or epoxy-janthitrems)

Janthitrems (or epoxy-janthitrems) are produced by AR37 endophyte. Cultivars containing AR37 provide a wide spectrum of insect control, including Argentine Stem Weevil larvae, Black Beetle adult, Porina, Root Aphid and Pasture Mealy Bug. Janthitrems can cause ryegrass staggers, but both frequency and severity are significantly less than standard endophyte.

Lolines

Lolines are produced by tall fescue and meadow fescue derived endophytes, providing plants with a very wide range of insect control. Unlike most other endophyte alkaloids, lolines are mobile in the plant and probably responsible for control of certain root feeding insects.

Diploid ryegrasses

Diploid ryegrasses have two sets of chromosomes per cell compared to a tetraploid, which has four. Diploids combine yield and robustness, meaning that even in less than ideal conditions, they are more likely to deliver for your stock.

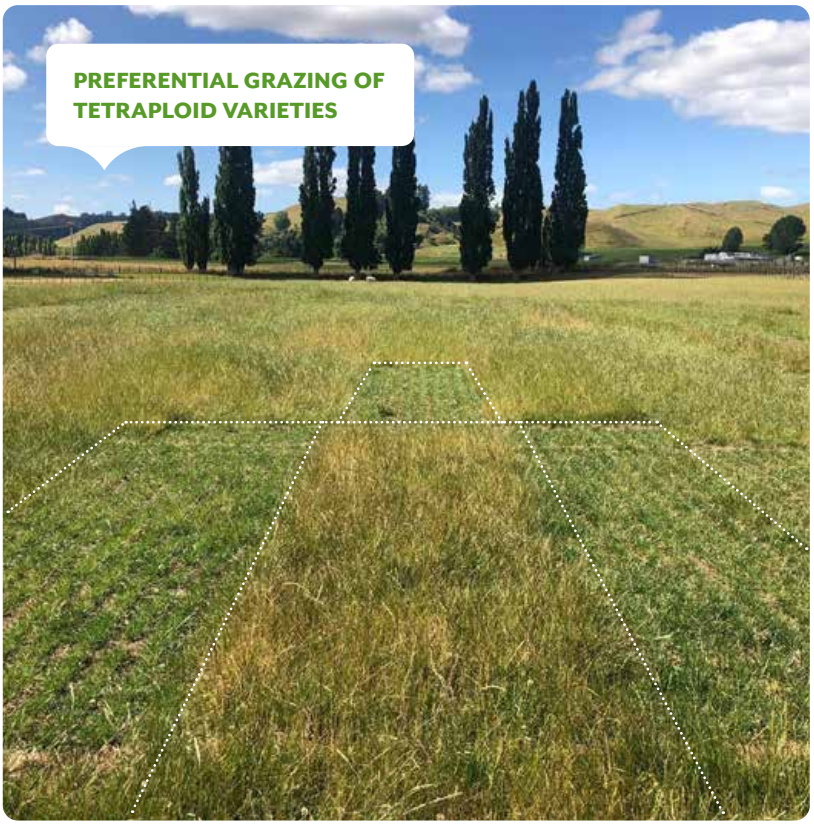
DEPENDABLE DIPLOIDS

- Densely-tillered
- Good robustness and versatility
- Competitive with weeds
- Persistence in lower soil fertility
- Ideal for grass to grass situations
- Can handle wetter environments
- Able to be set stocked or rotationally grazed

PGG WRIGHTSON SEEDS DIPLOID BREEDING PROGRAMME

Delivering New Zealand bred and trialled ryegrasses that you and your stock can depend on:

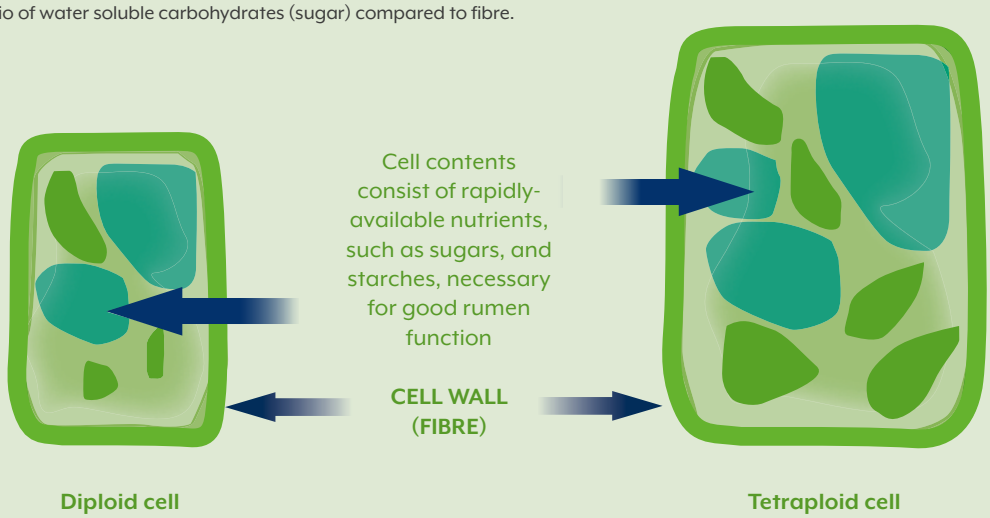
- Excess perennial ryegrass
- Rely perennial ryegrass
- Platform perennial ryegrass[#]
- Expo perennial ryegrass
- Maverick GII short rotation ryegrass
- Supercruise Italian ryegrass



Preferential grazing of tetraploid perennial ryegrass varieties (left, right and top centre) over diploid variety (centre).

DIPLOID AND TETRAPLOID RYEGRASS CELLS

The cells within a diploid ryegrass are smaller than in tetraploids, resulting in a lower ratio of water soluble carbohydrates (sugar) compared to fibre.



[#]*Platform has been bred, selected and successfully tested as a perennial and will function as a perennial ryegrass. Due to a small number of tip awns, Platform is certified as* Lolium boucheanum.

Tetraploid ryegrasses

Intensive farming systems require ryegrasses that produce bulk, high quality feed to drive animal performance and productivity. Tetraploid cultivars are a significant tool in helping achieve this goal, being naturally high in water soluble carbohydrates (sugars).

A tetraploid plant has four sets of chromosomes per cell (a diploid has two sets), which simply means tetraploid ryegrasses are more palatable for livestock. Animals prefer tetraploids over diploids if they have a choice and often graze tetraploid ryerass more quickly and evenly.

MORE FEED EATEN = BETTER ANIMAL PERFORMANCE

BETTER ANIMAL PERFORMANCE = MORE BOTTOM LINE DOLLARS

TIP:

Tetraploid seed is significantly larger than diploid seed and requires higher sowing rates (22-28 kg/ha).

TASTY TETRAPLOIDS

- Fast to establish
- Excellent palatability leading to good pasture utilisation by grazing animals
- Very high quality pasture
- Higher dry matter intakes leading to improved animal performance
- Great for silage quality
- Great clover compatibility

TETRAPLOID BREEDING PROGRAMME

PGG Wrightson Seeds internationally-acclaimed tetraploid breeding programme – delivering New Zealand bred and trialled tetraploids

- Base tetraploid perennial ryegrass
- Delish® tetraploid short rotation grass
- Lush tetraploid Italian ryegrass
- Feast®II tetraploid Italian ryegrass
- Winter Star II tetraploid annual ryegrass

PGG Wrightson Seeds are specialists in tetraploid technology; breeding market-leading cultivars since 1989. We offer a tetraploid portfolio including annual, Italian, short rotation and perennial ryegrasses with a range of endophyte options. These cultivars have built an impressive reputation with New Zealand farmers, due to their palatability, resilience and animal performance benefits

ANIMAL PERFORMANCE BENEFITS

- Improved palatability and intake – greater intake can lead to increased production and/or improved body condition
- More efficient rumen function – tetraploid ryegrasses can be broken down more quickly and completely in the rumen, due to the high ratio of cell contents to cell wall
- More clover – tetraploid ryegrass allows about 10% more clover in the pasture mix, further increasing pasture quality and animal performance

FARM MANAGEMENT BENEFITS

- Improved pasture utilisation – improved palatability means more grass is utilised. This can lead to easier pasture management by reduced topping requirements, less seed head development and improved animal performance
- Reduced stocking rates – improved palatability means greater intake and production per head and the potential to reduce stocking rates. A lower stocking rate may mean a reduction in farm costs (e.g. mating, vet costs)

GRAZING MANAGEMENT TIPS

- Avoid persistent overgrazing – the excellent palatability of tetrapolids can easily result in pastures being overgrazed. Monitor post-grazing residuals to avoid these getting too low and comprising ryegrass persistence
- Apply nitrogen as normal – tetraploid ryegrasses are naturally a darker green than diploids, but still require similar amounts of nitrogen

Sowing guide

High-producing pastures can be established through conventional cultivation or no-tillage techniques. Whatever the system chosen, the principles remain similar, with sound planning being the key to success.

1. SOIL TEST

Paddocks selected for renovation should always be soil tested 6-12 months before sowing to identify possible fertility deficits. Consult with a fertiliser representative for specific recommendations based on the soil test results.

2. SPECIES SELECTION AND ENDOPHYTES

It is important to choose species and endophyte types suited to specific geographical regions and stock classes. Refer to the selection guides for grass (pages 110-111), clover (page 112) and endophytes (pages 118-123) to help decide what cultivars and endophytes are best suited to your farming conditions.

3. SOWING RATES

A guide to sowing rates for individual cultivars is given on the product pages. As a general rule, pastures should be sown at rates of 15-35 kg/ha. The actual rate sown will depend on species used, drilling method, seed treatment and specific local conditions or experience. Successful establishment of perennial ryegrass/white clover pasture is less variable at higher sowing rates e.g. 25-30 kg/ha. For more information showing the benefits of higher sowing rates, see the box at the bottom of this page.

4. SOWING METHODS

Cultivation Pasture species require a fine, firm seedbed for optimum establishment. Excess trash and large clods will diminish results .

No-tillage techniques Pasture can be successfully established through no-tillage systems. The use of a total vegetation killer preliminary spray such as glyphosate will provide the best results. Add a broadleaf herbicide if necessary. A delay between spraying and drilling will aid moisture retention and reduce pest populations.

Drilling Pastures should be sown at a depth of 10-20 mm (any cultivars that differ from this will be highlighted in this manual).
The establishment of clovers will be adversely affected by sowing at a depth greater than these levels. Under all cultivation systems the use of harrows behind the drill will improve seed to soil contact.

5. PEST CONTROL

New pastures can be subject to pest and disease pressure. Several granular insecticides and seed treatments are available to protect the emerging seedlings. Refer to the seed treatment section (pages 238-259) for more information and an overview of the seed treatments available.

6. GRAZING MANAGEMENT

New pastures often benefit from a light grazing at 6-8 weeks after sowing. This encourages the grass plant to tiller and also assists clover establishment by allowing more light into the base of the sward. Ensure that the pasture is consolidated enough so that “pulling” and “pugging” are negated.

7. SUBSEQUENT FERTILISER

New pastures benefit from early applications of nitrogen applied from 3-4 weeks. Regular, subsequent applications of fertiliser based on herbage test results will prolong the life and improve the performance of new pasture. Consult with a fertiliser representative for specific recommendations.

What is the most economic sowing rate? And what is the best time for autumn sowing?

Trials undertaken by PGG Wrightson Seeds at Ballarat Research Centre in Australia, show the effect of time and rate of sowing on short-term ryegrass yield.

The trial compared the yield of an annual ryegrass sown at 10, 20, 30, 40 and 50 kg/ha at four intervals during the year. Following statistical analysis, the following key findings became evident:

- There was a reduction in dry matter yield of approximately 1,300 kgDM for every two weeks that sowing was delayed, irrespective of sowing rate
- For every 10 kg increase in sowing rate from 10 kg/ha to 40 kg/ha, you could expect an extra 500 kgDM of additional feed

Recommendations as a result of this study:

- Sow more seed earlier for maximum productivity of your pastures
- The most cost-efficient grass was that sown as early in the season as possible at a sowing rate of between 30-40 kg/ha

Factors affecting pasture persistence

Droughts and associated pest and weed issues have placed considerable pressure on ryegrass performance and persistence in many regions. Challenging seasons are nothing new to farming, but the current combination of factors in some regions is placing demands on our pastures like never before.

DROUGHT STRESS

Over recent years some regions have experienced three drought seasons in succession, with some of these droughts extending well into autumn (which is a key recovery and tillering period for ryegrass).

WET CONDITIONS

Heavy rain or prolonged wet conditions have exposed pastures to pugging, opening them up and slowing recovery growth rates.

GRAZING PRESSURE

Comparative stocking rates during summer/autumn and production expectations are higher than ever, particularly on dairy farms with high borrowing and staffing levels.

PEST PRESSURE

There can be huge variations in pest populations over different seasons, within different regions and even within different paddocks on an individual farm. Utilise a programme that incorporates a number of different pest management tools, including cultivation, contact insecticide application, slug bait application, seed treatment and endophyte that will provide the best overall pest management strategy.

WEED PRESSURE

Weeds are establishing in open pastures, competing against desirable species for light, moisture and nutrients, and are providing further hosts for pests such as Black Beetle.

NEW PASTURES

Due to the above challenges, new pastures are being placed under pressure before they are fully established. Some have failed within the first or second season because they simply never fully established.

CULTIVARS

Modern cultivars, particularly those with novel endophytes, are highly palatable right to ground level.

In most circumstances, it will be a combination of the aforementioned other factors that have led to poor performance or lack of persistence in pastures. These will differ for each paddock and on each farm. It is important to consider the challenges experienced in each paddock in order to understand why a pasture may be performing poorly or has failed and to determine changes necessary to deal with the problem.

An example of drought stress.

Establishing pasture.

Best practice for pasture management

There is an endless supply of information and advice regarding pasture management, often offering conflicting and sometimes simply poor advice. However, the core principles of ryegrass performance and persistence are still the same and these are the areas to concentrate on to do the job well.

NEW PASTURE ESTABLISHMENT

- **Plan and prepare for success**. Implement a renewal programme that addresses any limiting factors such as drainage, soil fertility, pest pressure and weed burden. Grass to grass renewal can work well in some situations, however where factors limiting ryegrass performance are present, a well, managed break crop will set up the paddock for new pasture. Take no shortcuts; remember ten seasons from a new perennial pasture is the goal

- **Choose an appropriate cultivar.** Where pests are prevalent, an appropriate endophyte is a key consideration. Beyond that, the type of cultivar needs to be right for the paddock (e.g. soil fertility) and grazing management (e.g. rotational grazing versus set stocking). The highest yielding cultivar is often not the best choice for a challenging situation. Talk to a retailer or your local PGG Wrightson Seeds Sales Agronomist for recommendations

- **Establishing new pastures** is about achieving a satisfactory level of tillering and root mass. From this point, a pasture will be resilient to ongoing grazing requirements and the challenges associated with periods of summer dry or winter wet. In general terms, we should have about 20 tillers for each ryegrass plant before we consider it established. A plant with 20 tillers is relatively big, so the drill rows should be practically closed over

- **Grazing management**. Allowing new pasture to reach the 2.5-3 leaves stage before grazing will ensure individual plants build up energy reserves required for tillering and root growth. Do not leave new pasture beyond the third leaf stage, as low light levels to the base of the canopy will shade new tillers and clover. Using new pastures for silage or hay is not recommended. Grazing to a short, even residual of 1,500 kgDM/ha encourages new tillers and clover growth by allowing light into the base of the pasture. This practice of grazing from third leaf down to 1,500 kgDM/ha should be carried out until the pasture is fully established. Light applications of nitrogen (N) throughout spring and into early summer will encourage tillering and growth. Broadleaf weeds will compete with tillering ryegrass for space and light, so must be controlled with a herbicide spray

- **Ongoing monitoring of new pastures**. Walk new pastures on a regular basis. Assess how far away they are from establishment targets and plan for the necessary grazing management, fertiliser application and weed control. Check these paddocks again going into summer and ensure they do not get overgrazed or grazed too often. Consider dropping them out of a round or two to take some pressure off them during the dry period. If perennial pastures are to last for 8-10 years, then we must put in this effort during the establishment phase. In this regard, new pastures are no different to young stock on the farm. If we care for them appropriately, we lay the foundation for good production for many seasons. If we don't, they tend to get beaten up!

ONGOING PASTURE MANAGEMENT

- Many of the recommendations for new pasture management continue to apply after the establishment period, as persistence is all about maintaining tillers and root mass. A well-established pasture will be more resilient to typical seasonal stresses and grazing requirements, however a higher standard of ongoing management will extend the lifespan of a pasture considerably

- Supply ongoing fertiliser requirements according to a soil test and yield targets and control broadleaf weeds

- During challenging seasons, timely and appropriate adjustment of stocking rates, grazing residuals and round lengths is essential for pasture recovery and persistence

Pasture renewal, particularly with modern cultivars and endophytes, presents the opportunity for improved farm productivity. This has been demonstrated in trial comparisons and on many farms throughout New Zealand. Persistence of ryegrass has been maintained in the breeding process, however the cultivar and endophyte options need to be used appropriately to ensure they cope with the modern grazing demands and challenges presented by the seasons. Attention to detail is key and doing the basics really well will deliver results.

Michael Norriss, Programme Leader of Grass Breeding, inspecting ryegrass trials at our Kimihia Research Centre in Lincoln, Canterbury.

Setting up a farm feed system

Selecting the correct pastures to go on your farm is like putting a puzzle together: each piece has its place. However, if a piece is incorrectly inserted the picture might not look as you had hoped.

Ryegrasses in New Zealand are split into five categories: annual, Italian, short rotation, long rotation and perennial. Annuals are short-lived, rapid-to-establish ryegrasses, while perennials are at the other end of the spectrum and live longer but are slower to establish. However, it is important to note that no grass lasts forever.

When selecting pastures for your farm, it is important to get the large pieces (typically perennial or long rotation ryegrasses) of the puzzle in the correct places. Perennial or long rotation grasses are categorised by their heading date. The heading date is the time in spring when seed heads first become visible in the pasture. Why is this important? Ryegrass has approximately a six week burst of growth prior to the seed head emerging. Once seed heads emerge, we see a decline in pasture quality due to more stem, an increase in dead material and less leaf. Having a minimum of two different heading date areas on your farm enables you to more strategically manage pasture growth and quality, for instance no more than 50% of your farm should be in one heading date.

Annual, Italian and short rotation ryegrasses can be used to undersow into existing pastures to thicken them up or extend their longevity until they are regrassed or as a pure sward pasture "crop". In areas with high insect pressure such as Black Beetle, the use of nil endophyte grasses (i.e. annuals/Italians) undersown into existing swards should be restricted to paddocks that are nearing pasture renewal. Alternatively, they can be used as a pure sward in paddocks that are to be taken out the following spring for crop.

Questions to ask when establishing what your farm's perennial or long rotation ryegrass needs are:

- What are the existing pasture cultivars on my farm?
- What are their heading dates?
- What area of farm is planted in them?
- Paddock use (e.g. lambing, sick cow paddock)?

A SUCCESSFUL FARM FEED SYSTEM

Incorporating a range of mid-season, late and very late heading dates into a farm system ensures that no more than a third of the farm should be heading at the same time, thereby assisting with the management of pasture quality.

1 MID-SEASON HEADING RYEGRASS

- Paddocks close to dairy shed (e.g. a sick cow paddock), paddocks needed in the first 2-3 weeks after calving and night paddocks
- Lambing/calving area

2 LATE-HEADING RYEGRASS

- Feed for early in the season to lift cows towards peak production
- Feed to lift milk yield of lactating ewes and beef cows for improved lamb and calf liveweight gain

3 VERY-LATE HEADING RYEGRASS

- Feed for dairy cow mating to hold cows at peak production and to help slow the rate of drop-off of peak production
- Feed to hold ewe milk production post-peak production period and boost lamb liveweight gains allowing more lambs to be drafted to the works off the ewe

DairyNZ Forage Value Index

A PROFIT-BASED EVALUATION 'TOOL' FOR PERENNIAL AND SHORT-TERM RYEGRASS CULTIVARS

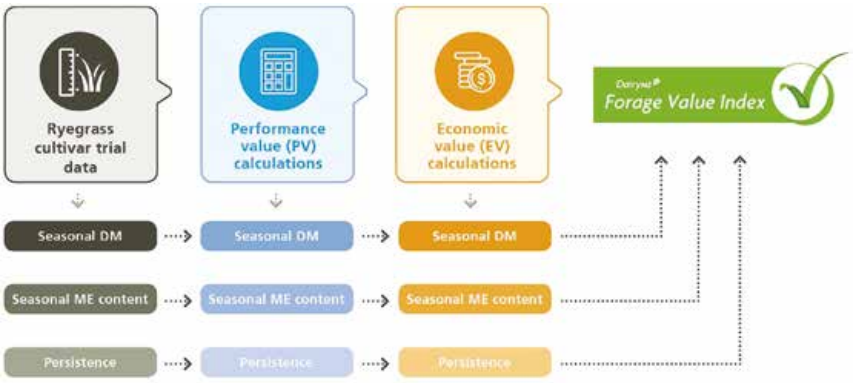
DairyNZ, in collaboration with the New Zealand Plant Breeding Research Association (NZPBRA) have developed a useful tool, the 'Forage Value Index', for the NZ dairy farmer to estimate the profit per hectare of short-term and perennial ryegrass cultivars for their region.

Main Features of the Forage Value Index (FVI)

- An objective, independent, economic-based ryegrass evaluation system
- Based on National Forage Variety Trial (NFVT) data supplied by NZPBRA
- Comparison of cultivar species performance for each region: upper North Island, lower North Island, upper South Island and lower South Island

Performance value (PV)

PVs are annually estimated for seasonal dry matter production for establishment, winter, early spring, late spring, summer and autumn. For seasonal dry matter production, a PV is the total increase or decrease in dry matter production over a period relative to the genetic base. For example, a late spring PV in upper North Island might be +200 kgDM/ha value over the months of September and October.



Economic value (EV)

EVs have been estimated for seasonal dry matter production for establishment, winter, early spring, late spring, summer and autumn for each FVI region. An EV is the effect on profit ($/ha) of a 1-unit change of a trait. For instance, if we increase dry matter production in summer by 1 kg per hectare, what is the effect on animal performance, feed conserved, supplement saved and ultimately farm profitability?

Future of the Forage Value Index

The DairyNZ FVI will steadily strengthen over time as more research is carried out, ensuring that:

- More cultivars are included in the FVI ratings
- More data on traits such as nutritive value and persistence is generated and included in FVI

FURTHER INFO

For more information on the DairyNZ FVI visit **dairynz.co.nz/fvi**

Pasture condition scoring

Condition scoring every paddock on the farm will help determine under-performing paddocks and identify those that may need to be renewed. To identify and prioritise which paddocks to target, we recommend walking all paddocks to properly assess plant density, insect damage, weed presence and to allow implementation of an undersowing or pasture renovation strategy.

USE THIS PASTURE CONDITION SCORE TOOL TO HELP WITH DECISIONS*

Run out paddocks scoring 1-3 will be those to target for undersowing or pasture renovation.

5 **Paddock covered in dense swards of desired grasses and clovers**
No action required. Would be happy if the whole farm was in this state

4 **Patches of low-level damage, some weeds, less vigorous grasses**
Check soil fertility. Apply autumn nitrogen (N) to encourage tillering. Paddock probably OK for the coming season

3 **Large sections of low level damage, weeds, less vigorous grasses**
Apply autumn N. Undersow in the autumn with perennial ryegrass (longer term solution) containing appropriate endophyte. Perennial ryegrass options include Platform or Excess sown at 12+ kg/ha

2 **Severe damage in parts, many weeds, patches of bare ground**
Either:
- Undersow with perennial ryegrass in autumn (e.g. Platform or Excess at 12+ kg/ha), or:
- Undersow with Italian ryegrass (e.g. Lush AR37 at 15+ kg/ha) in autumn and plan to renew in following 12-18 months

1 **Severe damage across entire paddock**
Spray out and sow into an annual ryegrass (e.g. Winter Star II at 28-30 kg/ha) and summer crop in spring. Plan to sow in perennial pasture in the following autumn

**Adapted from DairyNZ pasture condition score tool*

Once you've pasture condition scored the farm, you'll be able to prioritise which paddocks require undersowing.

TIPS AND TRICKS:

Timing

Aim to undersow paddocks before bare areas are filled in with unproductive grass and broadleaf weeds. Ideally, paddocks should be hard grazed to minimise competition during the establishment phase.

Early grazing management

Graze undersown paddocks when seedlings pass the 'pull test'. Avoid accumulating large covers as this will shade out recently sown seedlings and reduce tillering.

Endophtye

Using a novel endophyte is important when undersowing run out pastures, particularly in pasture with an existing pest issue such as Argentine Stem Weevil or Black Beetle.

Seed treatment

All seed that is undersown should be treated with Superstrike® to protect against pasture pests. This is cheap insurance and a small cost when considering the cost of re-drilling the paddock 6-8 weeks later.

NOTE - Pastures undersown with Superstrike® seed have a grazing withholding period of 21 days.

In late summer/early autumn while soil temperatures are still high, perennial ryegrass is a good option for undersowing. As the days shorten and soil temperatures drop below 12°C, we should switch to Italian (e.g. Lush AR37) and annual ryegrasses (e.g. Winter Star II) as they are much faster to establish and have better cool season activity.

Early undersowing allows seedling establishment to occur in more favorable conditions, which in turn maximises establishment, tillering and early dry matter production. By comparison, later undersowing may result in missing out on favourable growing conditions and the opportunity to produce valuable winter feed, while increasing the risk of invasive grasses and weeds establishing.

PASTURE OPTIONS

Perennial Grasses

Farm type

Farm type

Sowing rate

STANDARD SOWING RATE

15-25 kg/ha

UNDERSOWING

12+ kg/ha

Example pasture mixes

Dairy pasture mix

Platform perennial ryegrass 21 kg/ha
Legacy white clover 2 kg/ha
Quartz white clover 2 kg/ha

Sheep and beef pasture mix

Platform perennial ryegrass 21 kg/ha
Quartz white clover 2 kg/ha
Hilltop white clover 2 kg/ha

For increased animal performance, nitrogen fixation and pasture management, add Amigain red clover to pasture mixes at 4-6 kg/ha.

Platform PERENNIAL RYEGRASS*

- High yielding with strong year-round production
- Excellent feed quality
- Fine leaf with high tiller density
- Late flowering (+12 days)
- Strong persistence (AR37)
- DairyNZ FVI* 5-star status in the lower North Island region (Platform AR37)

Platform is a persistent diploid perennial ryegrass offering high yields of quality feed and year-round dry matter production. Outstanding quality is achieved through low aftermath seed head production and fine dense tillers making it a versatile option for productive environments.

Platform has performed strongly in New Zealand trials, demonstrating year-round growth with noted summer/autumn productivity. In independent National Forage Variety Trials, Platform AR37 has performed strongly and been awarded 5-star status in the lower North Island DairyNZ Forage Value Index.

In addition to Platform's fit in dairy systems, its dense, fine leaves and cool season growth also make this perennial ryegrass suitable for progressive sheep and beef systems. This feed profile is ideal for meeting the increased late winter/early spring feed demands on many New Zealand sheep and beef farms.

Breeding

Platform was bred from elite New Zealand genetics and north-west Spanish material and has undergone testing to ensure its adaptability across all ryegrass growing regions of New Zealand.

Heading date

Early	Mid-season	Late	Very late
		Platform: 12 days later than Nui	

Sowing and establishment

Platform perennial ryegrass can be sown at 15-25 kg/ha with Superstrike® treated clover.

Mix suitability

Platform perennial ryegrass combines well with other components of a pasture mix (e.g. short rotation ryegrass, cocksfoot and Grasslands Puna II chicory and clover).

Grazing management

Platform perennial ryegrass# will produce better under rotational grazing. Avoid hard set stocking during periods of stress (e.g. droughts, low soil fertility and insect attack).

For more information on AR37, see pages 118-120 and 122-123.
**For more information on the DairyNZ Forage Value Index see page 130.*
#Platform has been bred, selected and successfully tested as a perennial and will function as a perennial ryegrass. Due to a small number of tip awns, Platform is certified as Lolium boucheanum.

Platform: the quality all-round performer

KNOWLEDGE BASE ARTICLE
knowledgebase.pggwrightsonseeds.com

Average metabolisable energy (MJME/kgDM) of perennial ryegrass cultivars

Cultivar	Metabolisable energy MJME/kgDM	
Base AR37	11.30	a
Platform AR37	10.79	b
Rely AR37	10.52	b
Governor AR37	10.13	c
Trojan NEA2	9.78	c

Trial mean	10.50
Significance	***
LSD 5% level	0.36
CV%	2.2

Average metabolisable energy content of perennial ryegrass cultivars measured in Waikato between November 2019 and March 2020. LSD (5%) = 0.36 MJME/kgDM. Differences between cultivars must exceed the LSD to be statistically different.

If you're looking for a top performing perennial ryegrass that combines high dry matter production with exceptional quality, then look no further than Platform AR37.

Platform AR37 perennial ryegrass[#] is the latest diploid ryegrass from PGG Wrightson Seeds. Bred and developed by PGG Wrightson Seeds' team of plant breeders across New Zealand, Platform has been selected for increased tiller density, finer leaves and low aftermath seed head.

This combination of traits has led to a remarkable improvement in feed quality over other diploids, with feed tests for Platform returning impressive quality results traditionally only seen by tetraploid varieties.

Feed quality tests from a trial run on a Waikato dairy farm demonstrate the quality advantage that Platform AR37 provided over late-heading diploids Governor AR37 and Trojan NEA2 (see table).

These results show Platform maintaining consistently higher energy (MJME) values than the other diploid ryegrasses throughout the testing period from November to March. With higher energy intake leading to increased production, it is clear why farmers are asking for Platform again after trying it previously.

In addition to Platform's dairy fit, its dense, fine leaf type and impressive cool season growth make this perennial ryegrass a great option for sheep and beef systems. Platform's feed profile shows increased late winter/early spring growth matching the early season feed demands of most sheep and beef farms across New Zealand. Platform is now available with AR1 endophyte.

When choosing a perennial pasture mix to maximise stock performance, consider pairing Platform with high-performing legumes Legacy and Quartz white clover. Both Legacy and Quartz have been bred and selected within a pasture sward to provide superior production and persistence when mixed and drilled with ryegrass, tall fescue or cocksfoot.

Legacy's large leaf and upright growth habit enable it to compete with ryegrass, making it easy for cattle to graze. In contrast with a medium leaf size, Quartz white clover provides broad adaptability across more challenging and varied grazing systems, including sheep and beef grazing systems.

[#]Platform has been bred, selected and successfully tested as a perennial and will function as a perennial ryegrass. Due to a small number of tip awns, Platform is certified as Lolium boucheanum.

Perennial ryegrass case study

PLATFORM PERENNIAL RYEGRASS CASE STUDY

Farm type:	Dairy
Hectares:	165 (effective)
Location:	Te Awamutu
Name:	Friedemann and Miriam Deuschle

Friedemann and Miriam Deuschle have been 50/50 sharemilking in Te Awamutu on a 165 hectare effective property with a 450 cow herd for the past five years. During this time, they have developed an intensive regrassing programme with the input of Jarno Sammet, their local Farm Source Technical Service Representative (TSR). Following summer cropping, including Barkant® turnips and Pallaton Raphno®, paddocks are planted in new proprietary varieties, including Platform perennial ryegrass*.

An on-farm policy of 300 days lactation is achieved through early calving and milking into late May. To provide feed for this extended lactation period, the introduction of modern perennial ryegrass genetics with increased cool season activity has been critical to providing low-cost feed. Platform AR37 contains a combination of leading New Zealand and north-west Spanish genetics, resulting in both spring and cool season growth when it is needed most.

Platform's late heading date (12 days later than Nui), combined with a dense, fine leaf structure and low aftermath seed head, has also produced impressive feed quality results, traditionally seen by tetraploid varieties. On farm, Platform's low aftermath seed head emergence assists with the maintenance of pasture quality and peak milk production through the late spring and summer months. In independent National Forage Variety Trials results, Platform AR37 continues to perform and has a five-star status in the DairyNZ Forage Value Index for the upper North Island region.

Following an intensive regrassing programme, the farm recorded a 25% lift in milk production. "We can only say it's the grass we are grazing and with the dense, fine tillering that Platform provides. We think we have a winner," says Friedemann.

Friedemann Deuschle (left) and Farm Source TSR Jarno Sammet (right), inspecting Platform AR37 ryegrass.

**Platform has been bred, selected and successfully tested as a perennial and will function as a perennial ryegrass. Due to a small number of tip awns, Platform is certified as* Lolium boucheanum.

For more information on the DairyNZ FVI see www.dairynz.co.nz/fvi

Farm type

Farm type

Sowing rate

STANDARD SOWING RATE

22-28 kg/ha

Example pasture mixes

Dairy pasture mix

Base perennial ryegrass 25-28 kg/ha
Legacy white clover 2 kg/ha
Quartz white clover 2 kg/ha

Sheep and beef pasture mix

Base perennial ryegrass 25-28 kg/ha
Quartz white clover 2 kg/ha
Hilltop white clover 2 kg/ha

For increased animal performance, nitrogen fixation and pasture management, add Amigain red clover to pasture mixes at 4-6 kg/ha.

Base TETRAPLOID PERENNIAL RYEGRASS

- Exceptional yielding tetraploid perennial ryegrass
- AR37 endophyte for strong persistence
- Very high tiller density
- Stunning late spring quality
- Excellent for dairy and intensive sheep/beef systems
- DairyNZ FVI® 5-star status in all New Zealand regions (Base AR37)
- Best suited to rotational grazing
- Superior year-round performance
- Excellent cool season yields

Ideal for high performance systems with a focus on pasture management and quality. Base tetraploid perennial ryegrass offers top production with increased animal preference, meaning higher animal intakes and easier management of post-grazing residuals.

Base was selected from high yielding, densely-tillered plants that survived two years of severe drought and hard grazing. Base pastures offer low aftermath heading to maximise summer quality and animal production.

Heading date

Early	Mid-season	Late	Very late
			Base: 22 days later than Nui

Sowing and establishment

Base tetraploid perennial ryegrass seed is heavier than diploid perennial ryegrass seed, so ideally should be sown at a 40% higher rate than diploid cultivars. Base should be sown at a minimum of 22 kg/ha as a pure sward with Superstrike® treated clover. Base performs best on sites with reasonable soil moisture and medium to high soil fertility.

Mix suitability

Base combines well with other components of a pasture mix (e.g. tetraploid short rotation ryegrass, tetraploid Italian ryegrass and Grasslands Puna II chicory and clover).

Grazing management

Base will produce and persist better under rotational grazing. Avoid hard set stocking during periods of stress (e.g. drought).

For more information on AR37 see pages 118-120 and 122-123.
**For more information on the DairyNZ forage value index see page 130.*

Perennial ryegrass case study

The Humphries family from left – David, Millie and Mark Humphries

BASE AR37 TETRAPLOID PERENNIAL RYEGRASS CASE STUDY

Property name:	Glen Moraig Farm and Te Tui Farm
Farm type:	Sheep and beef
Hectares:	640 (Glen Moraig) and 560 (Te Tui)
Location:	Waipukurau, Hawke's Bay
Name:	Humphries Farming Limited

Humphries Farming Limited operate a sheep and beef breeding and finishing operation from two properties located east of Waipukurau, central Hawke's Bay. They have been growing Base AR37 for four years as it performs well in challenging conditions and suits their farm system.

Glen Moraig Farm is located 25 km east of Waipukurau, a 640 hectare breeding unit running Romney ewes and hoggets as well as a Hereford breeding herd. The farm has heavy clay soils and receives an average annual rainfall of 1,200 mm. Following weaning, lambs and calves are then taken to the Humphries finishing unit, Te Tui Farm.

Te Tui has 560 hectares situated 10 km east of Waipukurau. The Humphries fatten the Glen Moraig young stock as well as finish winter trade lambs and Friesian bulls. Te Tui Farm offers a combination of argillite hills and fertile flats, where all stock rotationally graze paddocks planted with Base AR37. The paddocks are subdivided accordingly to optimise grazing management and longevity of Base AR37. The annual rainfall at Te Tui is 850 mm; combining this rainfall with the farm's soil type and suitable subdivision means the property is well-suited to growing Base AR37.

As Mark Humphries comments, "Base provides us with a high-quality finishing feed and we have found it to be very clover friendly." Being a tetraploid, Base is an excellent companion ryegrass for Quartz white clover, which is a key driver of animal performance.

"Our measure of performance is when livestock go over the scales and we have never been disappointed," says Mark.

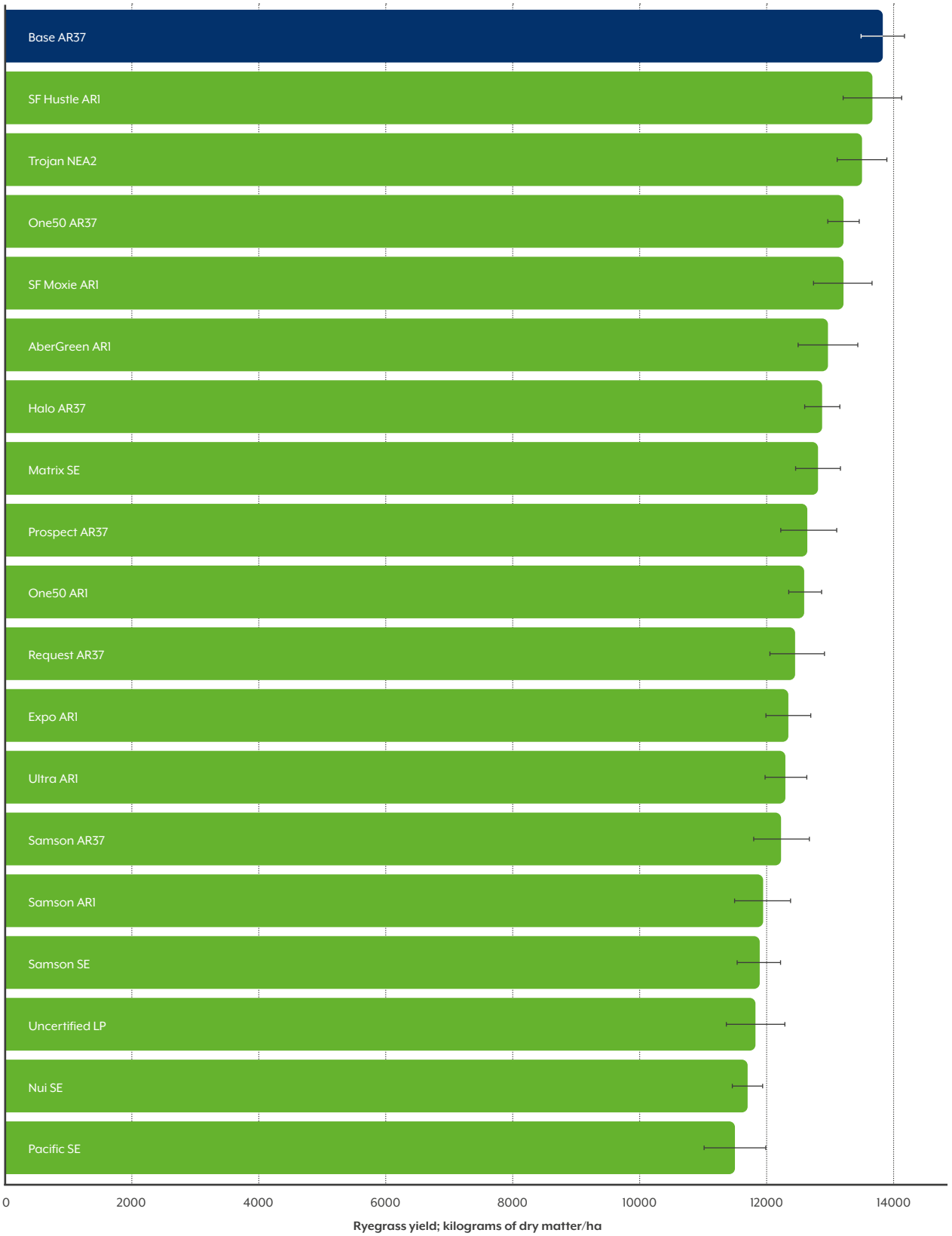
Base is sown with 6 kg/ha of clover and rotationally grazed by bulls and lambs. When pasture growth rates exceed livestock demands, selected paddocks are removed from the grazing round in late spring to be cut for baleage.

The Humphries are impressed by the performance of Base AR37, as it provides consistent growth across all seasons and recovers well from dry summers. Base AR37 has excellent palatability, which assists with ease of pasture management and enhances livestock performance.

Going forward, Humphries Farming will continue to use Base AR37 and recommend it to other farmers as it is a solid, all-round perennial ryegrass performer and is well-suited to meeting the demands of a finishing system. It recovers well, with great persistence, from a harsh summer dry environment.

National forage variety trials

Upper South Island Trials - perennial ryegrass total yield



NFVT summary 1991-2020 (August 2020)

Farm type

AR37

Farm type

AR1

Sowing rate

STANDARD SOWING RATE

15-25 kg/ha

UNDERSOWING

12+ kg/ha

Example pasture mixes

Dairy pasture mix

Excess perennial ryegrass 21 kg/ha
Legacy white clover 2 kg/ha
Quartz white clover 2 kg/ha

Sheep and beef pasture mix

Excess perennial ryegrass 21 kg/ha
Quartz white clover 2 kg/ha
Hilltop white clover 2 kg/ha

For increased animal performance, nitrogen fixation and pasture management, add Amigain red clover to pasture mixes at 4-6 kg/ha.

Excess PERENNIAL RYEGRASS

NEW ZEALAND BRED

- Excellent dry matter production
- Strong persistence (AR37)
- Mid-season heading (+7 days)
- Exceptional summer, autumn and winter growth
- Low aftermath seed head emergence
- Proven performance in upper North Island National Forage Variety Trials

Excess is a medium-leaved, diploid perennial ryegrass bred specifically for tougher environments. It produces exceptionally high dry matter yields and the mid-season heading date provides an earlier flush of spring growth that makes it ideal for lambing and calving.

Excess is a tried and tested perennial ryegrass offering excellent production in more challenging soil types. Recent independent National Forage Variety Trial results demonstrate the productivity advantages Excess AR37 provides in the challenging upper North Island environment.

Heading date

Early	Mid-season	Late	Very late
	Excess: 7 days later than Nui		

Sowing and establishment

Excess perennial ryegrass can be sown at 15-25 kg/ha with Superstrike® treated clover.

Mix suitability

Excess perennial ryegrass combines well with other components of a pasture mix (e.g. short rotation ryegrass, cocksfoot and Grasslands Puna II chicory and clover).

Grazing management

Excess will produce and persist better under rotational grazing. Avoid hard set stocking during periods of stress (e.g. droughts, low soil fertility and insect attack).

For more information on AR37 see pages 118-120 and 122-123.

Tom Buckley
Farm Manager
Owl Farm, Cambridge

"In our five-year-old paddock, Excess is persisting extremely well on lighter soil types, despite the challenging dry conditions over the past few seasons."

Farm type

Farm type

Sowing rate

STANDARD SOWING RATE

15-25 kg/ha

UNDERSOWING

12+ kg/ha

Example pasture mixes

Dairy pasture mix

Rely perennial ryegrass 21 kg/ha
Legacy white clover 2 kg/ha
Quartz white clover 2 kg/ha

Sheep and beef pasture mix

Rely perennial ryegrass 21 kg/ha
Quartz white clover 2 kg/ha
Hilltop white clover 2 kg/ha

For increased animal performance, nitrogen fixation and pasture management, add Amigain red clover to pasture mixes at 4-6 kg/ha.

Rely PERENNIAL RYEGRASS

- Strong persistence (AR37)
- Mid-season heading (0 days same as Nui)
- Good rust tolerance
- Very good summer, autumn and winter growth
- Fine leaf and dense tillers
- Excellent dry matter in challenging conditions

A versatile diploid with fine leaves and dense tillers bred to cater for a range of environments. Rely is a resilient option that can tolerate lower soil fertility and periods of set stocking.

Heading date

Early	Mid-season	Late	Very late
	Rely: Same as Nui		

Sowing and establishment

Rely perennial ryegrass can be sown at 15-25 kg/ha with Superstrike® treated clover.

Mix suitability

Rely perennial ryegrass combines well with other components of a pasture mix (e.g. short rotation ryegrass, cocksfoot, Grasslands Puna II chicory and clover).

Grazing management

Rely will produce and persist better under rotational grazing. Avoid hard set stocking during periods of stress (e.g. droughts, low soil fertility and insect attack).

For more information on AR37 see pages 118-120 and 122-123.

Farm type

Farm type

Sowing rate

STANDARD SOWING RATE

15-25 kg/ha

UNDERSOWING

12+ kg/ha

Example pasture mixes

Dairy pasture mix

Expo perennial ryegrass 21 kg/ha

Legacy white clover 2 kg/ha

Quartz white clover 2 kg/ha

Sheep and beef pasture mix

Expo perennial ryegrass 21 kg/ha

Quartz white clover 2 kg/ha

Hilltop white clover 2 kg/ha

For increased animal performance, nitrogen fixation and pasture management, add Amigain red clover to pasture mixes at 4-6 kg/ha.

Expo PERENNIAL RYEGRASS

- High water soluble carbohydrate (sugar) levels
- Strong, year-round dry matter production
- Late flowering and low aftermath heading
- Strong cool season growth
- Very high tiller density

Expo diploid perennial ryegrass is a densely tillered, late flowering perennial ryegrass bred to deliver high quality feed throughout the year. Available with AR37 or AR1 endophyte, Expo perennial ryegrass can be utilised in both rotational and set stocking grazing systems with medium to high soil fertility.

Heading date

Early	Mid-season	Late	Very late
		Expo: 21 days later than Nui	

Sowing and establishment

Expo perennial ryegrass can be sown at 15-25 kg/ha with Superstrike® treated clover.

Mix suitability

Expo perennial ryegrass combines well with other components of a pasture mix (e.g. short rotation ryegrass, cocksfoot, Grasslands Puna II chicory and clover).

Grazing management

Expo is suitable for rotational grazing systems or set stocking.

Dry matter production comparison of Expo AR1 versus AberDart AR1 (expressed as a percentage of AberDart AR1)

Entry	Winter	Spring	Summer	Autumn	Total
Expo AR1	122	100	117	124	111
AberDart AR1	100	100	100	100	100

Data are the mean of three completed trials located in Puturau, Waikato (1) and Lincoln, Canterbury (2). Expo AR1 produced a significantly higher yield than AberDart AR1 during establishment and in winter and autumn, but differences were not significant in spring, summer and total yield. Data is the mean of three completed trials that each ran for three years between 2006 and 2012.

For more information on AR37 see pages 118-120 and 122-123.

Cocksfoot overview

COCKSFOOT FARMING SYSTEM FIT

Cocksfoot is used throughout New Zealand farming systems, from flat intensive farms to extensive hill and high country stations with a variety of stock types. Cocksfoot by its very nature offers a great deal of flexibility and risk mitigation due to summer production and persistence achieved through drought and pest tolerance.

ENVIRONMENTAL FIT OF COCKSFOOT

Cocksfoot is a persistent, drought-tolerant species well-suited to dryland environments or lighter soils. Although cocksfoot is tolerant and will persist in lower fertility environments, productivity-exceeding perennial ryegrass can be achieved in certain environments with good soil fertility and grazing management.

Relative to ryegrass, cocksfoot offers increased tolerance to native pasture pests, including Grass Grub and Porina.

GRAZING MANAGEMENT AND REQUIREMENTS

Cocksfoot as a species needs regular grazings to manage seed head production and a compatible legume to support nitrogen requirements and maintain quality of the cocksfoot and overall pasture sward. It is important to select clovers suited to the environment and a soil nutrient status that supports legume growth and nitrogen fixation.

Grazing management of the mixed pasture sward should focus on promoting growth of clover and removing cocksfoot seed heads. For best results, maintain the pasture in a short and leafy state and consider the use of cattle and topping to remove excessive growth. Maintaining the sward in a short and leafy state should reduce the 'clumping' effect of cocksfoot.

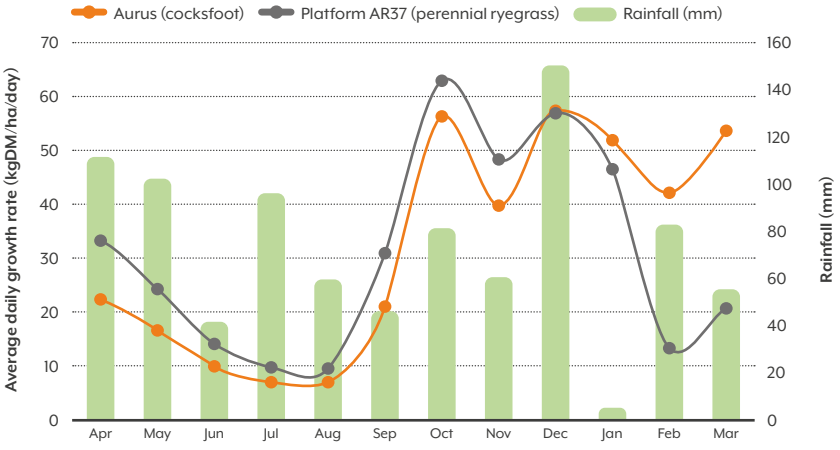
As a species, cocksfoot is extremely responsive to nitrogen. To maximise production, an appropriate legume content and/or strategic nitrogen applications are recommended to boost production.

AURUS DRYLAND FEED PROFILE

While perennial ryegrass provided slightly higher production when moisture was not limiting, the true advantage of cocksfoot can be seen through the drier summer months in this Canterbury trial (see graph below). With limited January rainfall, Aurus maintained high daily pasture growth rates while ryegrass growth rates declined significantly.

Average daily growth rates of cocksfoot and perennial ryegrass Fairlie, South Canterbury

April 2019 – March 2020



Summary of strengths and limitations of cocksfoot versus ryegrass

Strengths	Limitations
Strong summer and autumn growth	Not well-adapted to poorly drained or saline soils
Persistent under low soil fertility, but very responsive to higher fertility and nitrogen applications	Cocksfoot can be slow to establish and therefore is often sown with a companion grass species
Free from any substances known to be toxic to stock – endophyte free	Becomes bulky and quality declines under poor grazing management
Once established, cocksfoot is tolerant of most pests, including Grass Grub and Porina	
Highly competitive and persistent once established	
Cockfoot is the best grass option for hill country soils that have acidity issues	

Farm type

Sowing rate

STANDARD SOWING RATE
6-10 kg/ha

SECONDARY COMPONENT OF PASTURE MIX
1-3 kg/ha

Example pasture mixes

Dryland cocksfoot dominant mix

Aurus cocksfoot 10 kg/ha
Hilltop white clover 4 kg/ha
Bindoon sub clover 6 kg/ha

High fertility cocksfoot dominant mix

Aurus cocksfoot 10 kg/ha
Quartz white clover 2 kg/ha
Hilltop white clover 2 kg/ha

For increased animal performance, nitrogen fixation and pasture management, add Amigain red clover to pasture mixes at 4-6 kg/ha.

Wayne Nichol
Extension Agronomist
and Nutritionist,
PGG Wrightson Seeds

"Cocksfoot has long been recognised for its agronomic attributes in dryland farming situations. Relative to ryegrass, it has an ability to cope with summer dry conditions and tolerate grazing by key pasture pests such as Grass Grub and Porina."

Aurus COCKSFOOT

- High yielding variety with improved winter activity over Tekapo
- Strong persistence
- Excellent drought tolerance
- Upright growth habit allowing great clover content
- Suitable for set stocking and hard rotational grazing by sheep
- Excellent *Drechslera* tolerance observed in New Zealand trials

Aurus is an upright cocksfoot providing strong summer production and persistence well-suited to challenging dryland environments. A winter active cocksfoot with a parentage that combines Uruguayan and French genetics. Aurus' upright growth habit enhances its compatibility with high performing clover varieties, ideal for maximising nitrogen fixation. This combination offers both strong winter growth and good overall total yield. Plant breeders have selected Aurus for superior yield, strong disease tolerance and a later heading date (+6 days later than Tekapo).

Sowing and establishment

Pure swards of Aurus cocksfoot are suited to summer dry environments and should be sown at rates of 6-10 kg/ha (Superstrike® treated) with appropriate clovers and herbs. White clovers, including Hilltop (small leaf white clover) or Quartz (medium leaf white clover), along with Puna II chicory are well-suited to mixed pasture swards with Aurus cocksfoot.

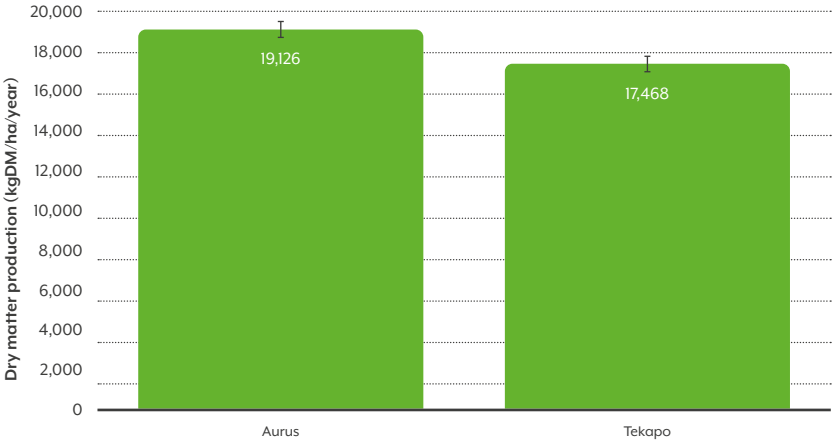
In perennial ryegrass pastures, Aurus can be included to improve summer production and persistence at sowing rates of 2-3 kg/ha. Alternatively, cocksfoot-dominated ryegrass mixes sown at rates ranging from 3-10 kg/ha can be used to suit farm systems where cocksfoot is the desired dominant species.

Due to its slower establishment, cocksfoot pastures should be sown Superstrike® treated in early autumn or spring to ensure a rapid uniform establishment.

Grazing management

Due to its slower establishment, early grazings of Aurus cocksfoot and ryegrass mixes should be frequent and light, using large mobs to reduce competition from the ryegrass. For post-establishment grazing management, see page 143.

Annual dry matter production (kgDM/ha) of Aurus cocksfoot versus Tekapo cocksfoot mean over three years in Lincoln, Canterbury



Total yield (kgDM/ha) mean of three years (2016-2019) in Lincoln, Canterbury.
LSD (5%) = 775 kgDM/ha/year, differences between cultivars must exceed the LSD 5% to be significant.

Tall fescue overview

TALL FESCUE FARMING SYSTEM FIT

Tall fescue is an alternative to perennial ryegrass, adapted to most regions of New Zealand in pasture mixes where production of ryegrass is limited by dryland environments, soil type or insect pests.

Trials have shown the performance of stock grazing tall fescue pastures to be equal to perennial ryegrass, but it requires good grazing management, appropriate herb and clover content and use of nitrogen fertiliser to achieve top animal performance.

ENVIRONMENTAL FIT OF TALL FESCUE

In addition to tolerance of heavy soils and short periods of waterlogging, tall fescue also performs extremely well in lighter dryland soils. To maximise production, tall fescue should be sown in soils with medium to high soil fertility.

Drought tolerance is another major advantage of tall fescue, making it ideal for dryland environments with low rainfall and high evapotranspiration rates. Tall fescue has an optimum growing temperature of 26°C; in contrast perennial ryegrass is 20°C. Tall fescue also has a larger root system, higher water use efficiency and an ability to induce dormancy (stop growing) during severe heat to protect itself.

GRAZING MANAGEMENT AND REQUIREMENTS

Tight grazing management through the spring period is required to maintain quality. The spring growth flush of Quantica is approximately 3 weeks earlier than ryegrass cultivars like Rely or Nui. Preparing for this early spring flush with enough grazing livestock and appropriate subdivision is key to maintaining quality. If set stocking in spring coincides with spring growth (e.g. during lambing) consider the use of cattle and topping to remove excessive growth.

On dairy farms, consider blocking tall fescue paddocks together. This makes managing tall fescue paddocks on a shorter round length easier. This can be aided by those with multiple herds, where one herd can focus on maintaining the shorter round length required of tall fescue paddocks.

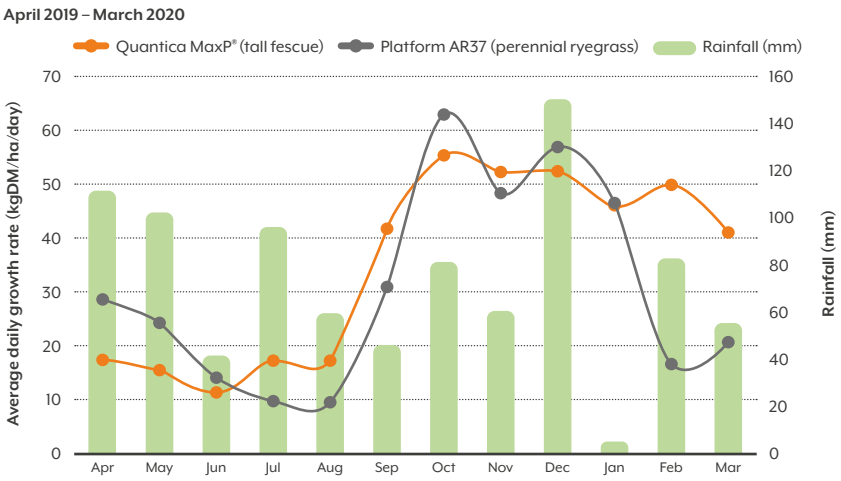
To maintain feed quality, do not allow pastures to exceed 3,000 kg DM/ha (approximately 18 cm) pre-grazing and maintain post-grazing residuals at about 1,500 kg DM/ha (approximately 3-5 cm). During periods of rapid growth, do not allow pastures to go ungrazed for longer than 30 days. Ideally graze when the plant is 15 cm high and the leaves are 15-30 days old.

If appropriate grazing pressure can not be maintained or if there is a lack of subdivision alternatives including ryegrass, cocksfoot or brome may be better suited.

QUANTICA DRYLAND FEED PROFILE

Quantica's early spring flush followed by significantly higher summer (February /March) production was noted in a Canterbury trial (see graph below). This dryland trial demonstrated Quantica's suitability for sheep and beef farms with early spring feed demands and those in dryland environments.

Average daily growth rates of tall fescue and perennial ryegrass dryland Fairlie, South Canterbury



Summary of strengths and limitations of tall fescue versus ryegrass

Strengths	Limitations
Clover friendly	Slower to establish
Drought tolerance – grows longer into a drought and will stop growing in severe heat to protect itself	Loses quality after 2–3 weeks during periods of rapid growth
Higher water use efficiency (uses rainfall more efficiently)	Requires greater grazing management, especially during the spring reproductive phase
Better heat tolerance – growth rates in summer can exceed ryegrass by 30-40%	Broader leaved and fewer tillers
Superior tolerance of heavy soils and short periods of waterlogging	On light soils or pumice soils with low organic matter, application of nitrogen fertiliser is sometimes required at higher levels to maintain quality
Better tolerance to insect pests due to greater root mass and MaxP® endophyte	
Can have lower facial eczema spore populations	

Farm type

MaxP

Sowing rate

STANDARD SOWING RATE
22-32 kg/ha

Example pasture mixes

Dairy pasture mix

Quantica tall fescue 22-28 kg/ha
Legacy white clover 3 kg/ha
Quartz white clover 2 kg/ha

Sheep and beef pasture mix

Quantica tall fescue 22-28 kg/ha
Quartz white clover 2 kg/ha
Hilltop white clover 2 kg/ha

For increased animal performance, nitrogen fixation and pasture management, add Amigain red clover to pasture mixes at 4-6 kg/ha.

Quantica TALL FESCUE

NEW ZEALAND BRED

- Soft fine leaves providing increased palatability
- High yielding with excellent cool season growth
- Excellent dryland production and autumn drought recovery
- Good disease (crown rust) resistance
- Low aftermath heading
- New Zealand bred for local conditions

Quantica is a soft, finely-leaved continental tall fescue selected for improved animal palatability and rust resistance. Quantica is a deep-rooted, robust, productive variety, offering greater persistence than perennial ryegrass. Quantica is able to tolerate waterlogging, soil salinity, Grass Grub and summer dry conditions. In trials, Quantica was noted for superior autumn recovery following severe droughts.

Sowing and establishment

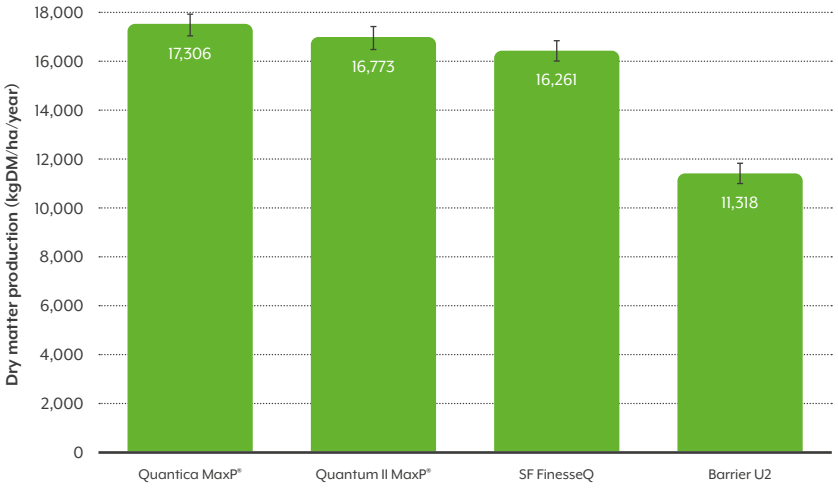
Tall fescues have relatively slow seedling growth compared with perennial ryegrass, so must not be sown in ryegrass mixes. Sow in spring or early autumn at 22-32 kg/ha (Superstrike® treated seed) with 4-6 kg/ha Superstrike treated white clover and Grasslands Puna II chicory. Sow within the range of 5-15 mm, certainly not deeper. In a lucerne mix, Quantica should be sown at 8-12 kg/ha with 8-12 kg/ha of Stamina 5.

MaxP®

MaxP® is a novel tall fescue endophyte that improves the ability of tall fescue pastures to handle pest attack and moisture stress. Unlike ryegrass endophyte, MaxP endophyte produces a loline compound. This compound, along with peramine, is likely to be a key factor in providing protection against Argentine Stem Weevil, Black Beetle, Pasture Mealy Bug and Root Aphid. Once established, tall fescue is naturally more tolerant to Grass Grub than ryegrass.

For more information on MaxP® endophyte see page 121.

Annual dry matter production (kgDM/ha) of tall fescue and festulolium cultivars mean of three years in Lincoln, Canterbury



Mean total yield (kgDM/ha) of three years (2016-2019) in Lincoln, Canterbury.
Differences between cultivars must exceed the LSD 5% (845 kgDM/ha) to be significant.

Tall fescue case study

QUANTICA TALL FESCUE CASE STUDY

Property name:	Quailburn Downs
Farm type:	Sheep and beef
Hectares:	2,500
Location:	Omarama
Name:	Trent Spittle

Quailburn Downs is a 2,600-hectare merino sheep and beef cattle station in Omarama. Of the total land area, 1,300 hectares dryland pastures and ryecorn, while 200 hectares is under centre pivot irrigation. The remaining area is a combination of undeveloped flats and hill country.

When planning pasture and crops for each of the land classes, consideration needs to be given to the challenging environmental aspects. The farm operates with an average annual rainfall of 533 mm, while experiencing the extremes of hot summers reaching temperatures over 30ºC and cold winters with frosts of -20ºC.

For Trent Spittle, Farm Manager and co-owner of Quailburn Downs, planting alternative species like tall fescue and cocksfoot has improved the productivity of his farm system. The dryland pastures are sown with species suited to environmental extremes including Stamina 5 lucerne, Quantum II tall fescue, Aurus cocksfoot and more recently brome. Quailburn Downs undertakes 250 hectares of pasture renewal annually. Lucerne is an ideal legume with its deep taproot accessing moisture lower down in soil profile, offering increased persistence during dry seasons. Stamina 5 was chosen for its ability to fix nitrogen for companion grasses, improving pasture performance along with its grazing tolerance.

Perennial ryegrasses struggle without irrigation on the farm, so alternative grasses better adapted to dry conditions and Grass Grub pressure have been planted. “We have sown tall fescue into paddocks with higher soil fertility and use strict grazing management, while cocksfoot is used in more extensive paddocks with low soil fertility,” Trent explains.

As part of the pasture renovation programme, ryecorn and Supercruise Italian ryegrass are both used as break crops. About 100 hectares of ryecorn is sown annually in early March.

"We leverage the winter hardiness and post-grazing regrowth potential of ryecorn in order to meet feed demands," says Trent.

Recently, 105 hectares of Supercruise Italian ryegrass and Hilltop white clover has been incorporated into the grazing rotation to act as a 24-month forage crop. Supercruise offers more longevity than ryecorn, as pastures persist for at least two years before a permanent dryland pasture is sown.

The centre pivots are the engine house of Quailburn Downs with 200 hectares of well irrigated, productive paddocks. Of the 200 hectares, 20 hectares are Cleancrop™ Firefly kale and Cleancrop forage rape, 90 hectares are Quantum II tall fescue dominant pasture with the remaining area a ryegrass-based pasture mix. In spring 2020, Trent sowed a perennial ryegrass, Platform AR1 with Aurus cocksfoot, and results have exceeded expectations.

Recently sown, Quantica tall fescue will provide an early spring flush of growth to bolster feed supplies and has greater tolerance to grass grub than ryegrass, a pasture pest on Quailburn Downs. When compared to Quantum II tall fescue, Quantica also offers additional benefits such as leaf fineness and density, ideally suited to Quailburn Downs’ system. Trent is looking forward to seeing how the new Quantica tall fescue paddocks perform over the coming season.

Young cattle, R1 and R2 are fed tall fescue pastures in spring, then a cut of balage is taken. During December and January, cattle have another grazing on tall fescue paddocks before finishing hoggets from October to November. Along with cattle, tall fescue is a suitable feed for Merino sheep, as less black scour parasites are observed compared to ryegrass-based pastures.

When compared to ryegrass, tall fescue demonstrates greater persistence to dry summer conditions as its deep root system seeks out available moisture in the soil, making it a reliable feed source when irrigation is restricted.

Farm Manager and co-owner Trent Spittle in a paddock of Quantica tall fascue.

"I recently was digging out a ditch in the tall fescue paddock and noticed the root system had grown over 60 cm down into soil profile," explained Trent.

Tall fescue is slower to establish than ryegrass-dominated pastures, the clover/plantain content is more prominent in the first few years.

Quailburn Downs follow a pasture renovation programme, where tall fescue is sown after brassica crops. Paddocks are direct-drilled to minimise soil disturbance and soil loss from wind erosion. Soil pH is around 5.8 with good soil fertility at Olsen P 30. Application of nitrogen fertiliser is limited to 30 units in spring and autumn. Tall fescue is well-suited to Quailburn Downs and will remain an important part of the farm system according to Trent.

Meadow fescue

(Fesctuca pratensis)

FAMILY: *Gramineae*

Meadow fescue is very similar to perennial ryegrass, with high palatability when vegetative and a fibrous root system. Meadow fescue has a natural endophyte relationship with *Neotyphodium uncinatum*, an endophyte family that produces the alkaloid lolines. Distinguished from tall fescue by hairless auricles, it has no rhizomes or stolons. It is a winter-hardy species, but produces limited cool season growth in cooler regions.

Grazing management

Meadow fescue is a palatable, soft-leaved plant that can be vulnerable to overgrazing. Often sown with tall fescue to improve palatability of tall fescue.

Seeds and sowing rate

Seed weight: 500,000 seeds/kg (similar to diploid perennial ryegrass)

Sowing rate: As the dominant grass in a pasture mix, sowing rate is typically around 20-24 kg/ha. In a tall fescue pasture mix, sow 10-12 kg/ha of meadow fescue with 10-12 kg/ha of tall fescue

Nutritional value

High when managed in a vegetative state

Grazing tolerance

Highly palatable so vulnerable to overgrazing

Longevity

Perennial

Anti-quality feed factors

Nil

Brome grasses

Prairie grass *(Bromus willdenowii)*, grazing brome *(Bromus stamineus)* and pasture brome *(Bromus valdivianus)*

FAMILY: *Bromus*

Species range widely from shorter-lived prairie grass to more persistent grazing and pasture bromes.

Prairie grass is a large-leaved, large-tillered plant that offers winter/early spring growth and drought tolerance, persisting for 2-4 years depending on management and environment.

Grazing brome a perennial brome with finer leaves and is more densely-tillered when compared to prairie grass. Grazing brome is suited to lighter, free draining soils, providing good winter and early spring growth.

Pasture brome is a perennial medium-tillered brome providing spring/summer growth in summer dry areas but moderate winter growth.

Grazing management

During winter, avoid grazing in adverse conditions as all bromes are more susceptible to pugging damage.

Grazing brome with finer leaves and denser tillers is more suited to closer/harder grazing.

Seeds and sowing rate

Seed weight: 90,000 seeds/kg (prairie grass, grazing brome and pasture brome)

Sowing rate: 25-30 kg/ha (due to large seed size) at a depth of around 10-20 mm. All brome species are sensitive to cold temperatures and should be sown when soil temperatures are above 12°C

Nutritional value

Medium to high if maintained in a vegetative form, although stems/seed heads are more palatable than cocksfoot and tall fescue, feed quality is still low

Grazing tolerance

Medium

Longevity

Prairie grass – short-lived perennial; grazing brome/pasture brome – medium to long term perennial

Anti-quality feed factors

Nil

Phalaris

(Phalaris aquatica)

FAMILY: *Graminae*

A very deeply-rooted rhizomatous perennial grass with broad leaves suited to drier soils with moderate fertility. Phalaris offers good winter and early spring production, while summer production is dependent on rainfall.

Grazing management

Once established, phalaris can withstand hard grazing. However, allowing plants to recover between grazing will enhance persistence. Spelling (restricting grazing) phalaris pastures for 6-8 weeks during winter increases the density of the sward.

Seeds and sowing rate

Seed weight: 550,000 seeds/kg

Sowing rate: Usually sown at 1-4 kg/ha with perennial ryegrass, or with cocksfoot and tall fescue, and legumes. Germination percentage of phalaris can be low, so seeding rates need to be adjusted accordingly. Due to toxicity issues associated with alkaloids, it is not recommended as a sole grass in a pasture mix

Nutritional value

Nutritional value when reproductive is lower than ryegrass, so it is important to avoid production of stem/seed head through the spring and summer months with grazing pressure

Grazing tolerance

Ability to withstand hard grazing and set stocking

Longevity

Perennial

Anti-quality feed factors

Phalaris produces tryptamine alkaloids that can (under some circumstances) result in sudden death syndrome or phalaris staggers, with sheep at greater risk than cattle

Timothy

(Phelum pratense)

FAMILY: *Graminae*

Timothy is a perennial grass suitable for moist summer regions of New Zealand. The spring flush is slightly later than mid-flowering perennial ryegrasses, but can provide a high-quality pasture, although most Timothy is sown in combination with other grass species. Without endophyte, Timothy is particularly vulnerable to Argentine Stem Weevil pressure, limiting its use to a small number of regions throughout New Zealand.

Grazing management

Similar grazing management to perennial ryegrass as to increased palatability, harder grazing pressure and set stocking can reduce persistence.

Seeds and sowing rate

Seed weight: 2,500,000 seeds/kg

Sowing rate: Typically sowing at 1-3 kg/ha with other grasses (e.g. ryegrass) in a pasture mix. When sown as the sole grass component of a pasture mix, sowing rates range from 6-8 kg/ha

Nutritional value

Similar to perennial ryegrass but higher quality during the reproductive periods of growth

Grazing tolerance

Low – avoid hard grazing or set stocking

Longevity

Perennial

Anti-quality feed factors

Nil

PASTURE OPTIONS

Short Rotation/ Italian/ Annual Ryegrass

Farm type

Sowing rate

STANDARD SOWING RATE
22-28 kg/ha

SECONDARY COMPONENT OF PASTURE MIX
4-7 kg/ha

UNDERSOWING
14 kg/ha

Delish® TETRAPLOID SHORT ROTATION RYEGRASS

- More rapid, reliable establishment than diploid types
- High dry matter production throughout the year
- High palatability
- Excellent summer forage quality (low aftermath heading)
- Improved disease resistance
- Ideal for undersowing

Delish® is a high yielding, fine-leaved and densely-tillered tetraploid short rotation (hybrid) ryegrass bred for improved disease resistance, persistence and low aftermath heading. Not only is it a tasty tetraploid but also an Italian ryegrass crossed with a perennial ryegrass, providing you with the best attributes of each. Rapid, reliable establishment coupled with good early season growth, low aftermath heading for good summer feed quality and greater longevity than an Italian ryegrass.

Heading date

Early	Mid-season	Late	Very late
		Delish®: 9 days later than Nui	

Sowing and establishment

Delish® tetraploid short rotation ryegrass seed is heavier than diploid seed, so ideally should be sown at a 40% higher rate than diploid cultivars. Sow at a minimum of 22 kg/ha in a pasture mix with Superstrike® treated clover or added to a perennial pasture mix such as Base tetraploid perennial ryegrass at 4-7 kg/ha. In an undersowing situation, sow Superstrike treated seed at 14 kg/ha. Delish performs best on sites with reasonable soil moisture and medium to high soil fertility.

Grazing management

As with all grasses, overgrazing of Delish should be avoided. Given the higher palatability of Delish, stock may graze it to lower residuals than diploid ryegrasses.

Farm type

Without Endophyte

Sowing rate

STANDARD SOWING RATE

20 kg/ha

SECONDARY COMPONENT OF PASTURE MIX

4-7 kg/ha

UNDERSOWING

12 kg/ha

Maverick GII

SHORT ROTATION RYEGRASS

- High annual yield
- Excellent summer quality (low aftermath heading)
- Robust, dense sward with exceptional cool season growth
- Very good disease resistance and persistence
- Suitable for high quality silage
- Ideal for undersowing

Maverick GII is a diploid, short rotation ryegrass providing excellent cool season growth. It contains both Italian and perennial ryegrass genetics with the ability to persist as well as some low endophyte perennial ryegrasses. Maverick GII is the perfect grass for high performance stock or for silage cropping.

Heading date

Early	Mid-season	Late	Very late
		Maverick GII: 17 days later than Nui	

Sowing and establishment

Maverick GII short rotation ryegrass can be sown at 15-25 kg/ha as a pure sward with Superstrike® treated clover or added to a perennial pasture mix at 4-7 kg/ha. In an undersowing situation, sow Superstrike® treated seed at 10-15 kg/ha.

Grazing management

Maverick GII is best suited to rotational grazing. For improved persistence, avoid hard grazing over summer.

Dry matter production comparison of Maverick GII, Maverick Gold and Tabu (expressed as a percentage of Tabu)

The following dry matter data compares Maverick GII, Maverick Gold and Tabu (expressed as a percentage of Tabu). Maverick GII, as seen below, establishes well and has excellent spring and summer dry matter production for a short rotation ryegrass.

	Establishment	Winter	Spring	Summer	Autumn	Total
Maverick GII	101	97	108	106	102	104
Maverick Gold	98	95	103	102	91	99
Tabu	100	100	100	100	100	100

Dry matter production data is an average of five 15 month trials (three from Kimihia Research Centre, Canterbury and two from Gordonton Research Centre, Waikato). The trials were established in autumn 2003, autumn 2004 and autumn 2005 (Kimihia only) and concluded in autumn 2004, autumn 2005 and autumn 2006, respectively.

Farm type

Sowing rate

STANDARD SOWING RATE

22-28 kg/ha

SECONDARY COMPONENT OF PASTURE MIX

4-7 kg/ha

UNDERSOWING

15+ kg/ha

Tom Buckley
Farm Manager
Owl Farm, Cambridge

"Lush AR37 has been a great option to bulk paddocks up for 18 months before going into crop the following spring. It accumulates bulk volume without compromising on quality (even in January) – and the cows love it!"

Lush TETRAPLOID ITALIAN RYEGRASS

- Ideal for undersowing or sown as a pure sward
- Quick to establish and short time to first grazing
- Exceptional summer yield and quality (low aftermath heading)
- Strong second year production – better than traditional Italian ryegrasses, offering quality feed for longer
- High rust tolerance for better dry matter yields and increased palatability

Lush tetraploid Italian ryegrass – a luscious quality forage. Rarely has a tetraploid Italian ryegrass shown such superb summer feed quality (low aftermath heading), high yield potential and persistence. An ideal option for undersowing into those opened up and thinned out pastures, as part of a pasture mix or sown as a pure sward. Lush is quick to establish with a short time to first grazing. A good tolerance to rust supports higher dry matter yields and increased palatability for grazing animals.

Aftermath heading

Lush – summer quality. Low aftermath heading means Lush with AR37 endophyte provides livestock with exceptional quality summer feed.

Persistence

Lush tetraploid Italian ryegrass comes with AR37 endophyte. Lush AR37 showed greater persistence than Feast® II in PGG Wrightson Seeds trials in both Canterbury and Waikato.

Animal information

It should be noted that Lush with AR37 endophyte may cause ryegrass staggers. For more information on AR37, see pages 118-120 and 122-123.

Sowing and establishment

Lush AR37 is perfect for undersowing into dairy pastures and intensive sheep/beef systems or as part of a pasture mix. For undersowing, Lush AR37 should be sown at a minimum of 15 kg/ha using Superstrike® treated seed.

Dry matter production comparison of Lush AR37 versus Feast® II (expressed as a percentage of Feast® II)

Year one

Entry	Establishment	Winter	Spring	Late spring	Summer	Autumn	Total
Lush AR37	102	103	95	99	118	133	106
Feast® II	100	100	100	100	100	100	100

Year two

Entry	Winter	Spring	Late spring	Summer	Autumn	Total
Lush AR37	105	97	106	146	163	114
Feast® II	100	100	100	100	100	100

Data are the mean from six completed trials sown in Puturau, Waikato (3) and Lincoln, Canterbury (3). Completed trials ran for two years. Data was analysed using Genstat.

Farm type

Without Endophyte

Sowing rate

STANDARD SOWING RATE

15-25 kg/ha

UNDERSOWING

10-15 kg/ha

Supercruise ITALIAN RYEGRASS

- Robust diploid Italian ryegrass
- Great late spring/early summer dry matter production
- High yields of quality feed
- Super-fast establishment

Supercruise is a fast-establishing diploid Italian ryegrass for the New Zealand market. Displaying all the required attributes of a high quality diploid Italian ryegrass, Supercruise has the endurance to go the distance. If you are looking for a cost-effective, short term pasture or a reliable option for undersowing into worn out perennial pastures, Supercruise is the grass for you.

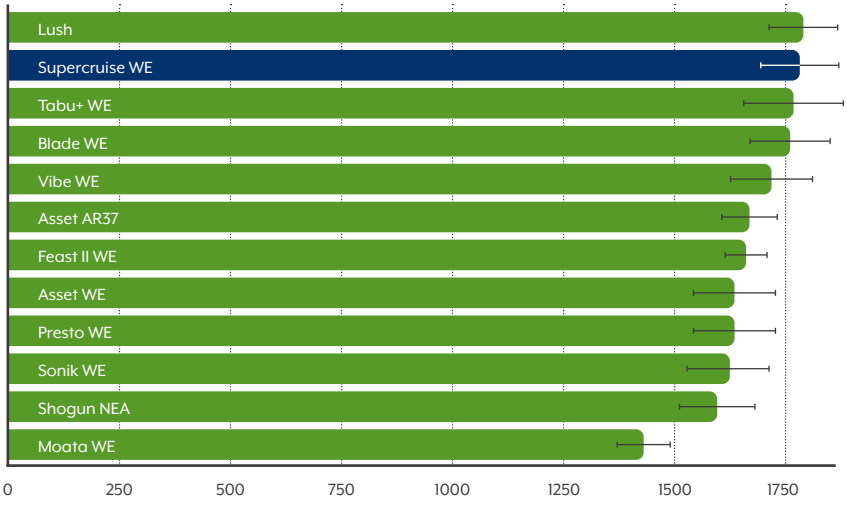
Sowing and establishment

Supercruise Italian ryegrass may be used as a specialist feed sown at a minimum of 18 kg/ha or undersown into existing pasture at a minimum of 10-15 kg/ha with Superstrike® treated seed to improve establishment.

Grazing management

Supercruise Italian ryegrass is best suited to rotational grazing. For best persistence, avoid hard grazing over summer.

National forage variety trials: Italian ryegrass autumn yield



NFVT summary 1991-2020 (August 2020)

Farm type

Without Endophyte

Sowing rate

STANDARD SOWING RATE

22-28 kg/ha

UNDERSOWING

15+ kg/ha

Feast® II TETRAPLOID ITALIAN RYEGRASS

- High dry matter production
- Ideal for high quality silage
- Outstanding summer quality for a high yielding Italian ryegrass (low aftermath heading)
- Enhanced palatability and acceptance
- Superior disease resistance and enhanced persistence
- More rapid and reliable establishment than diploid types

Feast® II is a high yielding, tetraploid Italian ryegrass with strong winter and early spring dry matter production followed by low aftermath heading for outstanding summer quality. The tetraploid nature of Feast II Italian ryegrass can lead to improved animal performance from increased dry matter intakes due to enhanced palatability and acceptance by grazing animals. Feast II is suitable as a specialist crop for grazing animals or silage production, while also being ideal for undersowing into existing pastures for a flush of winter growth of high quality feed. Feast II can persist for 2-3 years in summer moist environments with low insect pressure.

Sowing and establishment

Sow at a minimum of 22 kg/ha as a pure sward or a minimum of 15 kg/ha using Superstrike® treated seed in an undersowing situation.

Grazing management

Feast® II tetraploid Italian ryegrass is best suited to rotational grazing. For best persistence, avoid hard grazing over summer. Feast II is primarily used to significantly increase the winter and spring production of a pasture. For spring conservation, back fence during winter break feeding.

Farm type

Without Endophyte

Sowing rate

STANDARD SOWING RATE

25+ kg/ha

UNDERSOWING

15+ kg/ha

Winter Star II

TETRAPLOID ANNUAL RYEGRASS

NEW ZEALAND BRED

- Fast to establish
- Ideal between maize crops
- Autumn sow for high yields of quality autumn, winter and spring feed
- Quick, early feed for grazing animals or silage production
- Ideal for undersowing into existing pasture
- Improved spring production and feed quality

Winter Star II tetraploid annual ryegrass is suitable for quick winter feed with improved spring quality, making it ideal for silage and hay production. Winter Star II is high yielding with fast establishment, giving excellent autumn growth. As a tetraploid, Winter Star II has excellent feed quality and rapid establishment.

Sowing and establishment

Winter Star II should be sown as a pure sward at a minimum of 25 kg/ha, using higher rates for more winter feed, or at a minimum of 15 kg/ha using Superstrike® treated seed in an undersowing situation.

Grazing management

It is recommended that a rotational grazing system be used when feeding Winter Star II tetraploid annual ryegrass to optimise regrowth potential post-grazing.

Benefits of Winter Star II tetraploid annual ryegrass as a specialist grass between maize silage crops

	Winter Star II	Tama
Establishment (kgDM/ha)	1,539	1,382
Winter (kgDM/ha)	2,957	2,397
Early spring (kgDM/ha)	3,152	2,972
TOTAL (kgDM/ha)	7,648	6,751
Cultivar price ($/kg)	$4.59	$2.71
Seed cost/ha ($/ha)	$1,38	$81
Profit ($/ha)	$1,468	$1,337
Profit over Tama ($/ha)	$131	

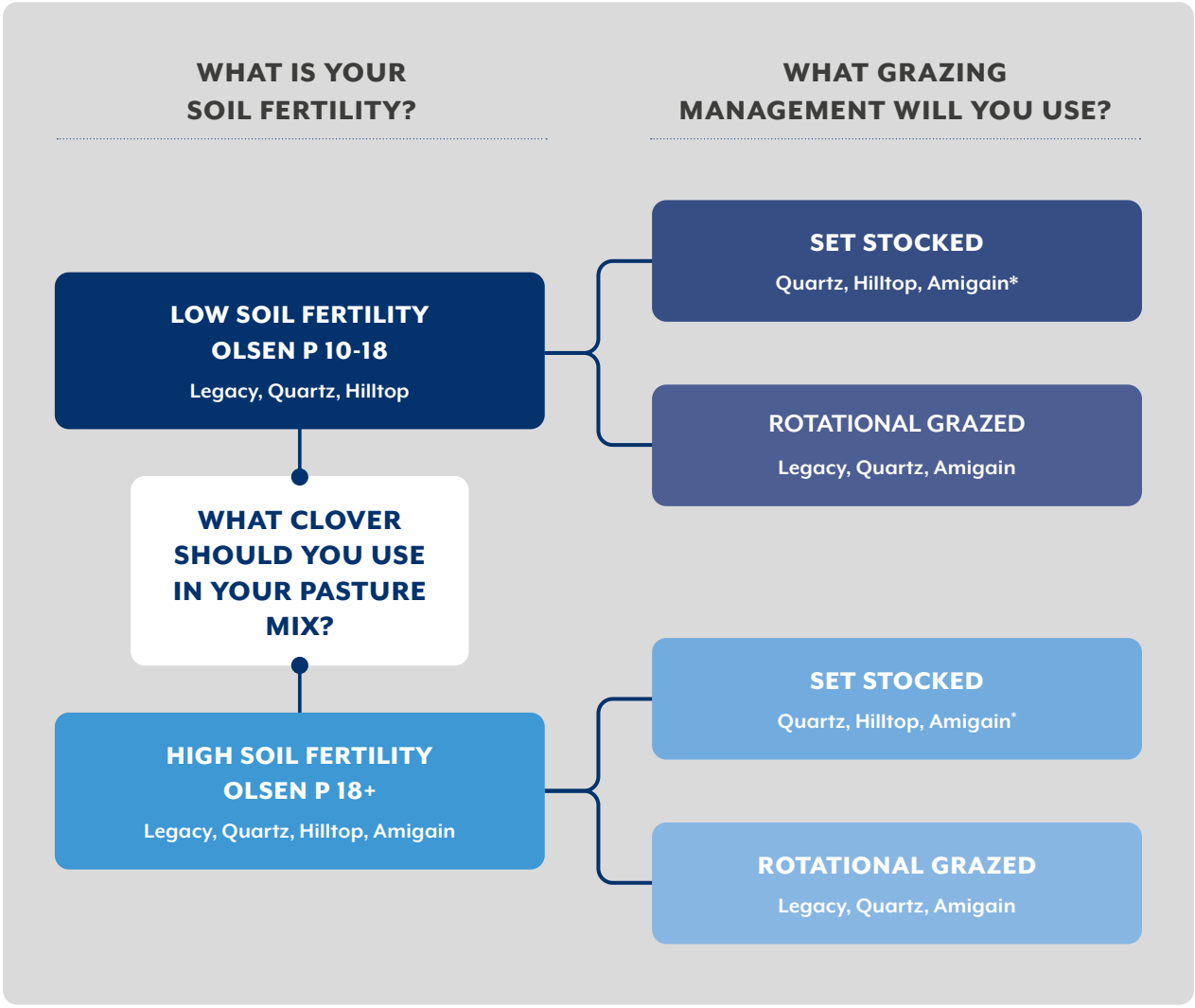
The above table is a combination of three winter feed trials sown in autumn 2011, 2012 and 2014. Establishment dry matter production includes March-May, Winter includes June, July and early spring includes August and September. Seed was sown bare at a rate of 30 kg/ha. Dry matter is valued at $0.21/kgDM standing. Cultivar prices are the estimated North Island retail price for bare Winter Star II and Tama seed. Prices exclude GST.

PASTURE OPTIONS

Clovers and Herbs

Clover selection guide

This diagram is intended as a guide only. For specific recommendations on the clovers best suited for your farming system, contact your local seed retailer, local PGG Wrightson Seeds Sales Agronomist (see page 261) or call **0800 805 505**.



**Set stocking of Amigain red clover should be limited to short periods, extended periods can reduce persistence.*

WHITE CLOVER
(Trifolium repens)

White clover is the most important and widely-grown legume in New Zealand pastures, suited to a wide range of soil types and environmental conditions. As a species, white clover has a fibrous spread and persists in a pasture by the production, branching and rooting down of stolons that run across the soil surface. White clover offers high feed quality, improved pasture management and the ability to fix nitrogen (N) at rates of 25 kgN per tonne of dry matter grown.

Types of white clover

There is a wide range of white clover types, ranging from smaller-leaved, prostrate types with high stolon density to larger-leaved, more erect types. Small-leaved varieties with higher stolon density and a more prostrate growth habit (such as Hilltop) enhance persistence in extensive sheep and beef pastures that are often closely grazed to low residuals for extended periods of time.

At the other end of the spectrum, large-leaved varieties with longer petioles (such as Legacy) are better suited to dairy or intensive cattle grazing systems. In these systems, large leaves and long petioles allow Legacy to compete with high-performing modern grasses in rotational grazing systems with higher pre-grazing residuals. Previously there has been a strong genetic link between high stolon density, small leaf size and lower dry matter yield; however, Legacy retains a higher stolon density than other large-leaved white clovers while maintaining high dry matter production.

Soil and fertility requirements

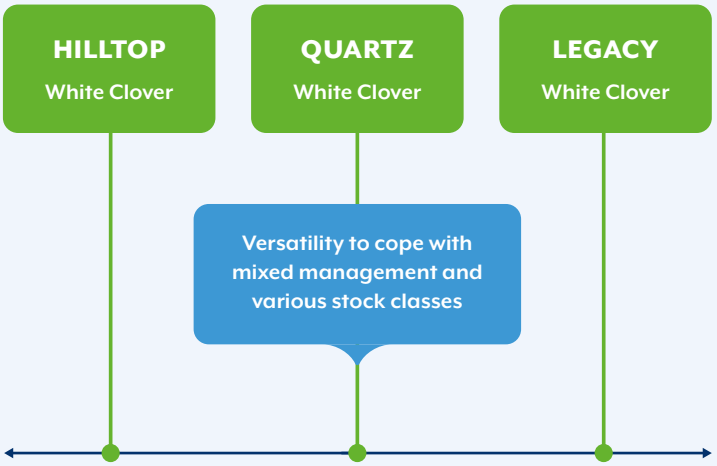
White clover is well-suited to a range of soil types, but is not tolerant of waterlogging and offers limited drought tolerance. When increased drought tolerance is required, consider red clover or annual clovers like subterranean clover. Adequate phosphate, potassium, sulphur, molybdenum and pH (5.8-6.2) will greatly increase clover presence and productivity in pastures.

Sowing and early grazing management

Sow in spring or autumn when soil temperatures are above 10°C. At lower temperature, clover establishment will be very slow and seedlings may be outcompeted by grass components of pasture mixes. For best establishment, sow white clover at 5-15 mm deep (slightly shallower than perennial ryegrass).

Following establishment, lightly graze as soon as seedlings no longer pull out to avoid grasses or herbs out-competing seedling clovers. Avoid high pasture covers, hay or silage cuts in the first 12 months to aid clover establishment and spreading via rhizomes.

CHOOSING THE RIGHT WHITE CLOVER



RED CLOVER *(Trifolium pratense)*

Red clover is another important legume in New Zealand farming systems, either in pasture mixes or as a speciality multi-year crop. In comparison to white clover, red clover is taprooted and does not spread via stolons. This deep taproot gives red clover a greater tolerance to summer dry conditions and provides significantly higher dry matter production during these periods than white clover.

Types of red clover

Red clover types range from traditional taller, more erect types to more prostrate modern varieties. Taller, more erect types are more suited to hay or silage production systems and are generally shorter-lived. Modern varieties like Amigain are more prostrate to tolerate grazing and have been bred to persist significantly longer in both pasture mixes and specialist red clover stands.

Formononetin is an oestrogenic compound in red clover that can have negative impacts on ewe fertility if fed prior to mating. Although Amigain has been selected for lower levels of formononetin, care should still be taken when feeding to ewes prior to mating. Pure stands of red clover are still considered high risk.

Soil and fertility requirements

Soil and fertility requirements are similar to white clover (see above), however red clover offers improved drought tolerance due to its taproot.

Sowing and grazing management

Sowing depth and optimum soil temperatures are similar to white clover, whereby red clover favours a shallow sowing depth (5-15 mm) and soil temperatures at 10°C and rising at the time of sowing.

Following sowing, light grazings should happen when seedlings no longer pull out. For pure red clover stands, allow seedlings to develop a root system and get to approximately 25 cm before grazing. Once established, rotationally graze to enhance persistence and avoid excessive stem growth that can limit forage quality.

Farm type

Sowing rate

4-6 kg/ha

Superstrike Legacy with grass and herb components

Seed weight

1,400,000 seeds/kg

Inoculum type

Group B

Wayne Nichol

Extension Agronomist
and Nutritionist,
PGG Wrightson Seeds

"Legacy is a New Zealand bred large leaf white clover that has been selected for improved adaptation to modern pastoral systems relative to traditional cultivars such as Kopu II. Published results prove that Grasslands Legacy, when sown with ryegrass, across a number of regional sites had significantly increased seasonal and annual yield under grazing relative to a number of comparable cultivars including Kopu II."

GRASSLANDS Legacy LARGE LEAF WHITE CLOVER

- Latest generation New Zealand bred white clover
- Bred to persist and perform in the modern pasture sward
- High performing, large leaf clover
- Dry matter yield that strengthens with time
- Large leaf captures more sunlight, leading to higher yields
- Increased yield leads to more nitrogen (N) being fixed, reducing the need for N fertiliser application
- Good option for rotational grazing

Grasslands Legacy is a high performing, large leaf white clover well-suited to rotational grazing in both dairy and drystock cattle systems. Dry matter yield strengthens over time. Its vigorous growth rate improves its tolerance to Clover Root Weevil. A tall growth habit ensures Legacy can persist and perform in a modern pasture sward, making it easier for animals to graze.

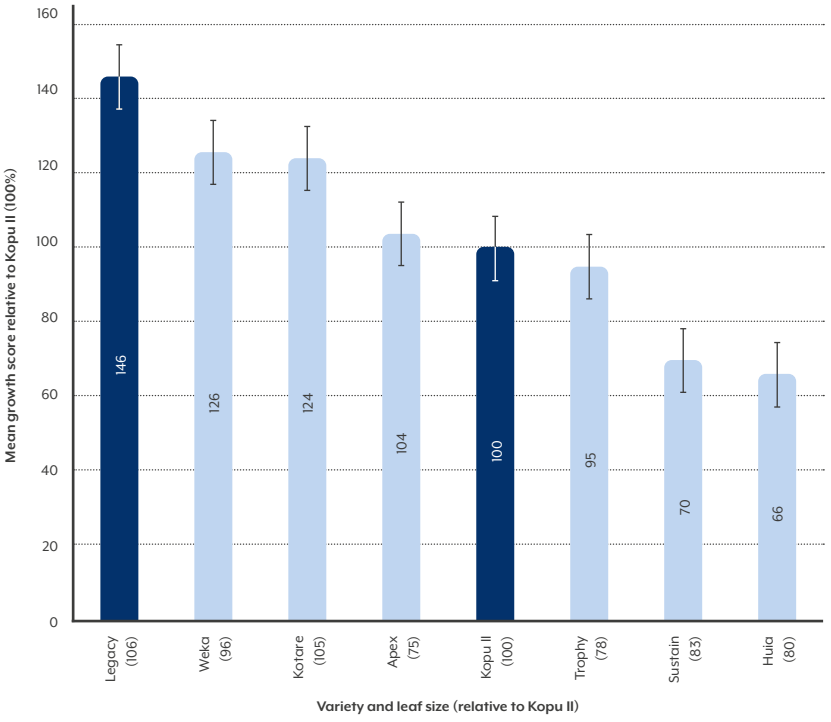
Sowing and establishment

Legacy white clover can be sown in autumn or spring at 4-6 kg/ha and is best sown with erect growing species such as ryegrass and tall fescue. The use of Superstrike® clover seed treatment will improve seedling establishment. For best performance, Legacy should be lightly grazed frequently during the establishment phase.

Grazing management

Due to its erect growth habit, Legacy is ideally suited for rotational grazing systems.

Performance of clover cultivars in perennial ryegrass sward under beef cattle grazing, Manawatu



Trial conducted by AgResearch in Manawatu over four years (2011-2015) under rotational grazing. Clovers were grown with diploid perennial ryegrass containing AR37 endophyte.

Farm type

Sowing rate

4-6 kg/ha

Superstrike Quartz with grass and herb components

Seed weight

1,400,000 seeds/kg

Inoculum type

Group B

GRASSLANDS

Quartz MEDIUM LEAF WHITE CLOVER

NEW ZEALAND BRED

- Excellent fit across multiple farm systems
- Excellent dry matter yields
- Versatile option that has broad adaptability across a range of conditions
- Used in pasture, specialist and renovating pasture mixes
- Excellent persistence from high stolon density (relative to leaf size)

Grasslands Quartz is a persistent, medium leaf white clover with broad adaptability across environments and farm systems. Quartz performs well under dairy, sheep and beef grazing management. When compared to Bounty white clover, Quartz offers higher dry matter yields and increased stolon density for even greater persistence. Quartz has been trialled throughout New Zealand and performed well.

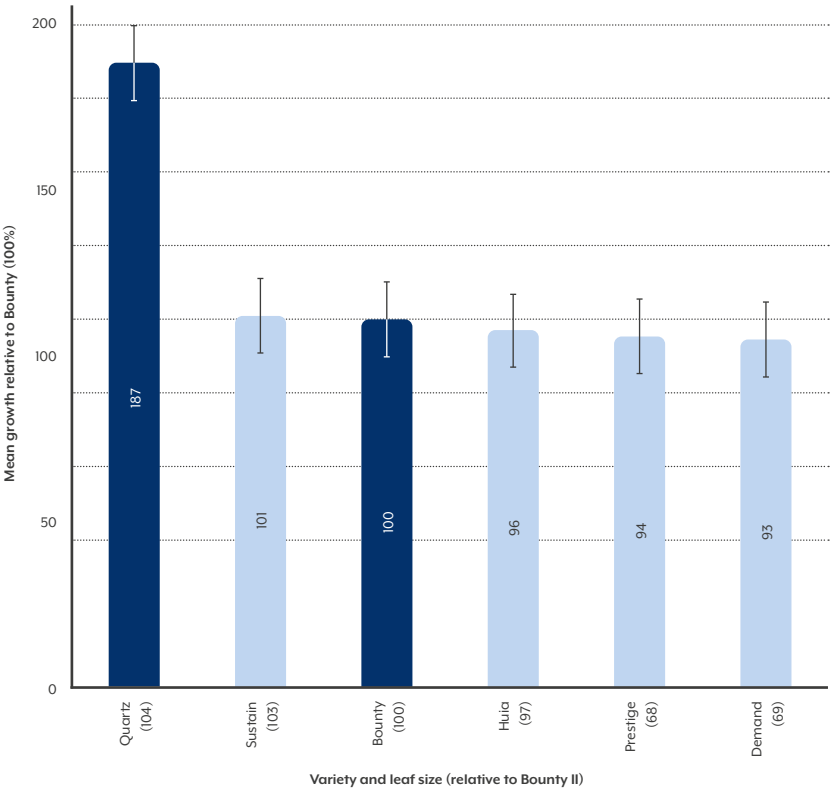
Sowing and establishment

Quartz white clover can be sown at 4-6 kg/ha following recommended pasture establishment procedures. Quartz performs best in moderate to high soil fertility. The use of Superstrike® clover seed treatment will improve seedling establishment.

Grazing management

Quartz will provide best results under rotational grazing systems for sheep, cattle and deer. It can cope with short periods of set stocking and oversowing situations.

Performance of white clover cultivars in perennial ryegrass sward under cattle grazing



Trial conducted by AgResearch in Manawatu over four years (2011-2015) under rotational grazing. Clovers were grown with diploid perennial ryegrass containing AR37 endophyte.

Farm type

Sowing rate

4-6 kg/ha

Superstrike Hilltop with grass and herb components

Seed weight

1,400,000 seeds/kg

Inoculum type

Group B

GRASSLANDS Hilltop SMALL-MEDIUM LEAF WHITE CLOVER

- Good persistence due to high stolon density, enabling it to tolerate a set stocking grazing system
- New Zealand bred to be competitive against invasive grasses such as Browntop
- Good option for low soil fertility and summer dry conditions
- Well-suited to wet and dry conditions of hill and high country grazing systems
- Oversowing option with Prillcote® seed treatment

Grasslands Hilltop was bred to cope with more challenging environments, from variable soil fertility to variable moisture availability, it is a very robust and persistent small-medium leaf white clover. When compared to Tahora II, Hilltop has a higher stolon density that has led to increased persistence. A breeding focus for Hilltop was to promote competitiveness against invasive grasses such as Browntop to help it survive in the reverted pastures often found in New Zealand.

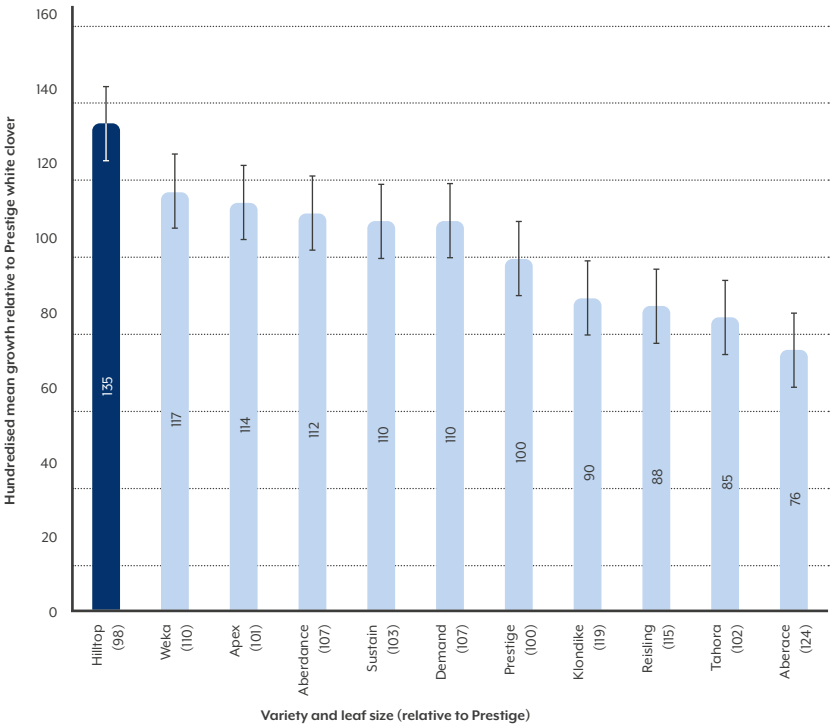
Sowing and establishment

Hilltop white clover can be established at 4-6 kg/ha following recommended pasture establishment procedures. The use of Superstrike® clover seed treatment will improve seedling establishment. It is also an ideal option for oversowing with Prillcote® seed treatment.

Grazing management

The grazing method used for Hilltop white clover will depend on the grass and herb components included in the pasture mix. It has been bred to cope with intensive sheep grazing, but can persist under a number of situations and stock classes.

Agronomic performance of clover cultivars in dryland Canterbury under sheep grazing (2014-2018)



Trial conducted at AgResearch Lincoln (2014-2018) with clovers sown as part of a mixed sward under sheep grazing. LSD (5%) = 19%; differences between cultivars must exceed the LSD to be statistically significant.

Oversowing overview

Clover is a important part of hill country pastures, as it improves feed value leading to enhanced animal performance and fixes nitrogen to bolster grass growth and quality. Top-performing hill country pastures contain at least 20% clover, yet many hill country paddocks have as little as 2% clover present. Fertiliser applications offer an opportunity to apply both fertiliser and clover seed at the same time, with the aim of increasing clover establishment in pastures.

Where should I oversow?

In dry regions the areas that give the best returns are usually south-facing slopes that are less than 35 degrees with good subdivision. Consider the soil fertility of hill blocks: soils with adequate phosphate, potassium, sulphur, molybdenum and pH (5.8-6.2) will enhance clover growth and presence.

When should you oversow?

Oversown seeds are vulnerable to the extremes of temperature and moisture availability. In dryland North Island environments, oversowing is completed in summer/early autumn when soil moisture is present and before soil temperatures decline significantly.
In contrast, South Island oversowing generally occurs in late winter/early spring to avoid unfavorable establishment during colder autumn and winter conditions.

Preparation for oversowing

Prior to oversowing, careful planning should be undertaken. Paddocks should be soil tested to allow blocks with higher soil fertility to be targeted for autumn oversowing.

During the season prior to oversowing, hard graze pastures to remove excess vegetation to allow seed to come into contact with the soil and support seedling establishment.

What species should I oversow?

Several clover species are available to fill a range of conditions, with white clover, red clover, balansa clover and subterranean clover (autumn) all suitable for oversowing.

Perennial white clovers, including Hilltop, are a good starting point for most oversowing projects. White clovers are well-suited to south-facing slopes with higher moisture levels.

Drier north-facing slopes are well-suited to annual clovers, including Bindoon subterranean clover and Taipan balansa clover, but do require specific management to set seed and establish a ‘seed bank’ for future years.

Seed treatment

Prillcote® seed treatment is recommended for aerial oversowing to improve ballistics and facilitate seed in reaching its target on the soil surface. Prillcote also contains rhizobia bacteria for fixing nitrogen, fungicides to protect against damping off diseases, a bird repellent and lime base that provides localised pH correction around the seedling.

Clover seed can be applied aerially with Superstrike® treatment, which provides adequate ballistics for seed to soil contact. Clover Superstrike® seed treatment includes fungicides, insecticides and nutrients to enhance seed germination and survival. Superstrike treated clover also contains rhizobia bacteria for fixing nitrogen.

Farm type

Sowing rate

PERENNIAL PASTURE MIX

4-6 kg/ha

Superstrike Amigain

SHORT-TERM PASTURE MIX

6-8 kg/ha

Superstrike Amigain

RED CLOVER STAND

10-12 kg/ha

Superstrike Amigain with 2-3 kg/ha Superstrike Quartz white clover

Seed weight

500,000 seeds/kg

Inoculum type

Group B

GRASSLANDS Amigain RED CLOVER NEW

NEW ZEALAND BRED

- Bred to persist and perform in both pasture mixes and pure red clover stands
- Semi-prostrate growth habit to enhance persistence
- Excellent quality suitable for driving animal production
- Selected for a more fibrous root system
- Lower formononetin (oestrogen) levels than older cultivars (see graph on page 167)
- Increased Clover Root Weevil tolerance compared to white clover
- Latest generation, New Zealand bred red clover selected from Georgian, Portuguese and Spanish genetics

Amigain is the latest generation red clover bred in New Zealand for increased persistence and performance in permanent pastures, high performance short-term pastures, silage mixes and pure sward red clover stands.

In a pasture mix, Amigain provides spring, summer and autumn productivity ideal for increased animal performance, enhancing pasture management and fixing nitrogen. As a specialist multi-year crop, Amigain provides high quality feed ideal for liveweight gain and/or improved condition scores of priority stock classes in sheep and deer systems.

Sowing and establishment

Grasslands Amigain red clover can be sown in early autumn or spring at 4-6 kg/ha (Superstrike®) in permanent pasture mixes with white clover, ryegrass, tall fescue or cocksfoot. During the establishment phase, grazing should be frequent and light to open pasture swards and allow establishment of legume content.

As a specialist short-term mix for animal production and/or high quality silage (2-3 years), Amigain red clover can be used at higher sowing rates of 6-8 kg/ha (Superstrike®) in association with other options such as Delish® AR1 short rotation ryegrass, Lush AR37 Italian ryegrass, Puna II chicory and/or Quartz white clover.

Red clover stands should be sown at 10-12 kg/ha (Superstrike®) with 2-3 kg/ha (Superstrike®) of either Quartz or Legacy white clover to enhance ground cover.

Grazing management

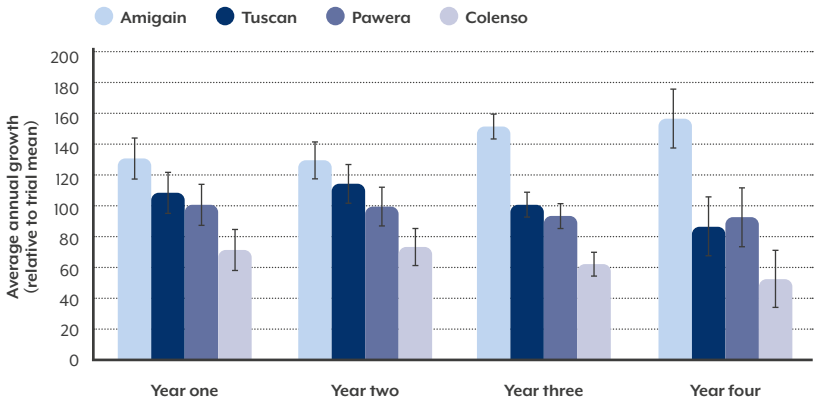
In a pasture mix, rotationally graze Amigain or set stock for short periods of time to maximise regrowth and persistence. To maximise forage quality, avoid stands exceeding 20-25 cm tall and graze to a 4 cm residual.

Amigain trial results

PERFORMANCE OF AMIGAIN RED CLOVER IN A PERENNIAL RYEGRASS SWARD

When trialled in a mixed perennial ryegrass sward at Aorangi, Palmerston North (2012-2015) under beef cattle grazing, Amigain persisted extremely well, with relative yield strengthening over time as the performance of traditional cultivars declined.

Performance of red clover varieties in a perennial ryegrass sward

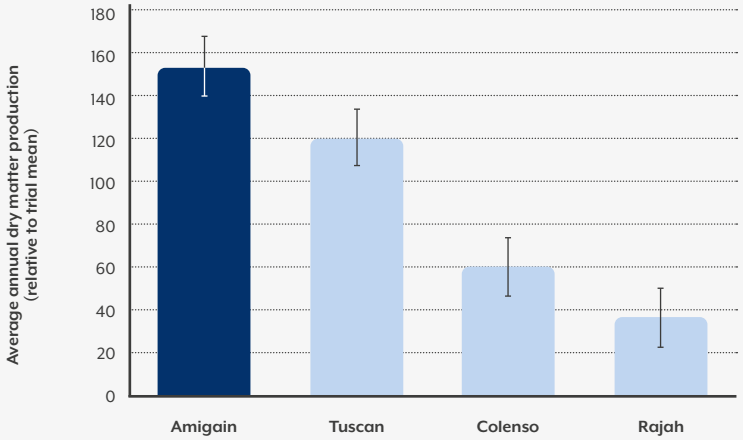


Aorangi, Palmerston North (2012-2015)

PERFORMANCE OF AMIGAIN SOWN AS A PURE SWARD

When trialled as a pure sward of red clover at Kerikeri under mixed sheep and beef grazing, Amigain produced the highest average yield over three years (2017-2019). A significant contributing factor to Amigain's success was its persistence and production in the second and third years of evaluation.

Performance of red clover varieties sown as a pure sward

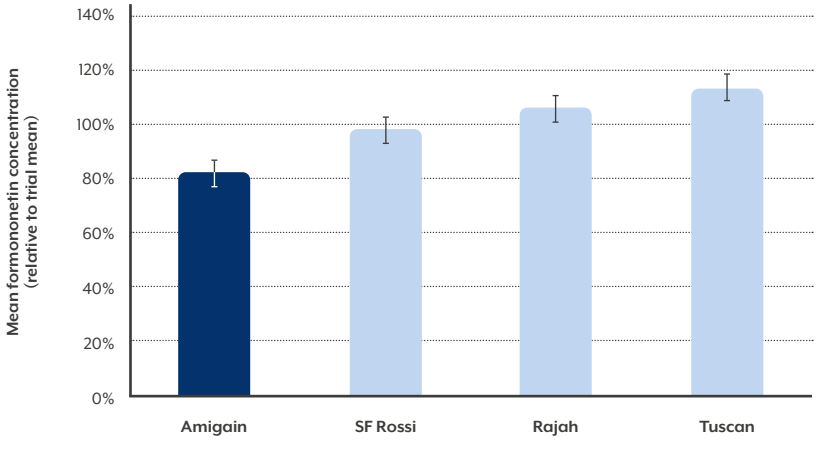


Kerikeri, Northland (2017-2019)

FORMONONETIN (OESTROGEN) LEVELS

Formononetin is an oestrogenic compound in red clover that can have negative impacts on ewe fertility if fed prior to mating. Amigain has been selected for lower levels of formononetin. Trial testing completed on 11 sampling dates (2016-2018) in Lincoln, Canterbury, demonstrated Amigain to have significantly lower formononetin levels than SF Rossi, Rajah and Tuscan.

Average formononetin concentration (% dry weight) of red clover varieties



Lincoln, Canterbury (2016-2018)

Farm type

Sowing rate

STANDARD PASTURE MIX

4-6 kg/ha

Prillcote or Superstrike

SPECIALIST STAND

8-12 kg/ha

Superstrike

Seed weight

550,000 seeds/kg

Inoculum type

Group C

Bindoon SUB CLOVER

- Highly productive, early to mid-season subterranean clover
- Suited to summer dry conditions with well-drained soils
- Resistance to Red Legged Earth Mite
- Excellent seed set for increased persistence

Subterranean clover *(Trifolium subterraneum)* is a prostrate annual clover well-suited to true dryland environments where white clover struggles to persist.

Bindoon was bred to replace traditional sub clover varieties and is recognised for its cool season productivity, high seed production and dense seedling regeneration.

Bindoon sub clover displays a very prostrate growth habit and produces a low, dense sward. Although relatively soft-seeded, it sets sufficient seed to ensure the reliable regeneration of plant populations.

Sowing and establishment

Bindoon sub clover is generally established via oversowing or drilling when soil moisture is present and before temperatures decline significantly. Fertiliser applications offer an opportunity to apply both fertiliser and sow clover seed at the same time. Consider the soil fertility of hill country blocks: soils with adequate phosphate, potassium, sulphur, molybdenum and pH (5.8-6.2) will enhance clover growth and persistence.

After sowing, there should be only light grazing until seedlings are firmly established and cannot be pulled out or trampled by stock. This is usually about six weeks after germination.

Grazing management

During its early stages of development, Bindoon should not be heavily grazed. However, once mature, the stocking rates can be increased. As with all sub clovers, grazing up to flowering will improve seed set. Once flowering begins, stocking rates should be reduced to allow for maximum seed production.

Following sowing paddocks should be allowed to set seed about every 5-10 years to maintain a productive seed bank. Paddocks can be walked in September/October to assess sub clover populations. If patches are more than 2 m apart in a straight line, it is generally worth allowing the paddock to set seed.

When the paddock contains large areas with no sub clover, oversowing or drilling in autumn is generally required to establish a population.

Farm type

Sowing rate

4-6 kg/ha

Prillcote or Superstrike

Seed weight

850,000-1,400,000 seeds/kg

Inoculum type

Group C

Taipan BALANSA CLOVER

- Mid-season annual clover providing early spring feed
- Excellent production - increased winter/early spring production compared to sub-clover cultivars
- Good adaptability across a wide range of soil types and pH levels
- Ability to tolerate periods of waterlogging
- Suited to pasture mixes with Winter Star II, Feast II®, Lush AR37 and Supercruise ryegrasses

Balansa clover (*Trifolium balansae*) is an annual clover offering strong spring production, excellent quality and the ability to tolerate waterlogged soils.

Taipan is a mid-maturing balansa clover with high levels of hard seed, allowing for flexibility when seasons are dry. Taipan can perform in various soil types and can grow in areas of medium rainfall with excellent waterlogging tolerance. With high dry matter production, Taipan can be grown for quality hay or as part of a perennial pasture system.

Sowing and establishment

Taipan balansa clover is typically sown at 4-6 kg/ha in autumn with pasture mixes that have grasses and other clovers included or can be used with short-term forage options (such as ryegrasses including Winter Star II and Supercruise) in autumn to boost spring growth and quality. Taipan can also be added at 4-6 kg/ha with spring-sown cereals, Italian ryegrasses (such as Supercruise/Feast® II/Lush) and forage brassicas to produce high quality feed in spring/early summer.

Grazing management

The first grazing of pasture mixes with Taipan should be light and occur once seedlings are firmly established and cannot be pulled out or trampled by grazing stock. This is usually about 6 weeks or more after sowing. Due to the degree of seed-hardiness of balansa, some seeds will continue to germinate over a period of time. If allowed to set-seed in the first season, it will continue to contribute to the pasture sward.

Taipan in a pasture mix with Lush AR37 (refer page 154 for more information on Lush AR37).

Persian clover

(Trifolium resupinatum)

FAMILY: *Leguminosae*

An annual clover capable of producing high spring yields. Often sown in pasture mixes with short-term ryegrasses and cereals in the autumn. Flower stems are hollow and high quality, but are generally grazed and not left to set seed.

Grazing management

Suitable for winter grazing but rotationally graze to post-grazing residuals of 2-3 cm (winter) and 4-5 cm (spring) to avoid over grazing, which will remove developing stems.

Seeds and sowing rate

Seed weight: 800-900,000 seeds/kg

Sowing rate: 6-8 kg/ha

Inoculum type: Group C

Nutritional value

High

Grazing tolerance

Moderate – avoid overgrazing which will remove developing stems

Longevity

Annual

Anti-quality feed factors

Bloat can occur in cattle. Pure swards have been associated with photosensitisation in sheep

Crimson clover

(Trifolium incarnatum L.)

FAMILY: *Leguminosae*

Crimson clover is an upright annual clover growing to a height of 0.6 m, providing significant spring growth but limited winter production. It prefers well-drained soils and does not tolerate waterlogging. Consider persian or balansa clovers if waterlogged soil is expected.

Grazing management

It can be grazed heavily during periods of active growth. In spring, grazing pressure should be reduced if intended for silage or hay production.

Seeds and sowing rate

Seed weight: 250,000 seeds/kg

Sowing rate: 8-10 kg/ha when sown as a pure sward or 2-4 kg/ha in pasture mixes

Inoculum type: Group C

Nutritional value

High

Grazing tolerance

Medium - high

Longevity

Annual

Anti-quality feed factors

Bloat can be associated with pure swards

Strawberry clover

(Trifolium fragiferum)

FAMILY: *Leguminosae*

Strawberry clover is a prostrate stoloniferous perennial clover suited to saline soils, offering greater drought and heat tolerance than white clover. Strawberry clover is also very tolerant of lower soil fertility and waterlogging.

Grazing management

Seed vigour is generally low, requiring light grazing through the establishment phase. Once established, strawberry clover can tolerate close, continuous grazing due to its prostrate growth habit and stoloniferous nature.

Seeds and sowing rate

Seed weight: 666,000 seed/kg

Sowing rate: 3-6 kg/ha as part of pasture mix

Inoculum type: Group B

Nutritional value

High

Grazing tolerance

It can tolerate heavy grazing pressure once established

Longevity

Perennial

Anti-quality feed factors

May cause bloat in cattle

Caucasian clover

(Trifolium ambiguum)

FAMILY: *Leguminosae*

Caucasian clover is a rhizomatous perennial clover that is adapted to a wide range of soil types and climatic conditions. It has a prostrate growth habit and is taprooted with numerous lateral roots. Caucasian clover produces high yields through the late spring and summer periods, but will become dormant through cooler months and periods of stress.

Grazing management

Once established, Caucasian clover can tolerate a range of grazing management practices. However, it is important to give it a period of recovery during late summer/early autumn to replenish root reserves.

Seeds and sowing rate

Seed weight: 450,000 seed/kg

Sowing rate: 2-5 kg/ha in perennial pasture mixes

Inoculum type: Specific CC283b

Nutritional value

High

Grazing tolerance

Persistent under grazing, but is very slow to establish

Longevity

Perennial

Anti-quality feed factors

May cause bloat in cattle

Chicory overview

(Cichorium intybus)

Chicory's been around awhile

- Chicory was talked about as a forage for New Zealand grazing animals back in 1915
- The first commercial chicory cultivar released was 'Grasslands Puna' in 1985

Chicory is a tasty, rapidly-consumed feed

- Voluntary consumption of chicory by lambs and deer is faster than when lambs and deer graze ryegrass; rate of chicory intake by lambs and deer is similar to intake of legumes

Chicory passes through the rumen quickly

- Rate of chicory breakdown/disintegration in the rumen is faster than for other forages. Chicory exits the rumen and passes to the intestines more quickly. It breaks down so quickly in deer that they ruminate less, or not at all, when grazing chicory

Chicory contains more minerals

- Chicory contains more minerals than most grasses and legumes; levels of calcium, magnesium, sodium, potassium, copper and zinc are high in chicory

Chicory contains condensed tannins

- Chicory contains more condensed tannins (CT) than grasses and most legumes

Chicory is suitable for rotational grazing

- Rotational grazing every 24 days is the ideal grazing frequency. Ensure post-grazing residuals are no lower than 10 cm to promote plant survival and optimise dry matter (kgDM) regrowth potential

Chicory and milk taint

- Feeding chicory as a high proportion of the diet may cause milk taint
- Levels of the taint compounds, sesquiterpene lactones (including lactucin), vary through the year
  - Levels are highest in spring and summer and low in autumn
  - Offer chicory for no more than one third of the complete diet on a dry matter basis, especially during spring and summer when taint compound levels are highest

Chicory and fatty acid carcase composition

- When lambs are finished on chicory, the carcase can contain a more desirable fatty acid profile

Chicory reduces internal parasite challenges

- Tall, upright chicory plants mean fewer infective parasite larvae are consumed by young stock and excellent feed quality boosts animals' immune system to cope with internal parasites

Chicory-fed cattle and ruminal bloat

- Ruminal bloat is much less likely for chicory-fed cattle than for those grazing clover or lucerne. Rapid passage of chicory from the rumen to the intestines reduces (but does not remove) risk

Chicory and soil nutrients

- High soil levels of nitrogen (N) and potassium (K) are scavenged by chicorys' long taproot. Chicory is a good option for effluent paddocks to help with accumulation and redistribution of excessive soil N and K

Chicory is water-use efficient

- Under moderate drought conditions, chicory uses water more efficiently than grasses and legumes

CHICORY IS A VERY HIGH QUALITY FEED

Chicory feed quality is better than grasses, but not quite as good as legumes.

Nutritional benefits of first year chicory versus ryegrass grown under the same conditions

Chicory compared to ryegrass has:	
More	**Less**
Energy (MJME)	NDF
Protein	Fibre
Pectins (soluble fibre; a great rumen microbe 'feed')	Lignin
Minerals (Ca, Mg, Na, K, Cu, Zn)	Silicon (so feed digests faster in the rumen)
Ash	
Similar levels of water soluble carbohydrates to ryegrass	

Farm type

Sowing rate

PURE STAND

5-7 kg/ha

STANDARD PASTURE MIX

0.5-2 kg/ha

GRASSLANDS Puna II CHICORY

- High dry matter production
- A true perennial chicory that lasts more than one year
- Multi-graze option, recovers quickly after grazing
- Semi-erect for better crop utilisation by grazing animals
- Better winter activity than Puna chicory
- Thick, deep taproot offering drought tolerance
- Strong persistence
- Tolerant to *sclerotinia*
- Excellent first year production

Grasslands Puna II chicory is a high yielding forage with good nutritional value for grazing animals. It is a high quality feed for spring to late autumn. Puna II is a New Zealand bred, broad-leaved, perennial forage herb with a true perennial chicory parentage. Extensive animal data has been generated on chicory. Grazing evaluations and trials have confirmed Puna II delivers high dry matter production, improved post-grazing regrowth and greater persistence.

Sowing and establishment

Chicory should be sown no deeper than 10 mm. Seed may be broadcast or direct drilled under favourable conditions. Soil temperatures of 12 °C for spring sowings are recommended; however, early autumn sowing is possible, as long as the chicory has established before going dormant in the cool season. Superstrike® seed treatment is recommended to improve establishment.

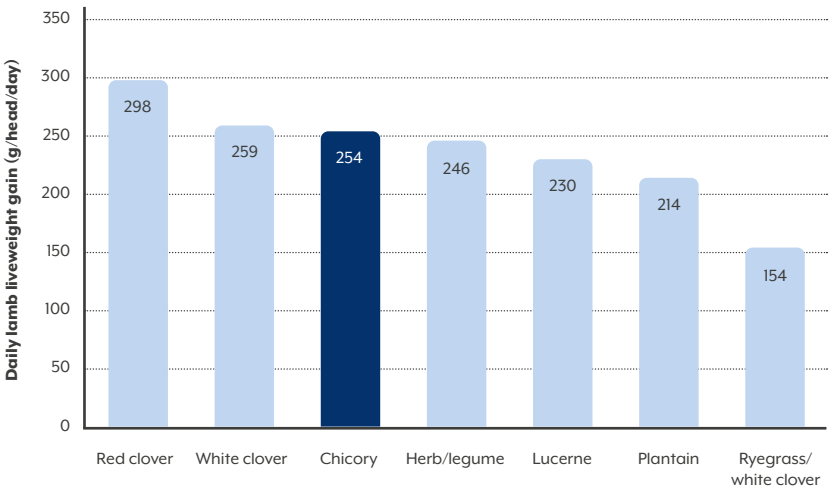
Mix suitability

Chicory combines well with most grasses and clovers and can be added to a pasture mix at 0.5-2 kg/ha. Chicory stands are established at 5-7 kg/ha (Superstrike® treated seed) or Superstrike treated white and/or red clovers at 4-6 kg/ha.

Grazing management

Grasslands Puna II chicory is cool season dormant, but with high growth rates over spring, summer and autumn. Chicory should be rotationally grazed for best performance and persistence. Hard grazing, particularly in wet conditions, may cause damage to the crown and can affect production and persistence.

Daily lamb liveweight gains in summer/autumn when intake was maximised in experiments using ryegrass and white clover pastures as the control



Reference; (Kemp, Kenyon, Morris) Massey University.

Farm type

Sowing rate

13 kg/ha
(1 bag/ha)

Rocket Fuel® CHICORY AND CLOVER MIX

Grasslands Puna II CHICORY | Grasslands Quartz MEDIUM LEAF WHITE CLOVER | Grasslands Legacy LARGE LEAF WHITE CLOVER | Grasslands® Sensation Red Clover

Rocket Fuel® is a mix of chicory, white clover and red clover with excellent animal performance potential. It produces a leafy, high quality feed over spring, summer and autumn when traditional pastures can decrease in quality. Rocket Fuel is a very versatile mix and it can be sown as a specialist finishing crop or a high protein milking option. Rocket Fuel can be used as a 6 month or 2 year crop, depending on the farm system and/or grazing management approach. A high proportion of clover assists with the supply of nitrogen into the soil profile, promoting the growth of chicory to provide a dense cover to discourage weeds, including volunteer grass. The red clover component, alongside chicory, will provide high quality feed through a dry season, helping to reduce risk in summer dry areas.

- Highly palatable
- Excellent feed for high liveweight gains
- Provides high quality feed through summer
- High protein option for dairy farmers
- Recovers quickly after grazing
- Clover provides fixed nitrogen
- High mineral content, particularly zinc, potassium and copper
- Grass can be incorporated into the mix in autumn

Rocket Fuel is a blend of Puna II chicory, Superstrike® (S/S) Legacy white clover, S/S Quartz white clover and S/S Sensation red clover.

Sowing and establishment

Rocket Fuel is sold in 13 kg seed bags which is the sowing rate per hectare. Ensure seed is sown no deeper than 10 mm. Seed may be broadcast or direct drilled under favourable conditions.

Soil temperatures of 12 °C for spring sowings are recommended; however, early autumn sowing is possible, as long as the Rocket Fuel® has established before the chicory goes dormant in the cool season.

Grazing management

Grazing should be delayed until plants are resistant to being pulled out (around 56+ days after sowing). Rocket Fuel grows rapidly from October to late April and should be rotationally grazed for best performance and persistence. Grazing in the first year should be quick and light to avoid overgrazing and optimise regrowth potential. Chicory can be dormant in winter and grazing of companion species during this period must be done carefully to avoid damage to chicory's crown, especially when wet. To ensure high dry matter yield and fast regrowth, graze between 25 cm and down to 6 cm.

Rocket Fuel is available while stocks last. Components of the mix may change.

Chicory case study

Greg Dickson and Shane Hannah in a Puna II chicory crop being grazed by steers.

PUNA II CHICORY CASE STUDY

Farm type:	Beef
Hectares:	160
Location:	Katikati
Name:	Pastoral Holdings Limited; Greg Dickson (Farm Owner) and Shane Hannah (Farm Manager)

Pastoral Holdings Limited operate a beef cattle breeding and finishing operation on a 160-hectare farm situated in Katikati, Bay of Plenty. Greg Dickson acquired the drystock unit in September 2018 to pursue his aspiration of a breeding programme for a commercial, purebred Augus stud. To achieve high efficiency in beef production, Pastoral Holdings have complementary quality pastures and cropping management to produce adequate feed to maximise liveweight gain and body condition.

In their current operation, they have 140 rising one-year steers with a target carcass weight/liveweight gain of 500 kilograms and are finishing 77 two-year steers at 600 kilograms. They recently expanded the breeding cow herd in January 2021 with 36 two-year-old heifers in calf. Aside from beef production, they also manage to achieve two silage cuts annually that totals to 390 bales. Prior to Pastoral Holdings taking ownership of the farm, the farm had poor infrastructure that has been gradually upgraded over the last few years. Farm Manager Shane Hannah has over 30 years experience in the dairy industry and is enjoying the challenge of building this beef breeding operation alongside Greg.

A reoccurring challenge for them has been the tough, dry summers. Inadequate soil moisture places strain on ryegrass, encumbering pasture growth and creating uncertainty around summer feed supply. For the 2020/21 season (third dry season), Pastoral Holdings decided to do something different and integrated Puna II chicory into their farm system to foster resilience. The decision to plant Puna II was made to enhance their beef finishing operation, while safeguarding their feed supply in dry summer conditions. They have grown 8 hectares this past year across three paddocks.

They have been impressed with the drought tolerance of Puna II. Its well-adapted, deep taproot is able to use water more efficiently than ryegrass, allowing it to persist and regrow in dry summers. Chicory offers a high-quality feed source and increased dry matter production from spring to late autumn, when ryegrass pastures often struggle. The high-performance crop is ideal for bridging the feed gap over summer (when ryegrass pastures decrease in quality), providing an excellent feed for high liveweight gains to sustain animal production. Shane further explained "The high protein content and lower risk of facial eczema makes it ideal for our grazing cattle."

The multi-graze option has led them to strip graze cattle throughout summer (on/off chicory every day since 22 December) with the added benefit of winter feed as a 12-month option to provide more protein to cattle. They followed best practice grazing management by ensuring post-grazing residuals were no lower than 10 cm for improved plant persistence and more kilogram of dry matter (kgDM) regrowth.

This summer 2020/21 was the first time Pastoral Holdings have used Puna II chicory in their farm system and "It has delivered on everything we anticipated." Greg explained "Utilising Puna II has allowed us to maximise animal performance, as its a high quality feed that gives us the flexibility to fill the summer feed gap. We managed to achieve four grazings from December 2020 to May 2021 with 4,000 kgDM every time."

Pastoral Holdings will continue to observe the dry matter production of Puna II chicory over the winter months; however, they are expecting exceptional yields in the second season. Greg says, "This year Shane has done a great job with grazing management and we're looking to use Puna II chicory again next summer with the addition of more area."

PASTURE OPTIONS

Lucerne

About lucerne

Lucerne is a perennial legume with a taproot that gives the plant access to water and nutrients deep in the soil profile. This gives the plant superior drought tolerance and preference over grasses in lower rainfall areas.

Lucerne is a multi-purpose plant that can be either grazed *in situ* or conserved as hay/silage to feed during times of the year when pasture quality or diet protein levels are low. Lucerne has excellent stock acceptance and produces impressive yields of high quality feed.

- Suitable for all stock classes (dairy, sheep, beef and deer)
- Suitable for ewes during lactation and mating
- Provides high quality feed through dry periods when most other species will typically be losing quality
- Lucerne produces high yields in dryland environments, especially on deeper soils
- Usually sown in pure swards and can be grazed or conserved for hay/silage production
- Shows greater drought tolerance than most other pasture species and responds quickly to moisture after drought

Figure 1: Annual dry matter yield in dryland monoculture

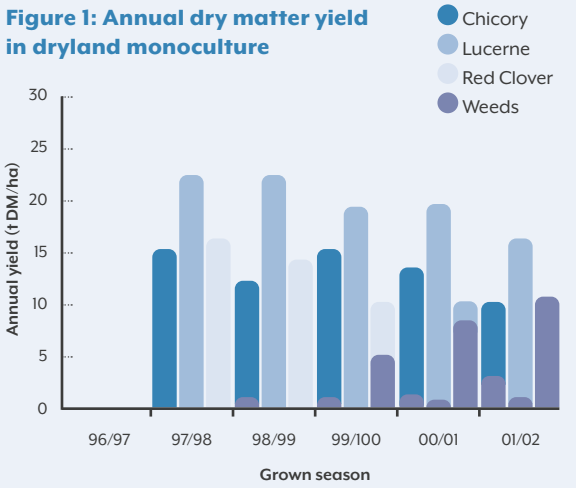
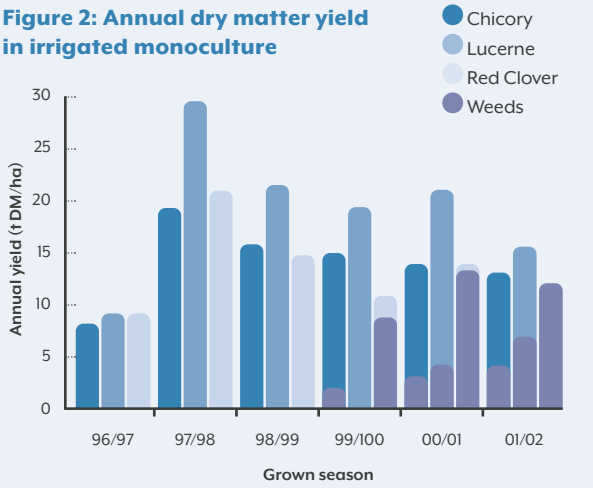


Figure 2: Annual dry matter yield in irrigated monoculture



TRIAL RESULTS

Source: Lincoln University

Annual dry matter yield in dryland and irrigated monocultures of four forage types

A Canterbury trial investigated the effect of dryland (Figure 1) and irrigated (Figure 2) monocultures on annual dry matter yields in tonnes per hectare (tDM/ha) associated with four forage types: chicory, lucerne, red clover and weeds.

Forages were grown on a Wakanui silt loam at Lincoln University in Canterbury, New Zealand. The trials were sown on 1 November 1996. Bars represent one standard error of the mean for comparison of species means within and between irrigation treatments. Upper bars are for total production and lower bars are for weed production (Brown *et al.*, 2005)

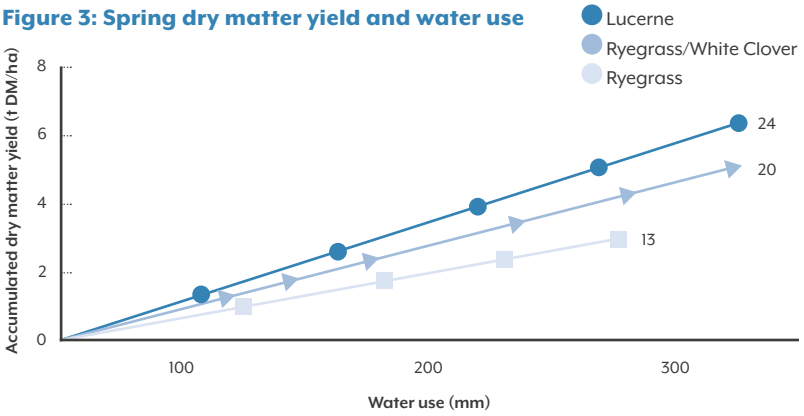
TRIAL RESULTS

Spring dry matter yield and water use of three forage types

A Canterbury trial compared the spring dry matter yield in tonnes per hectare (tDM/ha) and water use (mm) associated with three forage types: lucerne, perennial ryegrass/white clover and perennial ryegrass pasture.

The trial was sown in silt loam soil in Templeton, 4 km northwest of Lincoln University, between 29 September to 9 December 1993 (Moot et al. 2008).

Figure 3: Spring dry matter yield and water use



Benefits of lucerne

NITROGEN FIXATION

- Lucerne is a legume that can fix its own nitrogen, i.e. convert atmospheric nitrogen into plant available nitrogen reducing the requirement for application of nitrogen fertiliser
- Nitrogen fixation is directly proportional to herbage grown (lucerne produces approximately 25 kg N/t of above ground dry matter)
- Lucerne will fix more nitrogen annually than white clover pastures due to higher yield when soil moisture is limiting
- Lucerne does not require nitrogen application. This may decrease nitrogen fixation and encourage growth of weeds within the stand

LONGEVITY

- Typically, lucerne persists for 4-8 years in a pastoral system (stands can persist for as long as 15 years in drier environments where pressure from weeds is low, and is well controlled)
- Persistence is dependent on grazing management and pest and disease pressure
- Modern cultivars such as Stamina™ 5 tolerate diseases, Aphids, Sitona Weevil, fungi and viruses better than older cultivars such as Wairau
- Stand renewal is based on a decline in plant population and an invasion of taprooted and rhizomatous weeds, for example dandelion, yarrow and couch/twitch

INCREASED DRY MATTER PRODUCTION

- In a dryland environment, lucerne can produce up to 40% more dry matter than other pasture
  - Lucerne produced the highest annual yield compared with ryegrass/white clover pastures in an eight year dryland experiment at Lincoln University, Canterbury as shown in Figure 4 (lucerne produced 12.9 tDM/ha compared with 6.6 tDM/ha for ryegrass/white clover pastures in year 8)

ENVIRONMENTAL BENEFITS

Lucerne has the ability to extract rather than leach nitrate, i.e. "cleanup" nitrogen contaminated sites. This is due to its taproot extracting nitrogen at soil depths greater than other pasture species' root systems. This extraction can be used advantageously in areas near waterways where leaching is potentially an issue or in areas that receive high applications of nitrogen such as dairy effluent areas. This benefit is not currently captured well in New Zealand, but is an option to incorporate into our farming systems

GOOD DROUGHT TOLERANCE

- Lucerne is drought tolerant due to its water use efficiency (WUE). WUE is the ratio of total dry matter accumulation to total water input (kgDM/ha/mm of water used)
- Drought tolerance is influenced by soil depth, soil texture, plant species and root depth
- Lucerne has a taproot that can extract more available water from the soil profile than ryegrass cultivars. Ryegrass has a fibrous root system that is efficient at extracting water, but only within the top layers of the soil
- WUE is highest in spring
- Species with high herbage nitrogen content have high WUE. Lucerne has a higher herbage nitrogen content than most grass/clover pastures and therefore a higher WUE

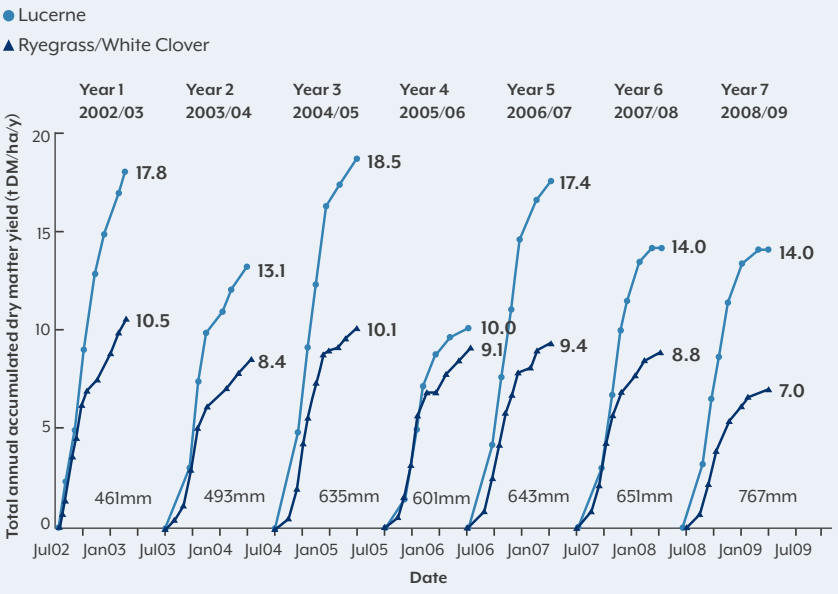
TRIAL RESULTS

Source: Lincoln University

Total accumulated annual dry matter production of two forage types over seven seasons

A Lincoln University study investigated the total accumulated annual dry matter production per hectare (tDM/ha/y) of perennial ryegrass/white clover and lucerne pastures for seven growth seasons (2002-2009). Accumulation for year 1 began on 4 September 2002 (Mills et al. 2008; Mills & Moot, 2010).

Figure 4:
Total accumulated annual dry matter production over seven seasons



Planning and establishment

PLANNING

- Identify an area to be planted in lucerne a minimum of 6 months prior to sowing
- Select free, draining soil
- Soil test to ensure pH>6, Olsen P close to 20, sulphur 10+ and potassium 6+
  - If pH is low, apply lime. It takes approximately 6 months for maximum lime to take effect
  - A high pH is required so that molybdenum is available to ensure the plant fixes nitrogen
- Identify problem weeds (break crops may be needed to remove these before lucerne can be planted)
- Cereal crops can be used to control weeds using short residual herbicides and allowing time for the fertility to build up
- Avoid lucerne to lucerne
- Chemical residue – take note of what products have been used historically in the paddock and when. Lucerne is sensitive to some chemical residues (speak to your local seed retailer if you have any concerns)
  - If the chemical history is uncertain, take an ice cream container of soil and plant radish seeds. Radishes are very sensitive to chemical residue; if they do not grow, there may be residue

ESTABLISHMENT

- Lucerne is usually spring sown
- Direct drill into a sprayed out block or sow into a fine, firm seedbed (5-15 mm or up to 25 mm when soil moisture stress is likely)
- Sow when the average soil temperature is above 8˚C in spring and 14˚C in autumn
- Untreated seed requires inoculation with rhizobia to fix nitrogen before sowing to ensure effective nodulation
- Sow at 8-10 kg/ha of inoculated seed or 10-14 kg/ha pre-inoculated Superstrike® seed
- Allow the lucerne to reach a minimum of 50% flowering (50% of the tallest stems have a flower) prior to the first grazing or silage/hay cut
  - If the stand has a high weed burden at establishment, it can be grazed/cut once if it is 15-20 cm tall and then left to flower a minimum of 50%
- If irrigation is available, apply water before sowing to ensure adequate soil moisture

  NOTE: For established stands, delay irrigation until 10-14 days after grazing
  - Irrigation encourages weed seed germination
  - When lucerne has been grazed or cut (i.e. leaves removed), the crop requires minimal water to regenerate leaf cover
  - Sitting water can cause roots to rot
- Weeds (annual and perennial) should only be sprayed in winter, not before
- Establishing plants are less tolerant of some herbicides compared with a mature stand

WHO SHOULD GROW LUCERNE?

Growing lucerne is appropriate for farmers who have:

- Annual rainfall less than 1,000 mm per year
- Free-draining soil
- Rotationally grazed stock
- Preference for nitrogen to be generated by a plant rather than urea
- High fertility and free draining soils with a pH over 6.0

Lucerne management and seed treatment

LUCERNE MANAGEMENT

Weed control

- Identify weeds present
- Always spray in winter for weed control (i.e. when the lucerne is dormant)
  - Dryland lucerne stands should be sprayed every second year (at least)
  - Irrigated lucerne stands should be sprayed annually
- Consult your local seed retailer for chemical recommendations

Insects and diseases

- Identify early and graze or cut the stand (removing the pest feed source)
- If pest infestations are high and are causing damage to yield, pesticide application is necessary
- Early winter graze to reduce over-wintering Aphid populations

Irrigation

- If irrigation is available, this can help when moisture is low. Although lucerne is highly drought tolerant, irrigation increases the potential to more than double the lucerne yield in dry years

  NOTE: Weed invasion can occur when irrigated too frequently and immediately after cutting or grazing
- The optimum frequency and timing of irrigation is dependent on how much water the soil can hold. Speak to your local seed retailer about soil water holding capacity
- When demand for water is low, delay irrigation until new leaves are visible and are ready to expand and out-compete germinating weeds
- Roots grow at 1 cm/day. Growth above the ground stops while reserves are put into the roots

Fertiliser

- Soil test annually to ensure fertility is maintained and appropriate fertiliser is used
- Leaf analysis during active spring growth can also be used in conjunction with soil tests to check soil fertility and fertiliser type
- Apply the recommended lucerne fertiliser after the first cut in spring and then after every second cut in a cut and carry system
- Grazed lucerne requires less fertiliser than hay cutting because nutrients are returned through dung and urine

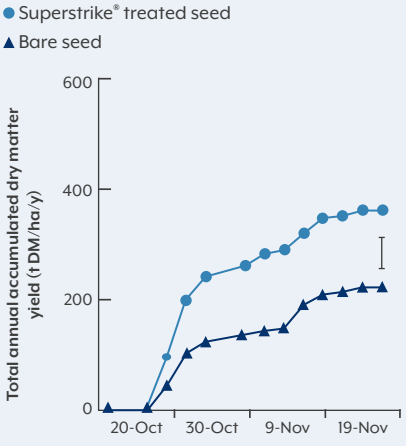
LUCERNE SEED TREATMENT

Superstrike® Lucerne

Superstrike® lucerne seed treatment contains:

- A strain of nitrogen-fixing bacteria (rhizobia) specific to lucerne
- A contact fungicide to control the 'damping off' disease Pythium
- Molybdenum and lime are included in the seed treatment to help improve root nodulation and boost early growth. Applying nutrients through a seed treatment process ensures they are in close proximity to the establishing seedling
- All lucerne seed should be Superstrike® treated

Effect of Superstrike® seed treatment on lucerne establishment in Lincoln, Canterbury



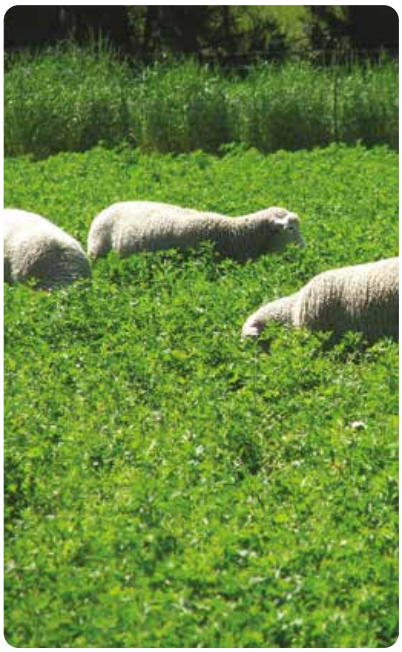
Results are adapted from 'Establishment of lucerne (Medicago sativa) sown on five dates with four inoculation treatments: (K. Wigley, D.J. Moot, Q. Khumalo and A. Mills) published in Proceedings of the New Zealand Grassland Association 74.

TRIAL RESULTS

In a Lincoln University trial, Superstrike® seed treatment provided a significant increase in the establishment population over bare seed.

At 28 days after sowing, Superstrike seed had a population of 386 plants/m^2 compared to bare seed with 227 plants/m^2. Refer to graph on the left (Wigley et al, 2012).

Lucerne grazing management



To practically manage lucerne grazing you need a 5-6 paddock rotation, such as the example provided below:

- 30 hectares of lucerne divided into 6 x 5 hectare paddocks
- Stocked at 300 ewes plus twins (i.e. 10-12 SU/ha)

Two to three weeks after lambing, stock are introduced to the lucerne paddocks. Once the first paddock is grazed, they are then rotated around the other five paddocks. Stock are left on each paddock for 5-7 days. Afterwards, the paddock is spelled for 35-42 days to recover.

Lucerne leaves grow from the top of each stem, unlike grass species where the growing point is located at the base of the plant. When lucerne is cut or grazed, new stems shoot from the base of the plant. These new stems need a chance to regrow, which is why rotational grazing rather than set stocking is recommended.

In large paddocks, break feeding will improve crop utilisation. As the leaves have the highest nutritive value, priority stock should have the first access to the stand, as stock preferentially graze the leaves first. Rough rule of thumb: for every 10 cm of lucerne that is above 20 cm height, yield is around 800-1,000 kgDM/ha.

When grazing lucerne frequently there is a compromise between the amount of green leaf surface area left to photosynthesise and yield.

SPRING

Focus on stock performance

- Start to graze the first paddock when lucerne is approximately 20-25 cm high, (1,500 kgDM/ha)
- Graze for 5-7 days until all green leaf and soft stem is gone
- Allow 35-42 days recovery (any shorter reduces root size and stem height)

As you move onto the next paddock, the lucerne will be taller; i.e. it may be 40-45 cm before you reach paddock six. Before you graze the sixth paddock, check the recovery of the first paddock grazed. If it is already 35 cm tall, you may need to increase stocking rate or drop paddock six from the rotation and conserve it. If it is only 20 cm tall, you may need to reduce the stocking rate.

Ideally ewes and lambs grazed on lucerne stay on lucerne for at least 8 weeks to maximise liveweight gain. For the first rotation, when lucerne is lush, ensure some fibre is available to stock (e.g. meadow hay).

- Have salt licks available for stock, as lucerne foliage is low in sodium
- Lucerne quality:
  - Lucerne leaf has 12 MJME/kgDM and protein is greater than 24%
  - The stem has approximately 8 MJME/kgDM and protein is greater than 14%

NOTE: delayed harvest increases the proportion of stem

SUMMER

Focus on stock performance

- Short rotation; 30-35 days recovery
- Water stress accelerates flowering, but leaf is still high quality
- Conserve a true surplus (i.e. where there is more lucerne available than stock demand)

AUTUMN

Focus on the lucerne plant replenishing root reserves

- Allow a minimum of 50% of the tallest lucerne stems to have an open flower at least once from mid-summer to autumn to allow root reserves to recharge before grazing
- Graze if drought is 'terminal', i.e. plants have stopped growing to avoid loss of leaves, then allow recovery to at least 20cm height after rain
- Long rotation; 42 days i.e. 6 weeks between grazings
- Aphids can be an issue. These can be cleaned up in late autumn/early winter by hard grazing once growth has stopped
- Shorter day length and decreasing temperatures signal the plant to start directing energy to root reserves for stand persistence and production next spring
- Ewes can be flushed on lucerne; however, if Leaf Spot is present then oestrogen levels may be affected

WINTER

- Hard graze when growth stops (e.g. once frost stops growth)
- Spray weeds before lucerne leaves grow back to minimise crop damage
- Resist the urge to graze regrowth after the first winter grazing, as this delays spring growth/first grazing and reduces yield
- The order in which paddocks are hard grazed and then sprayed in winter dictates the order they will be ready for grazing in spring

Farm type

Sowing rate

BARE SEED

8-10 kg/ha

SUPERSTRIKE® TREATED SEED

10-14 kg/ha

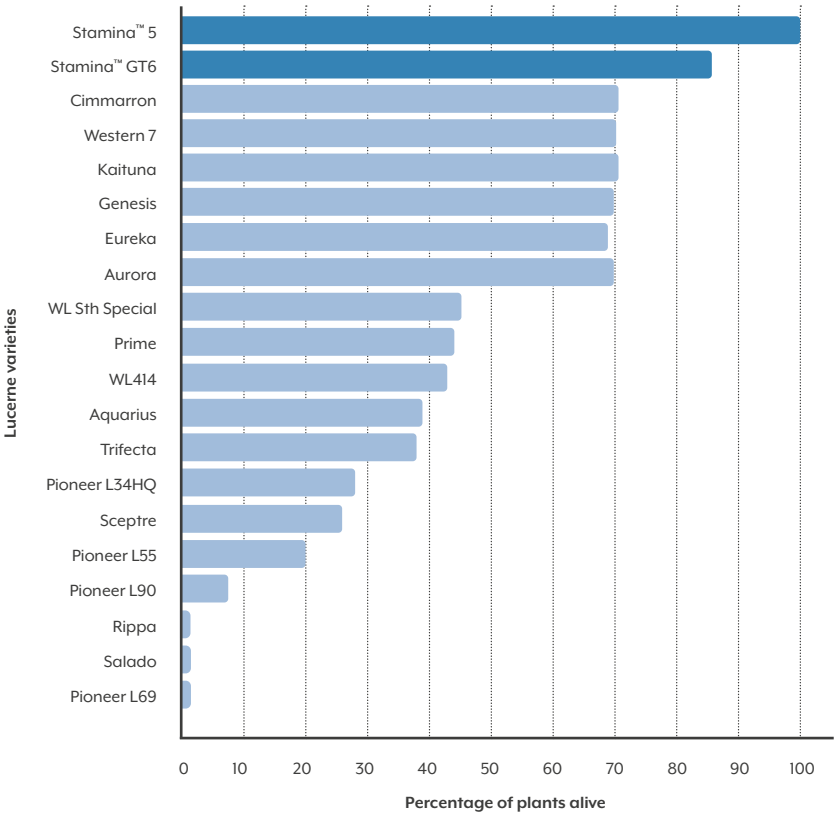
Stamina™ 5 LUCERNE

- A grazing-tolerant lucerne that is semi-dormant (5)
- Tolerates prolonged periods of set stocking and close grazing
- Highly productive in both grazing and hay/silage systems
- Strong persistence under grazing
- Produces excellent quality hay
- Good overall resistance to most lucerne diseases

Stamina™ 5 is a grazing-tolerant, semi-dormant lucerne offering excellent yield and forage quality in dryland conditions. High grazing tolerance makes Stamina 5 an ideal choice for grazing systems, while offering flexibility in silage stands that are occasionally grazed.

The chart below illustrates that once established, Stamina™ 5 lucerne can tolerate continuous and close grazing better than other lucerne cultivars. Like all lucerne, Stamina™ 5 will persist and produce best when rotationally grazed.

Percentage of plants alive after 5 years (including 2 years of set stocking) in Ballarat, Australia



Trial sown 1999, assessed for persistence 2004, PGG Wrightson Seeds Research, Ballarat, Australia.

Farm type

Sowing rate

BARE SEED

8-10 kg/ha

SUPERSTRIKE® TREATED SEED

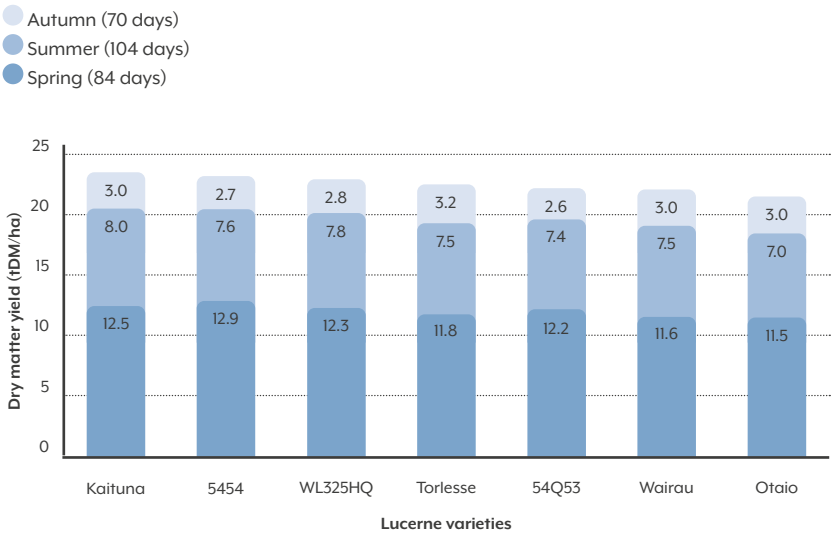
10-14 kg/ha

GRASSLANDS Kaituna LUCERNE

- Fine stemmed for better quality and palatability
- Semi-dormant in winter
- High annual dry matter production
- Versatile – persistent under grazing, hay/silage and mixed regimes
- Excellent pest and disease resistance

Grasslands Kaituna lucerne is a New Zealand developed lucerne selected for improved resistance to the range of insect pests and diseases. It is ideal for grazing and mixed regimes and is persistent under grazing and hay/silage production. Kaituna lucerne is highly productive in spring and summer, with later autumn and earlier spring growth than Wairau.

Three year average seasonal dry matter production of lucerne both grazed with sheep and cut for hay



Sown on 19 October 2000, the above trial conducted at Kimihia Research Centre in Canterbury measured the yield of various lucerne cultivars in spring, summer and autumn, over a period of three years.

Lucerne case study

KAITUNA LUCERNE CASE STUDY

Property name:	Gladstone Farm
Farm type:	Cropping, sheep and beef
Hectares:	300
Location:	Hawea
Name:	Sandy Urquhart

Sandy owns and manages Gladstone Farm along with his brother Andrew and their father Paul. The farm is located at Hawea Flat, Otago, where they have hot, dry summers and harsh, cold winters, along with high evapotranspiration rates. Given these conditions, lucerne is well-suited to their farm. 46 hectares of Kaituna lucerne was sown in October 2017, making this its third year. The crop is healthy and vigorous with little weed burden. The Urquharts take heavy cuts of Kaituna to sell as baleage or hay, then in mid-March buy in 30 kg lambs and finish them by rotationally grazing the Kaituna to sell in May. "We have harvested over 15 tonne of dry matter each year through three cuts and a final autumn graze with lambs. Kaituna always continues to produce dry matter in the heat, especially in comparison to other cultivars as it doesn't go to flower as early," says Sandy. The Urquharts recognise that Kaituna is a versatile crop for their farming operation. They are able to make high quality conventional bales of hay for horses as well as five-foot bales for farmers. Kaituna also provides them with the ability to make high quality lucerne baleage along with lucerne chaff. Finally, they can buy in lambs to diversify their system even further. They are on track for a dry matter yield of at least 15 tonne per hectare again this year. They planted a Kaituna/prairie grass mix in the summer of 2019 as they have been very pleased with the performance of Kaituna and are planning on further planting in the spring.

Sandy Urquhart standing in Kaituna lucerne on Gladstone Farm.

PASTURE OPTIONS

Regenerative Agriculture

Regenerative agriculture

Regenerative agriculture is a term used to describe farming in a way that aims to improve soil and water quality, promote biodiversity, increase soil carbon and foster animal and human welfare.

The definition of what is and isn't regenerative agriculture can be hard to define. Many of the techniques used in regenerative agriculture have been used for hundreds of years. Some may have fallen out of favour, but many of these techniques have been incorporated into current New Zealand farming practices such as rotational grazing, diverse pasture mixes and minimum tillage.

New Zealand pasture-based systems are based on strong research that has been refined over many years. In contrast, the benefits and relevance of some of the regenerative practices currently being promoted have only limited anecdotal New Zealand-based evidence to date.

Building soil organic matter is a key aim for regenerative farmers. In most cases, New Zealand soils have relatively high organic matter compared to some countries that have depleted soils through extensive cropping over centuries. The high organic matter content of many New Zealand soils is due to our recent soils and farmers utilising farm practices, such as rotational grazing, reduced tillage of soil, diverse pasture mixes, reliance on legumes and a focus on pasture-based systems.

Diverse multi-species pasture mixes are one of the most common regenerative agriculture practices. Typically, New Zealand pastures are based on simple combinations of grasses, legumes and occasionally herbs; however in the regenerative system, far more complex seed mixes are used. It is important to carefully consider both the positives and negatives of each species in a diverse pasture mix, especially when its intended for grazing animals.

Sowing cover crops and diverse pasture mixes that are to be incorporated into the soil is a well established and safe practice. However, caution is recommended if the intention is to graze these mixes as some species can be toxic to stock (e.g. buckwheat).

Broadly speaking, regenerative seed mixes can be split into two categories: cover crop mixes (also known as annual mixes) or more permanent grazing phase mixes.

UNINTENDED CONSEQUENCES OF REGENERATIVE MIXES

Allowing seed set of some species can establish a seed bank of unwanted species that will last many years. Carefully consider if these species are desired in the long term.

Green bridges. Multi-species mixes may create 'green bridges' allowing diseases such as clubroot or dry rot to survive in the soil or environment, causing disease in future crops.

Animal safety. Limited animal safety or performance information is available for some species currently being used in mixes. Low feed value species will affect animal performance and some species (e.g. buckwheat and mustard) can be toxic to grazing animals.

FLOWER CROPS

Grazing flowering crops (e.g. mustard or buckwheat) can pose a risk to animal health, as toxicity can occur. More animal welfare and safety research is needed.

DIVERSE PASTURE CROPS

Use a variety of species suited to your farm system and choose species on which there is animal safety data.

COVER CROP OR ANNUAL MIXES

These mixes are sown as a shorter-term option (less than 12 months), with the biomass grown either incorporated into the soil and/or eaten by livestock. Often the intention is to graze a third, trample a third and leave a third.

Cover crop mixes generally include many annual species that will grow quickly, aim to build up organic matter in the soil and fix nitrogen. Common species in these mixes include crimson clover, sunflowers, buckwheat, vetch, cornflower, forage rape, radish and forage cereals (e.g. oats, ryecorn and triticale). These species will promote an increased presence of insects such as bees and natural parasitoids.

A diverse mix containing annual cover crop species.

GRAZING PHASE PERMANENT MIXES

Grazing phase mixes are more perennial in nature than the cover mixes and are intended for grazing longer term. These mixes may be composed of perennial species such as ryegrass, cocksfoot, tall fescue, grazing brome, red clover, white clover, lucerne, chicory and plantain.

An example of a diverse perennial mix is shown (right) for those looking to increase diversity in pastures. The perennial nature of these species will last longer in the mix; however, not all species may be ideally suited to all environments or grazing systems and it is likely the pasture will become dominated by a smaller number of species.

Cultivar	Sowing rate (kg/ha)
Excess perennial ryegrass (diploid)	9
Aurus cocksfoot	2
Gala grazing brome	4
Phalaris	2
Meadow fescue	3
Stamina 5 lucerne	2
Amigain red clover	2
Quartz white clover	2
Puna II chicory	2
Ecotain® environmental plantain	2
TOTAL	30

Diverse pasture mix containing perennial grass, legumes and herbs.

It is important to note that there is limited crossover between cover crop mixes and grazing phase mixes in terms of the species used. Annual species tend to be fast-growing, vigorous and will generally enter reproductive growth stages earlier. In contrast, the longer-lived species tend to be slow-growing and poor competitors than faster establishing annual species, as a result mixing annuals and perennials can lead to dominance of annuals in the first year and bare ground in the second year.

The following section provides an overview of less common species and considerations around incorporating these into mixes. PGG Wrightson Seeds can supply most of these options, subject to availability. If you require further information, talk to your local PGG Wrightson Seeds Sales Agronomist (refer to page 261).

Sowing rates

Table 1 – Crop options

Crop options	Longevity	Bare seed weight (seeds/kg)	SOWING RATE (kg/ha)			Feed value	Grazing tolerance	Drought tolerance	Water-logging tolerance	Frost tolerance	Silage potential
			Pure sward	High	Low						
Tick beans (Faba beans)	Annual	1,100-2,850	100-200	50 (6-14 plants/m^2)	10	♦♦♦	♦	♦	♦♦	♦♦♦	♦♦♦
Sunflower	Annual	8,000-25,000	12-15	4-5 (3-13 plants/m^2)	1-3	♦	♦	♦♦	♦	♦	♦♦♦
Vetch (common)	Annual	11,000-15,000	50	15-25	3-4	♦♦	♦	♦♦	♦	♦♦♦	♦♦♦
Vetch (hairy)	Annual	18,000-29,000	25-40	10-15	2-3	♦	♦	♦♦	♦	♦♦♦	♦♦♦
Buckwheat	Annual	28,500	40-50	4-5	2-3	♦	♦	♦	♦	♦	♦
Daikon radish	Annual	70,000-88,000	8-12	4	1-2	♦♦	♦	♦♦	♦♦	♦♦♦	♦
Linseed	Annual	143,000	40	10	1-2.5	♦	♦	♦	♦	♦	♦
Mustard	Annual	166,000	8-12	3-4	1-2	♦	♦	♦	♦	♦♦	♦
Phacelia	Annual	330,000-500,000	5-10	2	0.25-0.5	♦	♦	♦♦	♦	♦♦♦	♦

Table 2 – Herbs and legumes

Herbs and legumes	Longevity	Bare seed weight (seeds/kg)	SOWING RATE (kg/ha)			Feed value	Grazing tolerance	Drought tolerance	Water-logging tolerance	Frost tolerance	Silage potential
			Pure sward	High	Low						
White clover	Perennial	1,400,000	-	4-6	2-3	♦♦♦♦	♦♦♦♦	♦♦	♦	♦♦♦♦	♦♦♦♦
Red clover	Perennial	300,000 (tetraploid) - 500,000 (diploid)	8-12	5-6	3-4	♦♦♦♦	♦♦♦	♦♦♦	♦	♦♦♦♦	♦♦♦♦
Sub clover	Annual	150,000	8-12	5-6	3-4	♦♦♦♦	♦♦♦	♦♦♦	♦	♦♦♦♦	♦♦♦♦
Balansa clover	Annual	850,000-1,400,000	6-10	5-6	2-3	♦♦♦♦	♦♦♦	♦♦♦	♦♦♦	♦♦♦	♦♦♦♦
Crimson clover	Annual	250,000	10-20	6	2	♦♦♦♦	♦♦♦	♦♦♦	♦♦	♦♦♦♦	♦♦♦♦
Persian clover	Annual	800,000-900,000	6-8	4-5	2	♦♦♦♦	♦♦	♦♦	♦♦♦	♦♦♦♦	♦♦♦♦
Strawberry clover	Short-lived perennial	666,000	-	6	2	♦♦♦♦	♦♦♦♦	♦♦♦	♦♦	♦♦♦♦	♦♦♦♦
Caucasian clover	Perennial	450,000	-	5	2	♦♦♦♦	♦♦♦♦	♦♦♦	♦♦	♦♦♦♦	♦♦♦♦
Lotus major *(Lotus pedunculatus)*	Perennial	1,200,000 (tetraploid) - 2,000,000 (diploid)	5	3	1	♦♦♦	♦♦	♦♦♦♦	♦♦♦	♦♦♦	♦♦♦
Birdsfoot trefoil *(Lotus corniculatus)*	Short-lived perennial	850,000	10	6-10	3	♦♦♦	♦♦	♦♦♦♦	♦♦♦	♦♦♦	♦♦♦
Plantain	Perennial	500,000	10	2-3	1	♦♦♦	♦♦♦♦	♦♦♦	♦♦	♦♦♦♦	♦♦♦
Sheeps burnet	Short-lived perennial	154,000	5-20	3-4	1-2	♦♦♦	♦♦♦	♦♦♦♦	♦	♦♦♦♦	♦♦♦
Lupins (blue)	Annual	4,000	10-40	10 (4 plants/m^2)	3-4	♦♦	♦♦	♦♦♦	♦	♦♦♦♦	♦♦
Sulla	Short-lived perennial	190,000	10-12	6	2	♦♦♦	♦♦	♦♦♦	♦	♦♦♦♦	♦♦♦♦
Lucerne	Perennial	500,000	10-14	6	3	♦♦♦♦	♦♦♦	♦♦♦♦	♦	♦♦♦♦	♦♦♦♦

Table 3 – Grasses

Grasses	Longevity	Bare seed weight (seeds/kg)	SOWING RATE (kg/ha)			Feed value	Grazing tolerance	Drought tolerance	Water-logging tolerance	Frost tolerance	Silage potential
			Pure sward	High	Low						
Perennial ryegrass	Perennial	255,000 (tetraploid) - 500,000 (diploid)	20-30	16-30	3-6	♦♦♦	♦♦♦♦	♦♦	♦♦	♦♦♦♦	♦♦♦♦
Cocksfoot	Perennial	1,000,000 - 1,200,000	8-10	6-10	2-3	♦♦	♦♦♦♦	♦♦♦♦	♦♦♦	♦♦♦♦	♦♦♦
Tall fescue	Perennial	400,000	22-32	16-32	3-4	♦♦	♦♦♦	♦♦♦♦	♦♦♦♦	♦♦♦♦	♦♦♦
Meadow fescue	Perennial	500,000	20-24	12-24	3-4	♦♦♦	♦♦♦	♦♦♦	♦♦♦	♦♦♦♦	♦♦♦
Grazing brome & pasture brome	Perennial	90,000	25-30	10-20	4	♦♦	♦♦♦♦	♦♦♦	♦	♦♦♦♦	♦♦
Prairie grass	Short-lived perennial	90,000	25-30	10-20	4	♦♦	♦♦♦	♦♦♦	♦	♦♦♦♦	♦♦
Phalaris	Perennial	550,000	-	4	1	♦♦	♦♦♦♦	♦♦♦♦	♦♦♦♦	♦♦♦♦	♦
Timothy	Perennial	2,500,000	6-8	3	1	♦♦♦	♦♦♦	♦♦	♦♦♦	♦♦♦♦	♦♦♦♦

Table 4 – Cereal options

Cereal options	Longevity	Bare seed weight (seeds/kg)	SOWING RATE (kg/ha)			Feed value	Grazing tolerance	Drought tolerance	Water-logging tolerance	Frost tolerance	Silage potential
			Pure sward	High	Low						
Barley (greenfeed)	Annual	18,000-25,000	90-120	45-60	5-10	♦♦	♦	♦♦	♦♦	♦♦♦	♦♦♦♦
Oats (greenfeed)	Annual	25,000-33,000	90-120	45-60	5-10	♦♦	♦	♦♦	♦♦	♦♦♦	♦♦♦♦
Wheat (greenfeed)	Annual	18,000-25,000	140-160	70-80	5-10	♦♦	♦	♦♦	♦♦	♦♦♦	♦♦♦♦
Ryecorn (greedfeed)	Annual	-	120	60	5-10	♦♦	♦♦	♦♦	♦♦	♦♦♦♦	♦♦♦♦
Triticale (greenfeed)	Annual	19,000	110-170	55-85	5-10	♦♦	♦♦	♦♦	♦♦	♦♦♦	♦♦♦♦
Sorghum	Annual	24,000-37,000	25-45	-	5	♦♦	♦	♦♦	♦	♦	♦♦♦
Maize (greenfeed)	Annual	2,500 - 4,400	100-150,000 seeds/ha	-	-	♦♦	♦	♦♦	♦	♦	♦♦♦♦
Millet (Japanese)	Annual	-	25-40	10	5	♦♦	♦	♦♦♦	♦♦♦	♦	♦♦♦♦

Key to Tables 1-4

♦ ***Feed value**: Low*
***Grazing tolerance**: Poor/ no regrowth*
***Drought tolerance**: Poor*
***Waterlogging tolerance**: Poor/none*
***Frost tolerance**: Poor/none*
***Silage potential**: Poor/none*

♦♦ ***Feed value**: Moderate*
***Grazing tolerance**: Moderate regrowth/requires lax grazing*
***Drought tolerance**: Low*
***Waterlogging tolerance**: Low*
***Frost tolerance**: Moderate*
***Silage potential**: Moderate*

♦♦♦ ***Feed value**: Good*
***Grazing tolerance**: Requires rotational grazing*
***Drought tolerance**: Moderate*
***Waterlogging tolerance**: Moderate*
***Frost tolerance**: Good*
***Silage potential**: Good*

♦♦♦♦ ***Feed value**: High*
***Grazing tolerance**: Tolerates set stocking*
***Drought tolerance**: Good*
***Waterlogging tolerance**: Good*
***Frost tolerance**: High*
***Silage potential**: High*

Sunflower

(Helianthus annus)

COVER CROP/ANNUAL SPECIES

FAMILY: *Compositae*

Sunflowers have large, decorative, daisy-like flowers that are usually golden yellow in colour and bloom from summer to autumn. The plants have hairy, often sticky leaves and tall, rough stems that can grow up to 3 m high. Each plant produces from one to seven flowers. Sunflowers prefer full sun and need protection from the wind.

Usage

Sunflowers are an attractant for beneficial insects and efficient in extracting moisture and nutrients from deeper in the soil profile unattainable to other species. Although bred for seed production, modern hybrid sunflowers can be used for forage or silage production on dairy and beef cattle farms.

Seeds and sowing rate

Seed weight: Small seed as high as 25,000 seeds/kg; large seed as low as 8,000 seeds/kg

Sowing rate: Needs to be adjusted according to seed size. Pure sward: 40,000 to 60,000 seeds/ha or 12-15 kg/ha. Mixes: 3-5 kg/ha will provide 5-13 plants/m^2 depending on seed size and field germination

Sowing depth: 50 mm

Time of sowing: Spring when soil temperature is 10°C and rising

Nutritional value

Low

Grazing tolerance

Low

Longevity

Annual 80-100 days

Anti-quality feed factors

Nitrate test before feeding sunflowers as forage, particularly after a drought

Phacelia

(Phacelia tanacetifolia)

CROP SPECIES

FAMILY: *Borages*

Fast-growing annual crop able to establish in around 8-10 weeks. Not frost-hardy. Phacelia is grown for its purple flowers that provide a valuable source of food that attracts a large number of insects. Phacelia can grow to approximately 100 cm in height. Mature flowering plants are upright, multi-branched, dark green and hairy. The leaves have leaflets cut into small lobes giving them a feathery appearance. A shallow root system with many dense, lateral side roots.

Usage

Phacelia is grown as a green manure annual crop and as a companion crop providing a nectar source for bees and parasitic wasps. Beneficial parasitic wasps prey on insect pests in productive crops growing in paddocks nearby.

Seeds and sowing rate

Seed weight: Small and lightweight seed, with an orange segment-type shape. It has a uniform dark brown cover and coarse texture. The seed is 2 mm in size and thousand seed weight (TSW) of 2-3 g

Sowing rate: Pure sward: 5-10 kg/ha; mixes: 2 kg/ha higher rate and 0.25-0.5 kg/ha lower rate. Phacelia establishes quickly and should not be sown with slow-growing species. It can be combined into mixes with other fast-establishing annual species (e.g. mustard, annual clovers and buckwheat)

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring to autumn when soil temperature is 10°C and rising

Nutritional value

Low

Grazing tolerance

Low

Longevity

Annual - varies 75-120 days

Anti-quality feed factors

Not recommended for feeding to livestock

Buckwheat

(Fagopyrum esculentum)

CROP SPECIES

FAMILY: *Polygonaceae*

An annual plant *(Fagopyrum esculentum)* with clusters of small, whitish or pinkish flowers and small, seed-like, triangular fruits. Buckwheat is a broadleaf plant, not a cereal, but the edible fruits can be used either whole or ground into flour. Buckwheat is a spindly plant with heart-shaped leaves and reddish, hollow stems.

Usage

Buckwheat forage can be fed to livestock, made into hay or ensiled. Buckwheat makes a valuable cover crop and provides green manure. It is fast-growing, flowers in 4-6 weeks and sets seed in 10-12 weeks. As a cover crop, its vigorous growth habit can suppress weeds and a longer flowering period attracts beneficial insects/pollinators. Buckwheat can make phosphorous more available in the soil due to its roots releasing acidic compounds.

Seeds and sowing rate

Seed weight: 28,500 seeds/kg

Sowing rate: Pure sward: about 40 kg/ha but heavier rates may be required in paddocks with a high weed burden. Cover crop mixes: 2.5-5 kg/ha is often used

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring to autumn when soil temperature is 10°C and rising

Nutritional value

Low

Grazing tolerance

Low

Longevity

Annual - 70-90 days

Anti-quality feed factors

Buckwheat contains fagopyrin, a dianthroquinone that is present in both the green and dried plant, but not the ripe seed. Consumption of fagopyrin can cause primary photosensitisation when livestock consume large amounts of buckwheat (e.g. selectively graze)

Linseed (Flax)

(Linum usitatissimum)

CROP SPECIES

FAMILY: *Linaceae*

Linseed is a rich green, upright plant, generally hairless. The leaves are lance-shaped. The flowers are five-petalled and cornflower blue in colour, although some varieties differ, with yellow or white flowers. The seed heads or bolls turn brown to yellow as the plant matures. It has a shallow but good lateral root system.

Usage

A component of fabric and linen yarn, while seeds are used for linseed oil. Used as a cover crop with potential to attract beneficial insects, mobilise phosphorus in soil and help soil compaction issues.

Seeds and sowing rate

Seed weight: 143,000 seeds/kg

Sowing rate: Pure stand: 40 kg/ha; not often sown as a pure stand. Minor component of a pasture mix: 1.25 - 2.5 kg/ha. Dominant component of pasture mix: 10 kg/ha

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring when soil temperature is 8°C and rising

Nutritional value

Low

Grazing tolerance

Low

Longevity

Annual, 30-40 days

Vetch - common

(TARES OR HAIRY VETCH)

Vicia sativa (common vetch), Vicia villosa (hairy vetch, sand vetch, winter vetch, woolly pod vetch)

CROP SPECIES

Broad-leaved common vetch (center) compared to narrow-leaved hairy vetch (left and right).

FAMILY: *Fabaceae*

Vetches *(Vicia spp.)* are winter growing annual legume with a vine-like growth habit. Vetch can grow up to 80 cm tall, with pale purple flowers around 2 cm long, often found in pairs but never in clusters. The leaves have 4-8 pairs of broad leaflets and end in clinging tendrils. Common vetch leaflets are broader than the narrow hairy vetch leaflets (refer to image). The seed pods, 5-7 cm long, contain 5-12 seeds. Common vetch is recommended for grazing stock, whereas hairy vetch (due to its toxins) is often only recommended for cover crops.

Usage

A multi-purpose crop, used for the production of grain, green manure, fodder or hay while providing other rotational benefits of legumes. Mixed crops of oats and vetch produce good quality hay and silage, while offering a suitable feed for grazing animals. Common vetch is less winter-hardy than hairy vetch. Unlike hairy vetch, common vetch is not hard-seeded and therefore poses a low risk of becoming a weed problem if plants escape at field edges before grazing or when incorporated as a cover crop.

Seeds and sowing rate

Seed weight: Common vetch: 11,000-15,000 seeds/kg
Hairy vetch: 18,000-29,000 seeds/kg

Sowing rate: Pure sward: common vetch 50kg/ha.
Oat-vetch combination mix: both cultivars are sown at the same time: common vetch at 15-25 kg/ha and oats at 30-60 kg/ha. For hairy vetch mixes, use 2-6 kg/ha

Sowing depth: 60-70 mm

Time of sowing: Spring to autumn when soil temperature of 15ºC and rising

Inoculum

Group E

Nutritive value

Medium

Grazing tolerance

Low

Longevity

Annual, 90-110 days

Anti-quality feeding factors

Reports of vetch being toxic to grazing animals often reflect one of three known health challenges associated with vetch, especially hairy vetch:

1) Neurological signs in animals include trembling, staggering and/or seizures, reflecting effects of vetch-specific toxins, vicine and divicine

2) Cyanogenic glycosides (hydrocyanic acid) in vetch may cause sudden death. Surviving animals show neurological signs and blood may change colour from dark to bright red

3) Severe inflammation of skin and other organs are occasionally seen in cattle that consume vetch, likely to be an immune-mediated reaction to unknown compounds found in vetch

Most health challenges in vetch-fed animals occur when vetch seeds are eaten. The risk to animal health is greatest when vetch plants are grazed at the reproductive stage.

Daikon radish

(Raphanus sativus var. longipinnatus)

FAMILY: *Cruciferae*

Meaning 'big root', Daikon is a mild-flavoured winter radish usually characterised by fast-growing leaves and a long, white, napiform root.

Usage

Daikon Radish is a fast-growing cover crop (40-90 days maturity) that helps to suppress weeds. Large taproots can improve soil structure and break up compaction. Cultivars can be selected to control soil-borne nematodes. Fodder radish will also scavenge nitrogen from the soil. Effective sown as a pure sward or in mixes with other cover crop species.

Seeds and sowing rate

Seed weight: 70,000-88,000 seeds/kg

Sowing rate: 8-12 kg/ha as pure cover crop. As a component in mixes, sow at 1-6 kg/ha

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring when soil temperature is 8ºC and rising

Nutritional value

Medium when leafy, but low when bolting to flower

Grazing tolerance

Low

Longevity

Annual

Mustard

Black mustard (Brassica nigra); white mustard (Sinapis alba)

FAMILY: *Brassicae*

Mustard plants are thin plants with spike-like clusters of 2-12 flowers. Individual flowers are 8 mm in diameter. The seeds are red to brown in colour and are produced from each flower. Mustard can grow 1.2-2 m in height and is an annual plant.

Usage

Black mustard seeds are exceedingly pungent. White seeds tend to be much milder. Brassicas such as mustard have high amounts of glucosinolates. When the mustard plant is incorporated into the ground and decomposition starts, glucosinolates are released into the soil. This release is what triggers the biofumigant response. The use of these plants may reduce the amount of pesticides required. The seed of black mustard may remain in the soil for several years and could escape from the sown paddock to become a weed. In contrast, white mustard germinates all at once so poses a lower risk of being a potential weed burden as long as plants are not allowed to set seed. Avoid using mustard if forage brassicas are part of the usual cropping programme, in order to reduce soil-borne disease build-up.

Seeds and sowing rate

Seed weight: 166,000 seeds/kg

Sowing rate: Pure sward: 8-12 kg/ha. As a component of mixes: 1-4 kg/ha

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring and summer sown when soil temperatures are greater than 5ºC

Nutritional value

Low

Grazing tolerance

Low

Longevity

Annual, 80-85 days

Anti-quality feed factors

Mustard with high glucosinolate concentrations may not be suitable for grazing by livestock

Sulla

(Hedysarum coronarium)

OTHER PASTURE OPTIONS

FAMILY: *Leguminosae*

Biennial or short-lived perennial, semi-erect to erect growing to 0.3-1.5 m. Stems are thick, becoming woody after full flowering. Strongly taprooted, over 2 m deep, with numerous secondary roots. Flower heads are bright crimson in colour. Good palatability. Contains condensed tannins.

Grazing management

Establishment: After sowing, the stand can be lightly grazed after 2-3 months

Grazing: For established sward, graze to 30-50 cm foliage height on a 6-8 week rotation in spring then 8-10 week grazing rotation in summer

Hay and silage: Growth characteristics make sulla suitable for conservation. Good-quality hay can be made if cut at flowering rather than the traditional pod-stage, while good quality, wilted silage can be made due to its high water-soluble carbohydrate concentration

Seeds and sowing rate

Seed weight: 190,000 seeds/kg (hulled)

Sowing rate: Dehulled seed can be sown at 10-12 kg/ha, as a component in mixes sow at 2-6 kg/ha

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring to autumn when soil temperature at 10°C and rising

Inoculum

Specific WSM1592, Group CB1335

Nutritive value

Medium

Grazing tolerance

Medium

Longevity

Medium

Anti-quality feeding factors

Contains condensed tannins

Cultivars

Wilpena

Tick beans (Faba beans)

(Vicia faba var. minor)

CROP SPECIES

FAMILY: *Leguminosae*

Vicia faba is an upright annual forage legume that can grow to a height of 1.5-2 m. It has a taproot and many fibrous lateral roots. Faba beans are a legume crop producing a tall and large canopy (20 t/ha fresh weight at late pod fill). Varieties with smaller, harder seeds that are fed to animals are called field bean, faba beans or tick bean. Note that the garden broad bean is also *Vicia faba,* but with a very large seed.

Usage

Being a legume, Faba bean is a nitrogen-fixing plant. It is a break crop that enhances cereal yield, as it decreases the occurrence of take-all and cereal cyst nematode. It tolerates waterlogging better than other legumes. Care must be taken with faba beans, as they are subject to a disease known as chocolate spot.

Seeds and sowing rate

Seed weight: Seed can vary in size from 0.5-0.8 g

Sowing rate: Sowing rates should be based on thousand seed weight and germination test results

Sowing depth: 20-50 mm

Time of sowing: Spring when soil temperatures are 10°C and rising

Inoculum

Group F

Nutritive value

Medium

Grazing tolerance

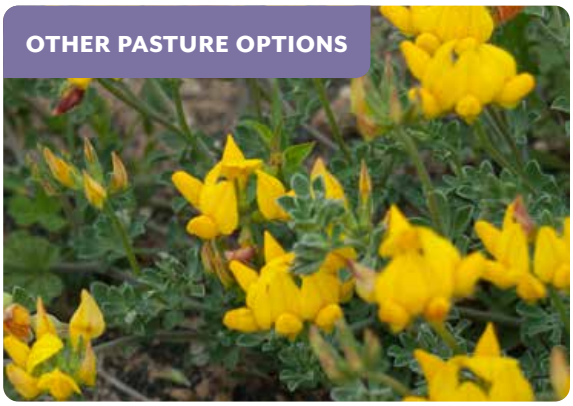
Low

Longevity

Annual

Lotus pedunculatus

(Lotus major) (syn: Lotus uliginosus)



FAMILY: *Leguminosae*

A perennial, five-leaved legume that spreads via creeping rhizomes. Flowerheads are yellow florets, often tinged with red that turn brown after flowering. Option for wet, acidic, infertile soil under lighter grazing pressure. Similar feed value to lucerne, but contains condensed tannins and is non-bloating. Can be cut at early flowering stage for hay.

Grazing management

Performs best under continuous lax grazing. Rotational grazing, particularly during late autumn to early winter, is detrimental to long-term survival. Lax grazing (leaving approximately 7-10 cm of residual leaf and stem) is critical, as recovery from grazing depends on secondary regrowth from lateral buds on the shoot stumps left behind after grazing. Foliage will die off at temperatures below -5°C, but plants generally recover.

Seeds and sowing rate

Seed weight: Small, yellow/golden, smooth and oval. 2,000,000 seeds/kg diploid and 1,200,000 seeds/kg tetraploids

Sowing rate: Pure sward: Up to 5 kg/ha. Mixed sward: 1-3 kg/ha

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring when soil temperature is 10°C and rising

Inoculum

Own required

Nutritive value

Medium-high

Grazing tolerance

Medium

Longevity

Medium

Cultivars

E-Tanin, Grasslands Maku, Grasslands Trojan

Lotus corniculatus

(Birdsfoot trefoil)

FAMILY: *Leguminosae*

It is shorter lived than *L*. pedunculautus. Erect-growing, five-leaved perennial legume with no rhizomes and minute stipules. Flowers heads are yellow in colour often tinged with red. Seed pods are similar in appearance to a bird's foot, hence the name. Thrives in infertile soils under lighter grazing pressure. It is primarily used in mixed swards with cocksfoot on acidic soils and phalaris/fescues in waterlogged soils. Similar feed value to lucerne, but contains condensed tannins and is non-bloating.

Grazing management

Performs best under lax continuous grazing. Rotational grazing, particularly during late autumn to early winter, is detrimental to long-term survival. Lax grazing (leaving approximately 7-10 cm of residual leaf and stem) is critical, as recovery from grazing depends on secondary regrowth from lateral buds on the shoot stumps left behind after grazing.

Seeds and sowing rate

Seed weight: Golden, smooth and oval. 850,000 seeds/kg

Sowing rate: Pure sward: 6-10 kg/ha. Mixed sward: 2-4 kg/ha

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring when soil temperature is 10°C and rising

Inoculum

Own required

Nutritive value

Medium-high

Grazing tolerance

Medium

Longevity

Medium

Cultivars

Grasslands Goldie

Plantain

(Plantago lanceolata)

FAMILY: *Plantaginaceae*

Plantain is a perennial herb that is used in a range of pasture mixes. Large-leaved, succulent, strongly-ribbed leaves are flattened and lance-shaped with upward fine hairs. Grows from a basal rosette. Plantain can be grown as a specialist crop or as a component in a pasture mix with grass or clover. Plantain can grow on a range of soil types; however, it performs best when grown on free-draining soils. Growth will be maximised on high-fertility soils not prone to waterlogging or treading damage in wet weather. In a pasture mix, Plantain can be made into hay and silage.

Grazing management

Establishment: Specialist plantain crops should be first grazed no earlier than the six-leaf stage (i.e. the plants have six fully-grown leaves). This is normally 7-8 weeks after spring sowing. This ensures plants have well-developed root systems to improve survival

Grazing: When plantain is part of a pasture mix, the paddock should be managed as a normal grass and clover pasture. This means post-grazing residuals of 1,500-1,600 kgDM/ha. In pure stands, target cover heights are measured by leaf height (ignoring the stems). Pre-grazing height is 25 cm (generally this is 4-6 weeks of regrowth)

Seeds and sowing rate

Seed weight: 500,000 seeds/kg

Sowing rate: As a component in a mixed sward: 1 kg/ha or more, depending on dominance of Plantain in the sward

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring to autumn when soil temperature is 8°C and rising

Nutritional value

High

Grazing tolerance

High

Longevity

Medium to high

Cultivars

Ecotain®, AgriTonic

Sheep's burnet

(Sanguisorba minor)

FAMILY: *Rosaceae*

A perennial herb used in New Zealand high country, but only to a small extent. Deep-rooted, growing greyish leaves from a basal rosette, leaves are divided into leaflets, arranged in pairs and with a terminal leaflet. Flowerheads are round, greenish and 10-15 mm in diameter. Survives dry summers and cold winters with good frost tolerance. Suited to semi-arid and drought-prone areas of New Zealand (e.g. Central Otago).

Grazing management

Sheep's burnet is slower to establish than lucerne, so a weed-free seedbed is important to reduce competition. Similar in grazing management to lucerne, targeting post-grazing residuals of 5-7 cm

Seeds and sowing rate

Seed weight: 154,000 seeds/kg

Sowing rate: Sown as a component in a mixed sward at 5-8 kg/ha. A lower sowing rate can be used for lucerne mixes. It can be drilled or broadcast, including aerial application (but lift sowing rate to 10-20 kg/ha)

Sowing depth: Shallow: 10-20 mm

Time of sowing: Spring to autumn when soil temperature is 8°C and rising

Nutritional value

High

Grazing tolerance

Medium

Longevity

Medium

Lupins

(Lupinus)

OTHER PASTURE OPTIONS

FAMILY: *Fabaceae*

Used as a green manure and feed for grazing livestock.

Russell lupin ***(L. polyphyllus)*** is a perennial herb (less than 1 m in height) with erect, hairy stems that branch from the base. Produces an erect flowerhead (15-60 cm long) bearing many slightly-scented, pea-like blue, purple, orange, yellow, pink or white flowers (12-20 mm in diameter) in September to February. It has been sown as feed for grazing animals in low fertility soils, low rainfall regions. Note: Environment Canterbury has classified it as a pest weed.

Narrow-leaved lupins ***(L. angustifolius)*** are an annual species that is early maturing and frost tolerant. Flower colour can be pink, white or blue. There are sweet and bitter varieties. It is one of the most common annual lupins used in New Zealand.

Yellow lupin ***(L. luteus)*** is a less vigorous annual plant with a branching growth habit. There are low alkaloid and non-shattering varieties.

Blue lupins ***(L. consentinii)*** are a deep-rooted annual species that are erect with strong stems growing up to 1.6 m in height. The stems and seed are bitter due the presence of alkaloids. Blue lupins can be grazed at modest stocking rates through winter as stock will largely avoid green blue lupin plants. During flowering, the flowers and green pods become palatable for grazing stock, but have high levels of alkaloids that can be toxic and present a animal health risk.

White lupin ***(L. albus)***, another annual species, provides seeds for food and feed, fodder and green manure. White lupins are more susceptible to frosts than other varieties and later maturing. There are high and low alkaloid varieties.

Grazing management

Ensure low alkaloid (sweet) cultivars are used for grazing animals. Lupins are best grazed prior to flowering, which is when the most feed is available. Utilise break feeding, allowing animals access to the crop for short periods at first, before extending the time on crop as animals become accustomed to grazing new feed source

Seeds and sowing rate

Seed weight: Will vary according to type

Sowing rate: Please seek advice before sowing. Sowing rates are based on plants required per 1 m^2 and adjusted for thousand-seed weight and germination percentage

Sowing depth: 20-50 mm

Time of sowing: Spring to autumn when soil temperature 10°C and rising.

Inoculum

Should be inoculated with rhizobium strain NZP2141

Nutritive value

Medium

Grazing tolerance

Medium

Longevity

Annual, except for Russell lupins that are perennial

Anti-quality feeding factors

Not suitable for cattle feed. If fed to sheep, be aware of alkaloid poisoning.

Some lupins contain certain secondary compounds, including isoflavones and toxic alkaloids (such as lupinine and sparteine)

Greenfeed cereals

Barley (Hordeum vulgare); oats (Avena sativa); wheat (Triticum aestivum); Ryecorn (Secale x cereal); Triticale (Triticosecale)

FAMILY: *Graminae*

Barley is generally considered the fastest-growing greenfeed. To be fed *in situ* or cut for silage production, mainly in the South Island. Sometimes sown in a mixed sward with tick beans, peas or vetch. Dry matter yield is generally less than other cereals, but it does reach maximum yield potential earlier.

Oats: Forage oats are mainly used for feeding livestock. They may be grazed, cut-and-carried or conserved as hay, silage or bailage. Oats are also used as a winter cover crop to protect soil from erosion and to absorb nitrogen that would be vulnerable to leaching during the winter. Oats are the best option if only one grazing is required.

Wheat is the least-used cereal as a greenfeed, with yields varying depending on the time of sowing and soil fertility. Greenfeed wheat can also be used for wholecrop silage, but not as widely used as triticale or barley.

Ryecorn is closely-related to barley and wheat and grown extensively as a grain, cover crop and forage crop. Ryecorn is used for its greater frost tolerance relative to other cereals and ability to regrow.

Triticale is a cross between wheat and rye, combining the disease resistance and hardiness of ryecorn and plant vigour of wheat. Triticale can be grown for greenfeed and fed *in situ* or cut for silage. The advantage of triticale over oats is its post-grazing regrowth potential and higher disease tolerance.

Grazing management

Crops are generally break fed with back fencing being essential to optimise regrowth potential. Crop utilisation normally does not exceed 65%. Crops can be grazed 4-6 weeks after sowing, but will take longer to reach maximum yield potential

Silage management

Green crop silage requires a wilting process like spring grass silage. Ideally, the crop should be wilted down to around 30% dry matter for ideal ensiling. Silage should be finely-chopped and sealed well in a stack or round bale and wrap. Inoculants are beneficial in aiding curing and resultant quality

Sowing rates

Barley (greenfeed): Spring sown at 90-120 kg/ha

Oats (greenfeed): Spring sown at 90-120 kg/ha

Wheat: 140-160 kg/ha

Ryecorn: 120 kg/ha

Triticale: Spring sown 150-170 kg/ha and 110-130 kg/ha if autumn sown

If cereals are sown with a legume such as pea or vetch, sowing rates should be halved. A lower sowing rate enables a higher dry matter yield to be achieved earlier

Sowing depth: At least 25 mm, but aim for 50 mm to avoid birds and root rot diseases

Nutritive value

Medium

Grazing tolerance

Low

Longevity

Low

Anti-quality feeding factors

- Nitrate poisoning
- Low calcium as greenfeed

Sorghum

(Sorghum spp.)

CEREAL OPTIONS

FAMILY: *Graminae*

Sorghum is an annual grass in the family Poaceae, grown primarily as a late sown forage option in New Zealand. Sorghum has an erect, solid stem with one or more tillers (additional shoots that grow subsequent to the parent shoot) and curving leaves measuring 30–135 cm in length. The inflorescence of the plant consists of spikelets arranged on branches at the head of the plant. When the plant flowers, yellow anthers begin to appear on the head.

Usage

Sorghum species embrace a wide range of types used for forage during summer. In New Zealand, the more appropriate terminology is forage hybrids; for example, Sprint (Sudan x Sudan grass forage hybrid) and BMR Rocket (Sudan grass x sorghum hybrid). Other hybrid crosses available include sorghum x sweet sorghum hybrids and sweet sorghum x sweet sorghum hybrids

Grazing management

Graze once the plants are 100-150 cm in height depending on cultivar. Plants shorter than this may have a higher concentration of nitrate and should not be grazed by livestock. Once plant height reaches 1.5 m, feed quality rapidly declines. To optimise regrowth potential, back fence and limit post-grazing residuals to 15 cm

Silage management

Maximum quality occurs when the crop reaches about 1 m in height. Do not cut following a frost. Wilt crops to 30-35% (use mower conditioner to help). Chop length is about 10-20 mm depending on crop moisture content. Use inoculants to increase feed value. Stack and cover immediately

Seeds and sowing rate

Sowing rate: Sowing rate is variable depending on hybrid type and growing conditions; discuss with your local Sales Agronomist (see page 261)

Sowing depth: 4-5 cm; broadcasting not recommended

Time of sowing: Sow in spring when soil temperatures are 17°C and rising

Nutritive value

Medium - crude protein and metabolisable energy rapidly declines with deferred grazing or cutting

Grazing tolerance

Low

Longevity

Low

Anti-quality feeding factors

Can release the toxic compound prussic acid, especially if the seedling is under 6 weeks old, placed under stress or has young regrowth

Maize (Greenfeed)

(Zea mays)

CEREAL OPTIONS

FAMILY: *Graminae*

Maize has a distinct growth habit, the lower leaves are like broad flags, 50-100 cm long and 5-10 cm wide. The stems are erect, conventionally 2-3 m in height, with many nodes, casting off flag-leaves at every node. Under these leaves and close to the stem grow the ears. The ears are female inflorescences, tightly-covered over by several layers of leaves; they do not show themselves easily until the emergence of the pale-yellow silks from the leaf whorl at the end of the ear. The silks are elongated stigmas that look like tufts of hair, at first green and later red or yellow.

Usage

Maize is a high-producing crop that can be grown for grain, greenfeed and silage.

Grazing management

Break feeding - crop break feed using a wire. Crop wastage can be high due to trampling. To reduce wastage do not allow the crop to become too mature.

Flail-type harvesting

Area of the crop is first laid flat. Harvester is then driven over in opposite direction to which the plants are lying. Often leads to high losses.

Precision choppers

Single- or two-row precision harvesters are used to cut and carry forage.

Silage management

Harvest the crop for silage when whole plant dry matter is approximately 35%. This dry matter value offers the best possible compromise between grain content, sugar content, stover digestibility and moisture content.

Seeds and sowing rate

Sowing rate: A higher sowing rate will increase the amount of feed available earlier in the season. If sufficient soil nutrients and moisture is available, then sow at around 150,000 seeds/ha. If feed is required late in the season, then use a lower sowing rate at 100,000-120,000 seeds/ha

Sowing depth: 50 mm

Time of sowing: Start sowing in spring once the soil temperature reaches 10°C

Nutritive value

Medium

Grazing tolerance

Low

Longevity

Low

Anti-quality feeding factors

Nitrate poisoning. No maize crop should be fed to livestock prior to 8 weeks after sowing. Young, rapidly-growing plants or those plants that are moisture, heat or drought stressed should be nitrate tested prior to feeding

Millet

Pearl millet *(Pennisetum glaucum)*, Proso millet *(Panicum miliaceum)*, Foxtail millet *(Setaria italica)*, Japanese Millet *(Echinochloa esculenta)* and Browntop millet *(Urochloa ramosa)*.

CEREAL OPTIONS

FAMILY: *Graminae*

Pearl millet *(Pennisetum glaucum)*: An erect annual grass, reaching up to 3 m high with a extensive root system.

Proso millet (*Panicum miliaceum*): An erect annual grass up to 1.2-1.5 m tall, usually free-tillering and tufted, with a rather shallow root system. It matures quickly in 45-100 days after sowing. The vegetative phase is usually completed 16-20 days after sowing.

Foxtail millet *(Setaria italica)*: An erect annual grass, fast-growing, leafy and tufted, 90-220 cm high. It has a dense root system of thin adventitious roots. Its stems are erect, slender and tiller from the base.

Japanese millet *(Echinochloa esculenta)*: Sometimes confused with barnyard grass *(E. crus-galli)*. It has a compact inflorescence with reddish-purple seed with no awns, while barnyard grass has an open-branched panicle and white seeds with conspicuous awns.

Browntop millet *(Urochloa ramosa)*: An annual/perennial warm-season grass often used in forage systems. The stem (culm) may be erect or prostrate along the ground. When growing erect, it can reach 1 m at maturity.

Usage

For grazing and silage management, seek advice

Seeds and sowing rate

Sowing rate: 10-40 kg/ha for a pure sward sown down or broadcast, but it will vary with cultivar used and growing conditions. As a component in crop mixes, sow at 5-7 kg/ha

Time of sowing: For Pearl millet, the ideal growing temperature ranges from 21-35°C. Foxtail millet is frost-sensitive and grows better between 16-26°C, although it does have a broader range of temperature tolerance (5-35°C). Most cultivars are intolerant to frost, limiting their use in New Zealand

Nutritive value

Medium

Grazing tolerance

Low

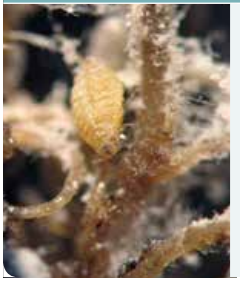
Longevity

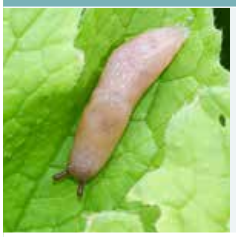
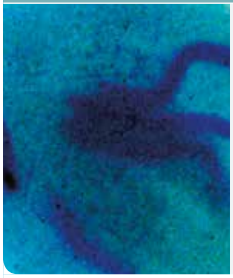
Low

PASTURE OPTIONS

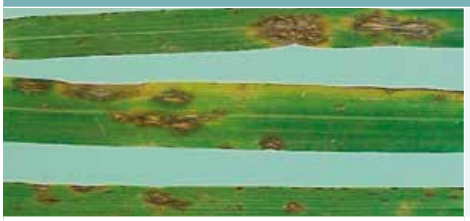
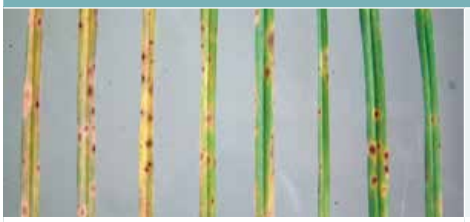
Pasture Pests and Diseases

Pasture pests

PEST		SYMPTOMS	IMPACT	CONTROL
Argentine Stem Weevil (ASW)				
	ASW is a common pasture pest throughout New Zealand. Adult ASW feed all year round on leaves, however not as significantly as larvae feeding.	Adult ASW damage is characterised by narrow rectangular holes in the tips of leaves. Larvae appear from October onwards and will feed on grass tillers. Larvae will mine the stem of vegetative tillers, causing them to turn yellow then ultimately die. Damaged tillers may show a small exit hole near the base of the tiller.	Damage, particularly from larval feeding, will result in plant persistence issues.	Use of Superstrike® grass seed treatment for seedling protection. Use of grasses with AR1, AR37 or MaxP® endophyte. Sowing grass after peak ASW flights. Cultivation to destroy larval weevil population.
Black Beetle				
	Black Beetle is a major pest in the northern North Island, with warmer years favouring population growth. Both adults and larvae damage pastures.	Adult feeding is noticeable in autumn when there are patches of yellowing tillers that are easily pulled from the pasture. They usually feed at the base of the plant at soil level. Larvae feed on the roots of grasses over summer, causing pasture to become loose and prone to pulling.	If weeds or non-endophytic species invade the pasture sward, this provides a feed source for Black Beetle adults and allows them to lay eggs, increasing risk of larvae damage.	AR37 or MaxP® endophytes will deter adult Black Beetle, but not larvae. Use of Superstrike® grass seed treatment to protect seedlings. Use of summer forage crops (e.g. brassica or chicory) to break the life cycle.
Black Field Cricket				
	Black Field Cricket is found throughout the North Island and in milder coastal regions of the South Island. In high populations they can cause significant pasture loss and damage.	Grass plants may be completely consumed down to the crown. Seeds and seedlings can also be attacked and areas with heavy infestation may become totally devoid of vegetation.	Damage is most significant during long dry spells as plants are less tolerant. In high numbers, crickets will compete with stock for pasture. Ten crickets/m² is considered economically damaging.	Cricket bait for Black Field Cricket control is recommended when populations exceed ten crickets per m². Insecticide application. Use of a summer forage crop (brassica or chicory).
Grass Grub				
	Grass Grubs are found throughout New Zealand and can cause severe damage to pasture.	Grass Grub larvae feed on the roots of a range of plants. Plants will wilt and may eventually die due to the roots being eaten away. The period of maximum feeding by grubs occurs in autumn and early winter.	Yellow patches of stunted growth appear in the pasture and plants may be readily pulled from the ground due to loss of roots.	Use of Superstrike® grass seed treatment for seedling protection. Granular insecticides sown in the root zone. Cultivation will reduce populations but can predispose pasture to damage 2-3 years later. Heavy stocking or rolling to squash larvae in autumn.
Root Aphid				
	Root Aphids are found throughout New Zealand and feed on ryegrass roots, sucking sap from the grass.	Root Aphids produce a white, waxy, mouldy-looking substance and are yellow/white in colour. In contrast, Pasture Mealy Bug (PMB) are white/pink. Root Aphids are also found slightly deeper beneath the surface than PMB. Signs of infestation are plant stunting and yellowing as a result of root damage.	Root Aphid feeding can have a significant impact on root growth. Combined with other stresses, Root Aphids can cause plant death.	Use of AR37 endophyte will provide good protection from Root Aphids.

PEST		SYMPTOMS	IMPACT	CONTROL
Clover Root Weevil (CRW)				
	Clover Root Weevil is a major clover pest and can have significant economic impact.	Adult Clover Root Weevil feed on leaves, creating evenly-shaped notches around the outside of the clover leaves. Larval feeding is the most damaging of the life cycle as they attack the roots and remove clover root nodules.	Larval feeding on roots and root nodules will reduce plant growth and the opportunity to fix nitrogen.	Chose cultivars with higher tolerance to CRW (e.g. Legacy). Nitrogen fertiliser to reduce the effects of reduced N fixation. Cultivation/The Programmed Approach™.
Porina				
	Porina moths fly during spring and early summer, while caterpillars and their subsequent damage will be most noticeable from April through to September.	Caterpillars are the most damaging part of the lifecycle. Caterpillars build vertical tunnels into the soil and emerge at night to feed on pasture plants. Bare patches appear in the sward and the incidence of flat weeds may increase. Fine casts of dirt usually appear on the soil surface.	Porina are grazers and will reduce the amount of foliage available to stock. At higher populations, they can destroy establishing plants and reduce long-term pasture quality and production.	Use grasses with AR37 endophyte. Regular pasture monitoring. Mob stocking of pastures to avoid poor quality pasture and build-up of debris. Insecticide application. Heavy stocking or rolling to squash larvae.
Slugs				
	A very common and significant pest in all crops. Slugs are present all year round, but are most damaging in spring and autumn.	Direct drilled crops are typically most at risk as the thatch and direct drill slits provide food and a refuge for slugs. Slugs will feed on germinating seedlings.	High populations can be devastating to crop establishment.	Always use slug bait in direct drill situations. Closely monitor ALL crops for Slug presence during establishment and treat accordingly.
Pasture Mealy Bug				
	A pasture pest mainly found in the Canterbury, Manawatu and Nelson regions.	Most damage is a direct result of feeding, so only high populations are important. Infestation can be recognised from the surrounding white waxy substance found in the crown of the plant. Pasture Mealy Bugs are approximately 2 mm long and pale pink/white compared to Root Aphids, which are yellow/white and smaller.	Reduced pasture persistence.	Use of grasses with standard, AR1, AR37 or MaxP® endophytes.
Clover Root Nematodes				
	Clover Cyst Nematode, Root-knot Nematode and Lesion Nematode are all known to affect white clover and possibly other clovers.	Nematodes are tiny soil-borne worms that attack clover roots in both established and establishing pasture. As Nematodes attack the roots, symptoms are difficult to see and only apparent as reduced production or poor establishment of clover.	Poor establishment of recently sown areas. In established paddocks, reduced plant growth and vigour along with reduced nitrogen fixation.	Use of Superstrike® clover seed treatment for seedling protection. Application of nutrients, including phosphate and molybdenum, to increase clover growth.

Pasture diseases

DISEASE	EFFECT	CONTROL
Rust		
	Rust-infected plants are less vigorous and smaller than those without the disease, leading to reduced yields as well as a reduction in palatability and nutritional quality.	• Use of resistant/tolerant cultivars • Close grazing at high stocking rates over summer • Applications of nitrogen fertiliser
Pepper spot		
	Leaves and petioles develop numerous, small discrete spots. Leaves turn brown, appear scorched and drop. A common disease of clover in wet areas from mid-summer.	• Timely grazing and harvesting • Chemical control
Grass – leaf spot, blights and blotches		
	Localised damage to ryegrass pastures throughout New Zealand. Disease causes loss of green leaf, reducing forage value and dry matter production.	• If disease is noted as increasing, graze or cut to stop infection build-up • Fungicide (Strobilurin) application
Clover – leaf spot, blights and blotches		
	Forage quality may be affected by spotting and defoliation, which can have an effect on pasture yield.	• Timely grazing and harvesting
Clover viruses		
	Symptoms are not always obvious, but can be more noticeable in spring and autumn growth. Symptoms can vary from leaf mottling, distortion, crinkling and size reduction through to plant stunting.	• Use of tolerant or resistant cultivars where available • Sowing cultivars well-adapted to a region to reduce plant stress and virus susceptibility • Allowing new pastures to establish well before stocking or mowing • Control of Aphid infestations
'Damping off' diseases		
	Symptoms are characterised by either the failure of seedlings to emerge or the toppling over and subsequent death of newly-emerged seedlings. Plants that are affected post-emergence usually appear shrivelled and discoloured at the shoot base. Damping off pathogens cause infection over a wide soil moisture and temperature range.	• Use of Superstrike® grass seed treatment to protect seedlings • Chemical control

An established pasture in Southland.

PASTURE OPTIONS

Corson Maize Hybrids

Corson Maize hybrids

RE-PLANT POLICY

Growing an excellent maize crop requires good planning and following best practice processes, however sometimes failures may occur.

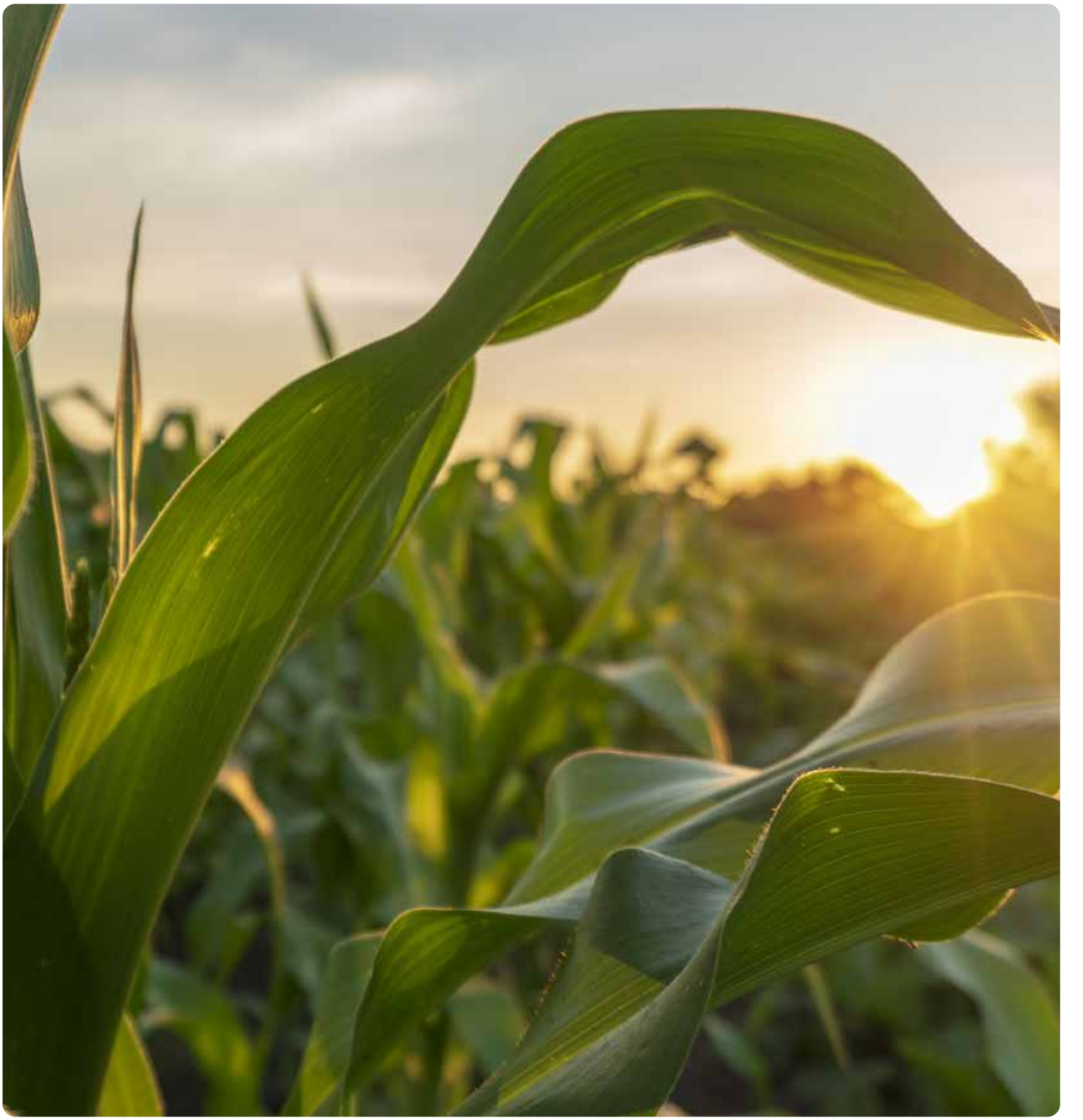
At Corson Maize we will share some of the cost of a failed crop. We will supply replacement Corson Maize seed at half price if, within two months of planting, the crop fails and needs to be re-planted.

This policy allows growers who have had a crop, sourced from any maize seed company, fail within two months of planting to purchase seed from Corson Maize at half price to re-sow the failed crop. This does not cover greenfeed maize products or sweetcorn and does not cover the cost of the seed treatment.

**Conditions apply – for full terms and conditions go to www.corsonmaize.co.nz*

FOR MORE INFO

Talk to your Corson Maize Sales Agronomist for further details, visit www.corsonmaize.co.nz or phone 0800 4 MAIZE



REGION 1	Very Early
REGION 2	Early
REGION 3	Early
REGION 4	Mid

Delitop

DUAL PURPOSE
Silage CRM 78 / Grain CRM 88

- **Very early maturing dual purpose hybrid**
- **High silage yield with reliable grain content for this maturity**
- **Excellent test weight grain suitable for food grade markets**

Delitop is a very early dual purpose hybrid for silage or a later planting option throughout the country. For grain, Delitop is accepted for food grade production in northern regions.

Excellent early growth, with very good drought tolerance and resistance to Northern Leaf Blight for this maturity.

Delitop has respectable yield performance for both silage and grain and produces high energy silage with excellent whole plant digestibility.

Hybrid traits	
Early Growth	★★★★★
Drought Tolerance	★★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★★
Total Energy	★★★★
Stalk Strength	★★★★
Root Strength	★★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Very Early
REGION 2	Early
REGION 3	Early
REGION 4	Mid

Booster

DUAL PURPOSE
Silage CRM 81 / Grain CRM 88

- **Very early maturity dual purpose hybrid**
- **Excellent yield stability**
- **Large bulky plant with excellent early growth**
- **Very good stalk and root strength**
- **Girthy well filled ears packed with large excellent test weight kernels**

Booster is a very early dual purpose hybrid suitable for South Island, lower North Island and other regions where an exceptionally high yielding, early maturing maize hybrid is desired.

From its excellent early growth it develops into a large bulky plant with a solid girthy ear. Very good standability and good late season plant health optimise Booster's yield stability providing a solid platform for silage and grain growers.

The large size and hard, flinty nature of its kernels make Booster relatively slower to grain harvest maturity compared to silage maturity. Still, the high yield potential and consistency combined with a very good agronomic profile are set to make Booster the hybrid of choice in the "very early" maize market.

Booster is bred by KWS.

Hybrid traits	
Early Growth	★★★★★
Drought Tolerance	★★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★
Total Energy	★★★★
Stalk Strength	★★★★
Root Strength	★★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★
Grain Drydown	★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Early
REGION 2	Mid
REGION 3	Mid
REGION 4	Late

CORSON MAIZE PAC 119 NEW

AriDapt™ DROUGHT READY MAIZE

DUAL PURPOSE
Silage CRM 90 / Grain CRM 90

- **Well balanced medium-tall plant with very good standability**
- **Very good Northern Leaf Blight tolerance and excellent stalk strength**
- **Excellent drought tolerance and staygreen**

PAC 119 is a high yielding, genuine dual purpose option for use in all the main maize growing areas of New Zealand. Whether as an early option in the upper North Island or a late option in the mid Canterbury region, PAC 119 has the required attributes to deliver optimal results.

Hybrid traits	
Early Growth	★★★★
Drought Tolerance	★★★★★
Staygreen	★★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★★
Root Strength	★★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Early
REGION 2	Mid
REGION 3	Late
REGION 4	Very late

CORSON MAIZE
Comet

MAIZE SILAGE
Silage CRM 92

- **A widely adapted silage hybrid with very good staygreen and excellent rust tolerance**
- **Broad leaves on a medium-tall plant provide plenty of bulk**
- **A high kernel-row count and deep kernels produce silage with high grain content**

Comet is a reliable and widely adapted silage hybrid which provides impressive results throughout the North and upper South Islands.

Plant Comet as full maturity option in the upper South Island and a mid-maturity option in the lower North Island. It also performs well in the upper North Island in areas where Northern Leaf Blight isn't a major concern.

Comet has a large semi-flex ear and produces plenty of bulk with high yields of soft textured grain, making it an excellent choice for both silage growers and end-users.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★
Total Energy	★★★★★
Stalk Strength	★★★★
Root Strength	★★★
Rust Tolerance	★★★★★
Northern Leaf Blight	★★
Grain Drydown	NA

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Early
REGION 2	Mid
REGION 3	Late

PAC 249

DUAL PURPOSE
Silage CRM 95 / Grain CRM 97

- **Mid-season dual purpose hybrid for central regions**
- **Proven drought tolerance with AriDapt™ technology**
- **Performs well at lower planting rates**

PAC 249 is a reliable high performing dual purpose hybrid that delivers optimal yields of silage and grain across a wide range of environments and soil types. It is a medium-tall hybrid with very good staygreen and plant bulk.

Cobs are large and well filled with good sized kernels producing silage rich in grain. PAC 249 performs particularly well on light soils, recognised as a hardy hybrid capable of outperforming hybrids in the 100-104 CRM maturity bracket.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★★★
Staygreen	★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★
Root Strength	★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★
Grain Drydown	★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Early
REGION 2	Mid
REGION 3	Late

Velocity

DUAL PURPOSE
Silage CRM 95 / Grain CRM 98

- **The first maize hybrid bred in Germany released by Corson Maize, gives further genetic diversity to our portfolio**
- **Fast growth through to tassel stage delivers quick canopy closure**
- **Excellent total energy maize derived from high silage yield**

Velocity produces a medium statured plant that is deceiving in its capability to produce high silage yields with very good digestibility and starch content. Uniform ears with excellent test weight grain give Velocity the added advantage of being able to be harvested for grain if required.

Velocity has excellent stalk strength and with very good root strength can stand confidently through to harvest for either silage or grain. Very good tolerance to rust infection adds to its strong late-season plant health.

Velocity is bred by KWS.

Hybrid traits	
Early Growth	★★★★
Drought Tolerance	★★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★
Total Energy	★★★★★
Stalk Strength	★★★★★
Root Strength	★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*
NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Early
REGION 2	Mid
REGION 3	Late

C29-A1

DUAL PURPOSE
Silage CRM 96 / Grain CRM 96

- **Strong performance as an early maturity dual purpose hybrid**
- **Very tall plant producing high grain content silage**
- **Excellent silage and grain yields**

Distinct with a very tall bulky plant and large, well filled ears, C29-A1 retains its plant health late into the season to maximise its huge silage and grain yield potential.

While primarily targeted at the silage market, A1 does not compromise on grain yield and will deliver high yields of large, softer textured grain. A1 will perform best on medium to heavy soil types and in other situations where there is adequate fertility and soil moisture to complete the growing cycle.

Hybrid traits	
Early Growth	★★★★
Drought Tolerance	★★★★
Staygreen	★★★★★
Whole Plant Digestibility	★★★★
Total Energy	★★★★
Stalk Strength	★★★★
Root Strength	★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Early
REGION 2	Mid
REGION 3	Late

CORSON MAIZE
N39-Q1

DUAL PURPOSE
Silage CRM 97 / Grain CRM 100

- **Early to mid-maturity silage hybrid for most North Island regions**
- **Tall plant with high grain content**
- **Excellent silage and grain yields**

While primarily targeted at the silage market, N39-Q1 can also be taken through for grain with confidence. This hybrid is characterised by a tall plant and a large flex ear giving it excellent silage yields with high grain content. It has a sound agronomic package including very good stalk strength and drought tolerance.

Q1 is an exciting option for silage growers in the southern North Island as a mid-maturity hybrid or in the northern North Island regions as an early maturity option.

Hybrid traits	
Early Growth	★★
Drought Tolerance	★★★★★
Staygreen	★★★★★
Whole Plant Digestibility	★★★★★
Total Energy	★★★★★★
Stalk Strength	★★★★★
Root Strength	★★★★★
Rust Tolerance	★★★★★
Northern Leaf Blight	★★★★★
Grain Drydown	★★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Early
REGION 2	Mid
REGION 3	Late

Afinity

DUAL PURPOSE
Silage CRM 97 / Grain CRM 100

- **Full season grain hybrid for lower North Island**
- **Ear uniformity provides consistent yields**
- **Robust agronomic package**

Afinity is a medium-tall hybrid characterised by a uniform, well-filled cob with a deep kernel which gives a high yield of medium textured grain.

Afinity has strong agronomic traits, with very good stalk strength, excellent Northern Leaf Blight resistance, very good staygreen and a very good husk cover for maximum ear protection.

Afinity is suited to the southern North Island as a full maturity grain hybrid and as an early to mid-maturity option for the northern North Island including the East Coast.

Hybrid traits	
Early Growth	★★
Drought Tolerance	★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★★
Total Energy	★★★★★
Stalk Strength	★★★★
Root Strength	★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Mid
REGION 2	Mid
REGION 3	Late

PAC 314

DUAL PURPOSE
Silage CRM 101 / Grain CRM 101

- **Mid season dual purpose hybrid for all North Island regions**
- **Medium-tall, well-structured plant with plenty of eye-appeal**
- **AriDapt™ drought ready technology ensures reliable results across environments and seasons**

PAC 314 is an attractive, medium-tall plant with good early growth and excellent drought tolerance and adaptability. The broad semi-erect leaves and nice thick stalks of PAC 314 provide good bulk for silage. Dent-type grain quality is very good and will be readily accepted by grain buyers and feed mills. Excellent grain and silage results to date put this hybrid at or near the head of the pack, regardless of maturity, soil type or location.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★★★
Staygreen	★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★
Root Strength	★★★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Mid
REGION 2	Late
REGION 3	Very late

PAC 344

DUAL PURPOSE
Silage CRM 102 / Grain CRM 102

- **Mid-full season dual purpose hybrid for central and upper North Island regions**
- **Unique, medium-height, compact plant with thick stalks and very broad leaves**
- **Excellent stalk strength, ear-rot and Northern Leaf Blight profiles**

PAC 344 is an exceptionally fast and strong starting hybrid and maintains this advantage throughout the season with excellent staygreen and Northern Leaf Blight resistance and very good rust tolerance and finishing ability.

PAC 344 shows excellent early vigour, uniformity, vegetative growth and plant integrity. Drought tolerance is very good but can be improved by lowering plant population density. Grain quality is very good.

Hybrid traits	
Early Growth	★★★★★
Drought Tolerance	★★★★
Staygreen	★★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★★
Root Strength	★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Mid
REGION 2	Late
REGION 3	Very late

CORSON MAIZE

N51-N4

DUAL PURPOSE
Silage CRM 102 / Grain CRM 104

- **Competitive and stable grain and silage yields**
- **Wide adaption across northern regions and soils**
- **An excellent choice for silage and grain growers throughout the East Coast, Bay of Plenty and Waikato**

N51-N4 has been long recognised as a market leading grain hybrid. Over the last few years N4 has demonstrated a strong aptitude for silage particularly in more challenging situations. A strong all-round agronomic profile is highlighted by excellent drought tolerance and root strength, with very good ratings for early growth, stalk strength and tolerance to leaf diseases. Feed quality parameters also rate very good to excellent. Fast drydown from medium to soft density grain means it is suited to starch and feed markets.

Hybrid traits	
Early Growth	★★★★
Drought Tolerance	★★★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★
Total Energy	★★★★★
Stalk Strength	★★★★
Root Strength	★★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Mid
REGION 2	Late

CORSON MAIZE G49-T9

TV TENDER LEAFY

MAIZE SILAGE
CRM 104

- **Exciting silage hybrid that delivers very good yield potential**
- **Tall dark green plant with flexible stalks and large ears**
- **Reliable agronomic traits assist in maintaining maximum yield potential**

G49-T9 produces a tall crop with large ears which combine to provide its high dry matter yield potential and dependable silage quality. Along with very good whole plant digestibility and total energy, it will favour both the silage grower and the silage user.

T9 is widely adapted and suitable for maize silage growers on all soil types targeting high silage yields. Moderate populations are recommended to get the best balance of cob to stover.

Hybrid traits	
Early Growth	★★★★
Drought Tolerance	★★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★
Total Energy	★★★★
Stalk Strength	★★★★
Root Strength	★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★
Grain Drydown	NA

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Mid
REGION 2	Late

PAC 343

DUAL PURPOSE
Silage CRM 105 / Grain CRM 104

- **Attractive medium-tall plant. Well balanced canopy with thick stalks**
- **Reliable high yields of medium textured grain. Large kernels and excellent grain quality.**
- **Very good staygreen, drought tolerance and standability**
- **Finishes strongly owing to its very good stress tolerance and late season plant health**

PAC 343 has a strong agronomic package and has proven itself to be a resilient top end performer over the last four seasons ranking equally well in high and low yielding environments for both silage and grain. Ears are of a good consistent size and tightly packed with starchy light-coloured grain.

Drought and general stress tolerance is very good. In stressed situations, plant size may be reduced but grain yield will be much less affected providing good silage yields with a very high grain content. A top performer in light and heavy soils and seems to be quite tolerant of wet feet. This is a reliable hybrid that promises to deliver excellent results for silage and grain growers.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★★
Staygreen	★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★
Root Strength	★★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Mid
REGION 2	Late

PAC 432

DUAL PURPOSE
Silage CRM 105 / Grain CRM 107

- **Tall but well balanced type, moderately leafy**
- **Large uniform ears typically 18 kernels around, with large kernels**
- **Very good drought and stress tolerance**
- **Excellent stalk strength and Northern Leaf Blight resistance**
- **Excellent staygreen and late season plant health**

PAC 432 is a tall but well balanced plant with large consistent ears set at a low to medium height. Early growth is typically slow but growth increases during the vegetative period resulting in a very strong and robust plant. Kernel type is medium-soft (semi dent) and kernel size is above average. Very good drought/stress tolerance and excellent stalk strength, staygreen and plant integrity create a solid platform for both silage and grain growers. Trial results to date put this hybrid reliably among the top performers in this very competitive maturity group.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★★
Staygreen	★★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★★
Root Strength	★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★★★
Grain Drydown	★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

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For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Mid
REGION 2	Late

DUAL PURPOSE
Silage CRM 107 / Grain CRM 107

- **Dual purpose hybrid with impressive stature and yield**
- **Very good stalk and root strength**
- **Medium-soft kernel texture**

Plenitude is a dual purpose hybrid producing high yields of both grain and silage. The large leaves on this tall plant catch the eye and the medium-soft textured kernels suit both silage and grain users. With a CRM of 107, it is ideally placed as a longer hybrid in the upper North Island and East Coast.

Plenitude has performed exceptionally in trials over several seasons in New Zealand and will find a fit with growers who require both quality and yield from a hybrid of this maturity.

Hybrid traits	
Early Growth	★★★★
Drought Tolerance	★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★★
Total Energy	★★★★★
Stalk Strength	★★★★
Root Strength	★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Late
REGION 2	Very late

CORSON MAIZE
PAC 430

AriDapt™ DROUGHT READY MAIZE

DUAL PURPOSE
Silage CRM 108 / Grain CRM 108

- **Medium-tall plant**
- **AriDapt™ drought-ready technology ensures outstanding yield stability across environments and seasons**
- **Well balanced canopy provides good bulk. Long, girthy ears typically 18 kernels around**
- **Excellent grain quality, very good staygreen and standability**
- **Finishes strongly owing to its excellent drought tolerance and late season plant health**

PAC 430 is a robust, medium-tall plant with broad leaves. This hybrid is consistently among the top performing hybrids for both grain and silage trials. Very good staygreen, very good plant integrity during drydown and a nice low ear height, combined with its very good stalk and excellent root strength means PAC 430 stands very strongly.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★★★
Staygreen	★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★
Root Strength	★★★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Late
REGION 2	Very late

NEW

Pelota

MAIZE SILAGE
CRM 109

- **Tall, bulky plant**
- **Good cob size and uniformity**
- **Very good early growth and Northern Leaf Blight tolerance**

Pelota is a large bulky plant with an impressive stature. Good sized cobs are set quite high. Pelota is positioned as a silage hybrid on good ground (including peat) and should deliver impressive yields.

Pelota shows very good early growth and Northern Leaf Blight tolerance. Its very good root strength and staygreen makes it an attractive plant later in the season.

Hybrid traits	
Early Growth	★★★★
Drought Tolerance	★★★
Staygreen	★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★
Root Strength	★★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★★
Grain Drydown	NA

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1	Late
REGION 2	Very late

CORSON MAIZE

PAC 456

DUAL PURPOSE
Silage CRM 109 / Grain CRM 109

- **Full season dual purpose hybrid for northern and central regions**
- **Very good staygreen and a lengthy grain fill period provides a long harvest window**
- **Very good rust resistance and late season plant health**

PAC 456 is a tall, high yielding dual purpose hybrid with a large bulky canopy and long harvest window. Purpose bred in Europe for dry matter and energy production.

PAC 456 can have a high ear placement particularly if planted at high rates, this means that planting rates should not go above 90,000 seeds/ha for grain crops. However, good grain quality, yields, drydown, standability and plant integrity during grain drydown make this hybrid a top performer for both grain and silage. Husk cover is very good and ears are large and packed with large deep kernels ensuring silage of high grain content and energy.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★
Staygreen	★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★
Root Strength	★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1 Late

CORSON MAIZE

Z71-F1

TENDERLEAFY

MAIZE SILAGE
CRM 111

- **Full maturity TENDERLEAFY® silage hybrid developed in New Zealand by Corson Maize**
- **Very large plant with high grain yield and a sound agronomic package**
- **Excellent yield performance in this maturity**

Z71-F1 offers very good early growth developing into a tall, bulky plant with large ears as well as very good staygreen which contributes to a wide harvest window. F1 has a high grain content and very good whole plant digestibility.

F1 is suitable for warmer northern regions where early planting is possible. It is ideally suited to contract silage production, targeting high yields and quality silage. Dairy farmers can take advantage of its performance by planting early on a run-off.

Hybrid traits	
Early Growth	★★★★
Drought Tolerance	★★★★
Staygreen	★★★★
Whole Plant Digestibility	★★★★
Total Energy	★★★★★
Stalk Strength	★★★★
Root Strength	★★★★
Rust Tolerance	★★★★
Northern Leaf Blight	★★★★
Grain Drydown	NA

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1 Late

PAC 564

DUAL PURPOSE
Silage CRM 113 / Grain CRM 115

- **Bulky, medium height plant**
- **Exceptionally high and stable yields**
- **Excellent cob size and uniformity**
- **Thick stalks, strong roots and low ear placement with very good lodging resistance**

PAC 564 is is a unique medium, bulky hybrid in this ultra-full season bracket dominated by tall plants. PAC 564 has shown itself to be much more resilient, adaptable and resistant to lodging than all other hybrids tested in this bracket. It has very good drought and Northern Leaf Blight tolerance and responds well to higher planting rates whilst still performing well at lower rates.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★★
Staygreen	★★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★
Root Strength	★★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★★
Grain Drydown	★★

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

REGION 1 Very late

PAC 624

MAIZE SILAGE
CRM 115

- **Ultra-full season silage hybrid for Northland, Waikato and the Bay of Plenty**
- **Huge cobs typically 20 kernels around with large kernels**
- **Very good staygreen with a long grain fill period**

PAC 624 is a purpose-bred silage hybrid for early plant situations in the warmer northern regions and is firmly positioned as a market leader in this ultra-long maturity group. Large girth cobs packed with soft, starchy grain combined with good digestibility ensures silage of excellent quality is produced.

The hybrid has good standability, however the sheer size of the plants means that it can become overcrowded at high planting rates, increasing cob height and reducing standability and cob tip fill. For this reason we recommend lower than usual planting rates that will still produce very high yields.

Hybrid traits	
Early Growth	★★★
Drought Tolerance	★★★★
Staygreen	★★★★
Whole Plant Digestibility	ID
Total Energy	ID
Stalk Strength	★★★★★
Root Strength	★★★★
Rust Tolerance	★★★
Northern Leaf Blight	★★★★
Grain Drydown	NA

Key:

★	*Poor*
★★	*Below Average*
★★★	*Good*
★★★★	*Very Good*
★★★★★	*Excellent*

NA	*Not Applicable*
ID	*Insufficient Data*

All ratings are not comparable to any other companies' ratings and are based on observations by Corson Maize staff.

For more information on hybrid traits visit www.corsonmaize.co.nz

Harvesting maize for silage in the Waikato region.

Seed Treatment

Seed treatment contents

Superstrike® treated Base tetraploid perennial ryegrass seed. Gloves should be worn when handling treated seed.

SEED TREATMENT

OTHER INFORMATION

Seed treatment

Seed treatment is the process of applying additives to seed such as insecticides, fungicides, nematicides, nutrients and biological agents to provide plant protection and growth enhancement benefits during the seedling establishment period.

The first four to six weeks after sowing is a critical period in the life of a new plant, as seedlings emerge and develop their physical make up. Sowing treated seed provides protection during the germination and establishment stages when emerging seedlings are most vulnerable to attack from invasive insect pests and disease pathogens.

Seed treatment can improve seed germination, seedling emergence, plant vigour, stand establishment and total yield, helping to ensure the crop or pasture is on its way to reaching its full genetic potential.

Cleancrop™ Hawkestone swede.

SEED TREATMENT AT PGG WRIGHTSON SEEDS

PGG Wrightson Seeds is a leading provider of seed treatment products to the New Zealand forage seed market and has been for over 50 years. We have a range of filmcote treatments and seed coatings, providing early crop protection solutions across forage brassica, forage grass, legume and herb seed. We have three well-established brands: Ultrastrike®, Superstrike® and Prillcote®. Our seed treatment products are applied to an extensive range of cultivars from the PGG Wrightson Seeds and Agricom forage brands, as well as cultivars from other seed companies.

An establishing pasture of Superstrike® treated grass and white clover in Canterbury.

The product development cycle

At PGG Wrightson Seeds, we invest heavily in research and development to bring new products and technologies to the market. In the seed treatment area, we work with organisations that are focused on science and innovation, including leading international crop protection companies and Crown Research Institutes such as AgResearch.

PGG Wrightson Seeds has developed a range of proprietary formulations over the last 50 years that have been constantly updated and improved as new technologies from our suppliers have entered the seed treatment market.

New crop protection products are extensively tested before commercialisation in the New Zealand market. Environmental studies and efficacy trials on insect or disease protection are undertaken by the chemical supplier prior to the registration of a new active ingredient. When evaluating new technologies, we carry out trials at our Kimihia Research Centre (Lincoln, Canterbury) to ensure that important seed quality parameters such as germination and endophyte viability are not compromised and there is good compatibility with other additives in a specific formulation. Field trials in different regions throughout New Zealand provide our research and development team with scientific data to support the introduction of a new formulation to the market.

Benefits of seed treatment

INSURANCE POLICY

Reduces risk and helps safeguard investment in forage seed. The cost of failed pasture establishment can be in excess of $2,000/ha with lost production and re-planting costs. In a forage crop situation, the loss of plants can significantly reduce potential crop yield, as well as increasing the overall feed cost.

AGRONOMIC BENEFIT

Seedlings protected by seed treatment are in a better position to withstand environmental stresses, including pest and disease pressure. Seed treatment helps maximise seedling establishment and nurture early plant growth, helping ensure the crop or pasture is in a position to reach its full yield potential.

TARGETED PROTECTION

Seed-applied chemicals are target specific against a range of economically damaging insect pests and diseases during the plant establishment period.

INTEGRATED PEST MANAGEMENT

Complements traditional broadacre crop protection methods and other new plant protection technology such as endophytes, as part of an integrated pest management approach.

REDUCED ENVIRONMENTAL IMPACT

Delivers very small quantities of chemical active ingredient to the soil in comparison to broadacre applications. Chemicals are rigorously tested to ensure they have no detrimental effects on the environment.

IMPROVES SOWING ACCURACY

The addition of seed coating material to seed can increase weight and size to provide a more accurate and uniform spread of seed in aerial oversowing applications and enable uniform plant spacing in precision drilling.

USER-FRIENDLY

Reduces the need to handle chemicals on farm. It also allows more flexibility when weather conditions make it difficult to apply broadacre crop protection products.

Ultrastrike® treated brassica seed.

The economic cost of pests

A Canterbury replicated trial showing the impact of insect pests on plant establishment for Ultrastrike® treated versus untreated kale seed.

The economic benefits provided by seed treatment have been captured in many scientific trials over the years. The following brassica trial highlights the financial impact pests can have in a farming system. The trial in Canterbury demonstrated that Ultrastrike® treated kale seed produced an additional 7,800 kg of dry matter per hectare (DM/ha) than untreated seed at harvest. The net financial benefit was $1,500/ha, a high return on the $60/ha investment in seed treatment (see table to right).

The replicated plot trial was sown on 4 November 2016 following cultivation, whereby Ultrastrike treated and untreated kale seed were sown at 4 kg/ha. Pre-emergent insecticide (300 ml/ha Magister and 300 ml/ha Lorsban) was applied on 7 November 2016. Plant counts were undertaken at 13, 28 and 40 days after sowing. The trial was yielded on 6 June 2017.

An observation from the trial was that the poor establishment of the untreated seed was largely attributed to Springtail pressure during the first 2-4 weeks after sowing. Although a pre-emergent insecticide was applied, this did not protect the untreated seed from eggs, which hatched after the insecticide spray was applied. The Ultrastrike treated seed was protected against Springtail (including eggs that hatched) for six weeks after sowing, by which time the treated seed plots were well-established with good plant canopy.

	ULTRASTRIKE® SEED	UNTREATED SEED
Plant numbers/m² 40 DAS	111	34
Crop yield/ha 214 DAS	15,900 kg	8,100 kg
Feed value/ha#	$3,180	$1,620
Seed treatment net return*	$1,500	-

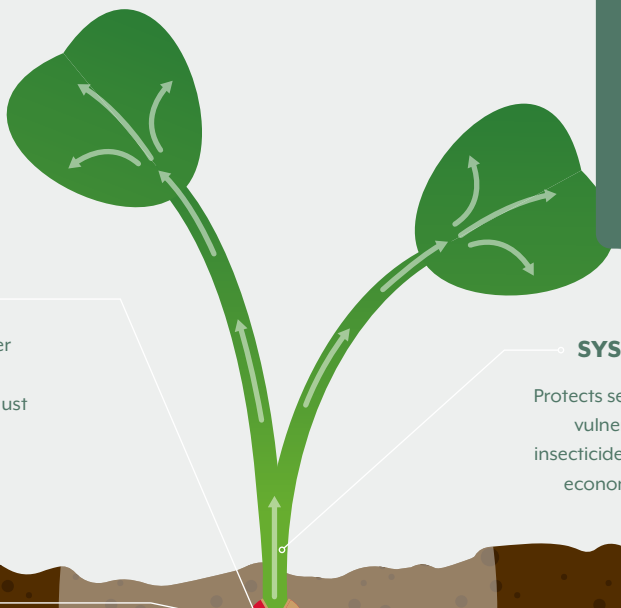
#Feed value of the winter feed crop valued at $0.20/kgDM.
**Estimated retail cost of the Ultrastrike® seed treatment is $60/ha.*
DAS: Days after sowing.

Springtail insect on brassica leaf.

Building better seeds: what's in seed treatment products?

The seed treatment formulations developed by PGG Wrightson Seeds contain additives that are unique to the seed type and/or end use. These additives combine to provide a better environment for seedling establishment and early growth. Most products contain a systemic insecticide, with at least one contact fungicide, along with other beneficial additives including micronutrients.

SEED TREATMENT ADDITIVES



POLYMER

Binds active ingredients and other additives to the seed to ensure precise coverage and minimise dust emissions, which in turn protects applicators, end users and the environment.

SYSTEMIC INSECTICIDE

Protects seedlings when they are most vulnerable to insect pressure. The insecticides are target specific against economically damaging foliar and root feeding insect pests.

COLOURANT

Identifies that seed has been treated, while also helping to deter birds from consuming surface-applied seed, with green and blue colourants proven to be the most effective.

SYSTEMIC NEMATICIDE

Protects the root zone of clover seedlings from soil-dwelling nematodes during establishment.

MICRONUTRIENT

Applying molybdenum to seed is a cost-effective way of ensuring seedlings have a start-up supply of this important micronutrient, which is required for plant growth and root nodulation in legumes.

INOCULANT

The clover and lucerne seed treatments contain rhizobia strains specific to these seed types.

CONTACT FUNGICIDE

Protects seedlings from common soil-borne fungal pathogens. Young seedlings are most susceptible to disease infection during establishment, particularly those under environmental stress.

LIME

The application of fine lime in legume seed treatment can provide a localised increase in soil pH around the seedling, assisting root nodulation. Lime also benefits aerial oversowing with the added weight improving seed ballistics.

It should be noted that while each specific seed treatment contains a range of additives, none of the seed treatment products contain all of the additives featured in the graphic above.

Seedling protection

The application of crop protection products such as insecticides and fungicides to seed provides a targeted and cost-effective method of protecting forage seed from point of sowing through to full establishment.

INSECTICIDE

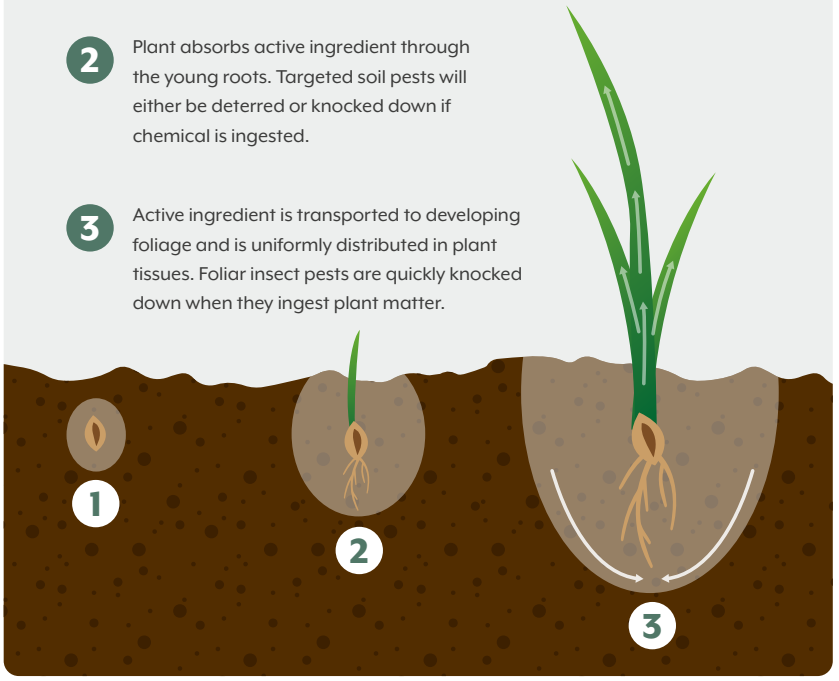
Insecticides included in seed treatment products are typically systemic in terms of their transmission, protecting seedlings during the first 6 weeks of establishment to the point where plants are in a much better position to withstand pest attack. Ryegrass cultivars that contain novel endophyte are able to protect the plant over the long term, however in the first 4-6 weeks of seedling establishment the endophyte is not fully expressed within the plant. Seed treatment is able to bridge the gap and protect the plant during this period.

Systemic insecticides offer a very effective mode of action, providing both anti-feeding and knock down effects against target insects, protecting the plant above and below ground (refer to diagram).

It is important to note that some pests such as Slugs and Black Field Crickets will not be controlled by seed treatments, hence the need to incorporate other forms of pest control into the reseeding programme. Also, when a target pest population is high (e.g. Springtail), an additional form of pest control such as a foliar applied insecticide may be required to support the protection provided by seed treatment.

MODE OF ACTION

1. Chemical active ingredient is graduallly released into the soil after the seed is sown, forming a protective barrier around the seed.
2. Plant absorbs active ingredient through the young roots. Targeted soil pests will either be deterred or knocked down if chemical is ingested.
3. Active ingredient is transported to developing foliage and is uniformly distributed in plant tissues. Foliar insect pests are quickly knocked down when they ingest plant matter.



FUNGICIDE

The fungicides in seed treatment products use contact transmission to protect seedlings in the first three to four weeks of establishment. The importance of fungicide protection is often undervalued, with plant damage in many situations incorrectly identified as another factor, such as nutrient deficiency or insect attack. Fungicides are beneficial when planting into cool or damp soils, since these conditions may increase the risk of fungal attack or delay the speed of germination. When germination is delayed through soil moisture deficiency, the seed will remain protected by fungicide until it germinates.

Fungicides provide a knock down form of protection during early seedling growth. Chemical active ingredient is released into the soil after the seed germinates, protecting developing roots against soil-borne fungal pathogens. The active ingredient also acts as a steriliser, 'locking in' the germination potential of a seed line by protecting against fungal pathogens on the seed.

Utlrastrike® treated Cleancrop™ Hawkestone swede.

Brassica seed treatment

Ultrastrike® brassica

Forage brassica crops are extremely vulnerable to insect attack during the plant establishment period. The loss of plants early can have a major impact on the final crop yield. Brassica seed treatment provides a low cost but very important early plant protection tool, helping ensure crops establish successfully so that they can reach their full yield potential.

ULTRASTRIKE® BRASSICA

Ultrastrike® brassica is a filmcote seed treatment that provides establishing brassica crops with a superior level of insecticide protection in addition to fungicide protection and a start-up supply of molybdenum.

ADDITIVE	PEST AND DISEASE PROTECTION/ NUTRIENTS	BENEFIT
SYSTEMIC INSECTICIDE	Springtail, Aphid, Argentine Stem Weevil (adults and larvae), Nysius*	Above and below ground protection during the first 6 weeks after planting against economically damaging insect pests. Trials have shown protection against Aphids extending out to 8 weeks after planting.
CONTACT FUNGICIDE	'Damping off' *(Pythium, Fusarium, Rhizoctonia solani)*	Protects the root zone from 'Damping off' fungal pathogens in the first 3-4 weeks of establishment.
NUTRIENT	Molybdenum	Molybdenum is distributed evenly around the seed and available for fast uptake by the germinating seedling.

**In situations conducive to high Nysius pressure, where a brassica crop is sown next to a lucerne crop or established under hot, dry conditions, a foliar insecticide application may be necessary 2-3 weeks after sowing to enhance seedling protection.*

Steers grazing Ultrastrike® treated Pallaton Raphno®.

Ultrastrike® treated Cleancrop™ Toto turnip.

WHERE SHOULD ULTRASTRIKE BRASSICA BE USED?

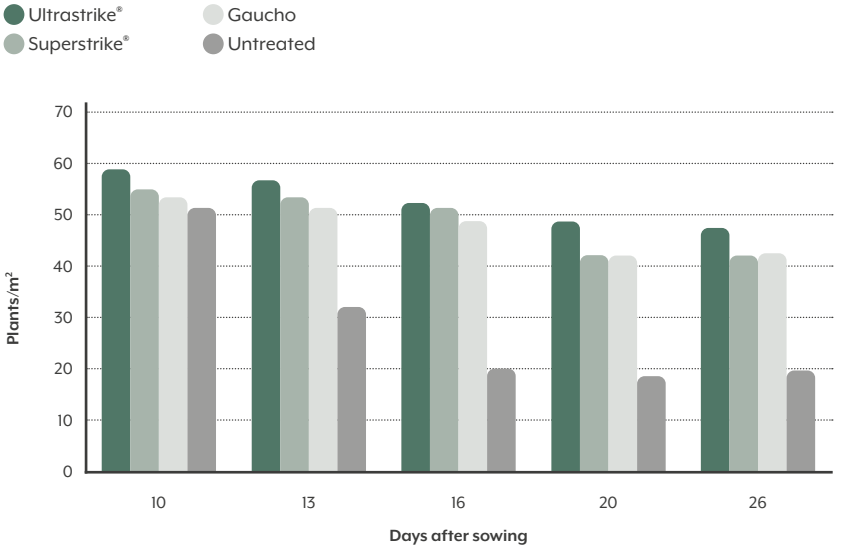
Ultrastrike® brassica seed treatment is recommended for all spring and autumn sown forage brassica seed including rape, turnips, kale and swedes, where seedlings are likely to face risk from the target pests and diseases (see table above). Ultrastrike® is a filmcote seed treatment with no weight gain, therefore seed should be sown at the same rate as untreated seed. Livestock should not graze Ultrastrike® treated brassica crops in the first 6 weeks after sowing.

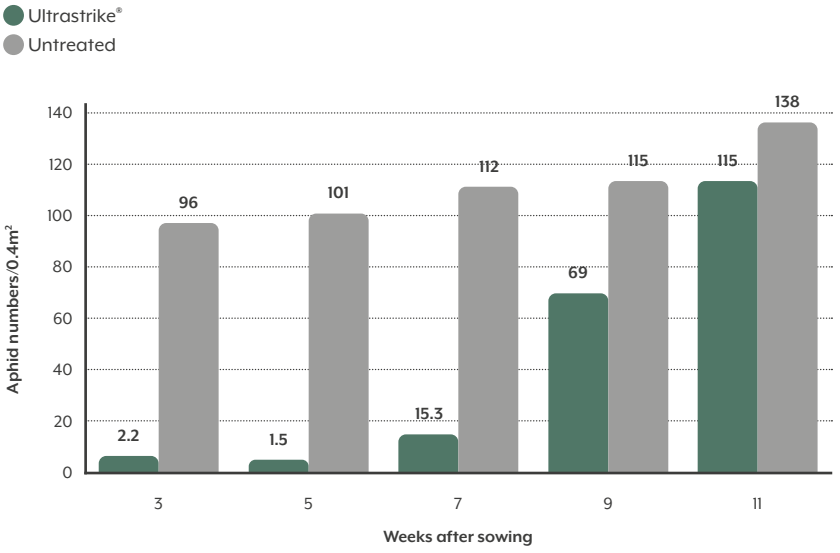
TRIAL RESULTS

Brassica establishment under Nysius pressure

This non-replicated split paddock trial in Taihape measured the effect of insects on the establishment of brassica seed. The trial was sown with Ultrastrike®, Superstrike® and Gaucho® treated kale seed along with untreated kale seed. Plant measurements were undertaken at 10, 13, 16, 20 and 26 days after sowing (DAS). Plant numbers were taken from a total of 5 fixed quadrats per treatment. At 12 DAS, a flight of Nysius descended upon the paddock, significantly reducing the number of seedlings in the untreated area. Plant numbers in the treated seed plots held up well under the Nysius pressure. An application of contact insecticide was applied 14 DAS.

Trial conducted by PGG Wrightson Seeds





Aphid protection effect of Ultrastrike seed treatment on an Aphid population

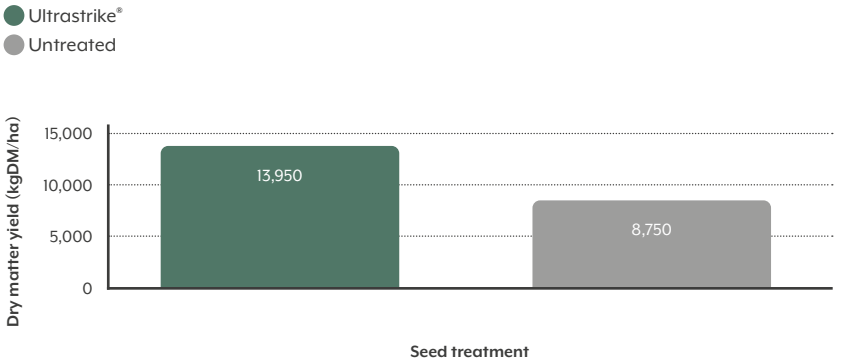
This replicated field trial in Canterbury measured the effect of seed treatment on Aphid populations. The trial was sown with Ultrastrike® treated and untreated kale seed. At 14 DAS, a total of 56 Cabbage Aphids were added every 7 days and held in confinement in field cages placed in the forage rape crop. Aphid populations were measured at 3, 5, 7, 9 and 11 weeks after sowing, with the Ultrastrike® treated seed providing significantly improved protection against Aphids up to 8 weeks after sowing.

Trial conducted by PGG Wrightson Seeds, Kimihia Research Centre, Lincoln

Brassica crop yield

This replicated field trial was sown in Canterbury in November 2017 following cultivation. The trial compared the crop yield of Ultrastrike® treated kale and untreated kale seed. Dry matter yields were measured at 183 DAS with the Ultrastrike treated kale showing a statistically significant yield increase of 5,200 kgDM/ha.

Trial conducted by PGG Wrightson Seeds



SUPERSTRIKE® BRASSICA

Superstrike® brassica is a filmcote seed treatment that provides establishing brassica crops with insecticide and fungicide protection in addition to a start-up supply of molybdenum.

ADDITIVE	PESTS AND DISEASE PROTECTION/ NUTRIENTS	BENEFIT
SYSTEMIC INSECTICIDE	Springtail	Above and below ground protection during the first 6 weeks after planting against New Zealand's most prevalent brassica establishment pest.
CONTACT FUNGICIDE	*'Damping off' (Pythium, Fusarium, Rhizoctonia solani)*	Protects the root zone from 'Damping off' fungal pathogens in the first 3-4 weeks of establishment.
NUTRIENT	Molybdenum	Molybdenum is distributed evenly around the seed and available for fast uptake by the germinating seedling.

WHERE SHOULD SUPERSTRIKE BRASSICA BE USED?

Superstrike brassica seed treatment is recommended for spring-sown forage brassica seed including rape or turnips, where Springtail is the main insect threat at establishment. Superstrike is a filmcote seed treatment with no weight gain, therefore seed should be sown at the same rate as untreated seed. Livestock should not graze Superstrike treated brassica crops in the first 6 weeks after sowing.

Sales Agronomist Brian Young and farmer Peter Kane inspecting a paddock of Ultrastrike® treated Cleancrop™ Firefly kale in Southland.

GAUCHO® BRASSICA

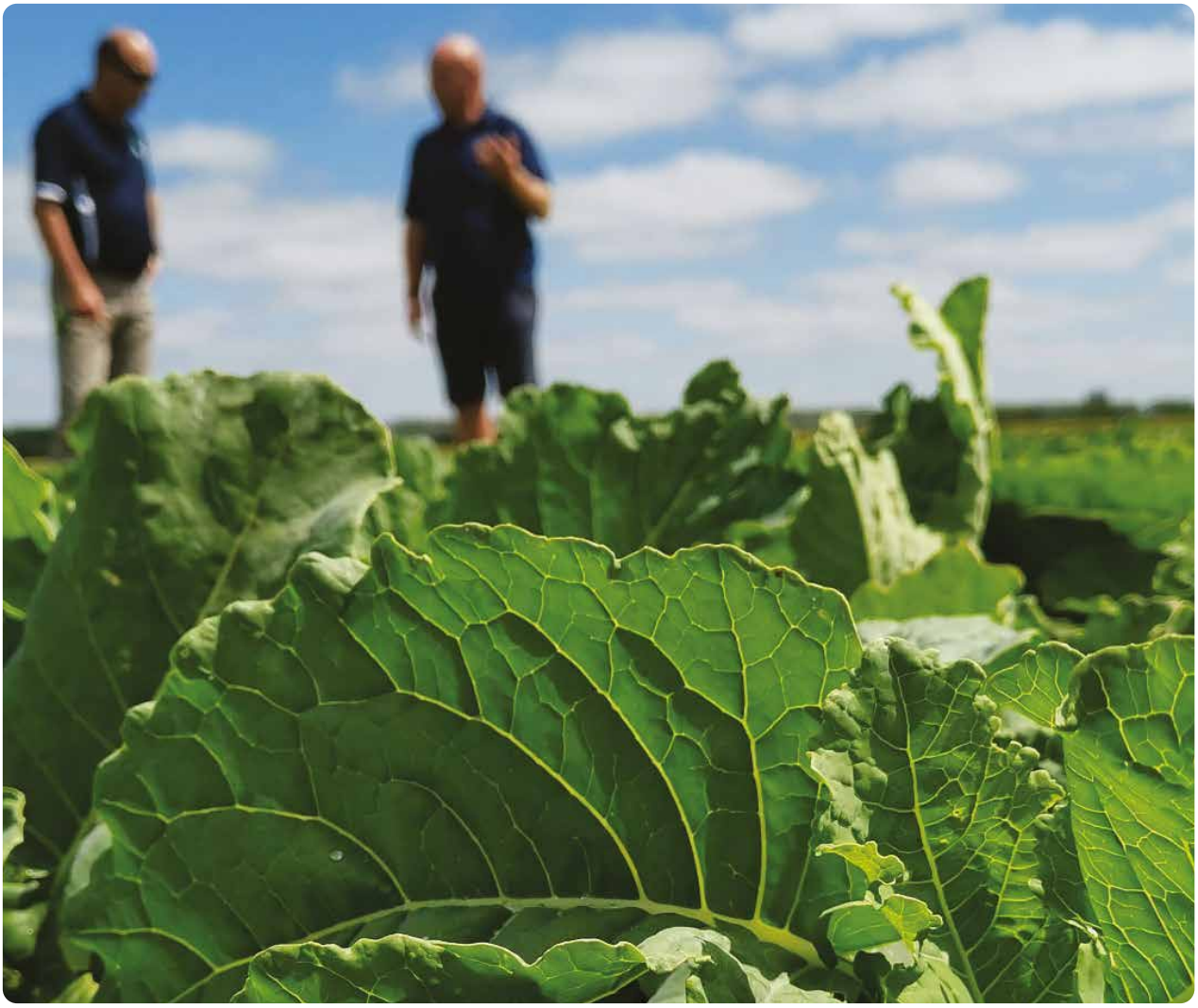
Gaucho® brassica is a filmcote seed treatment that provides brassica crops with protection against common insect pests during plant establishment.

ADDITIVE	PESTS AND DISEASE PROTECTION/ NUTRIENTS	BENEFIT
SYSTEMIC INSECTICIDE	Springtail, Aphid, Argentine Stem Weevil (adults and larvae), Nysius*	Above and below ground protection during the first 6 weeks after planting.

**In situations conducive to high Nysius pressure, where a brassica crop is sown next to a lucerne crop or established under hot, dry conditions, a foliar insecticide application may be necessary 2-3 weeks after sowing to enhance seedling protection.*

WHERE SHOULD GAUCHO BRASSICA BE USED?

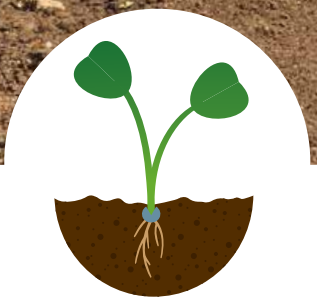
Gaucho brassica seed treatment is recommended for spring and autumn sown forage brassica seed. Gaucho is a filmcote seed treatment, therefore seed should be sown at the same rate as untreated seed. Livestock should not graze Gaucho treated brassica crops in the first 6 weeks after sowing.



Gaucho treated Corsa kale in Canterbury.

ULTRASTRIKE® PELLETED BRASSICA

Ultrastrike® pelleted brassica combines a weight build-up seed coating with the crop protection and plant nutrition additives of the Ultrastrike seed treatment (refer to pages 245-246). The pelleted seed coating is currently available for swede cultivars.



The combination of the weight increase and uniform sizing means Ultrastrike pelleted brassica seed can be sown using a precision drill. The uniform placement of seed produces an evenly-distributed crop, allowing bulb yields to be maximised. Field trials have consistently shown that precision planted swede crops out-yield conventionally drilled crops, where plant spacings are not uniform (refer to trial results, page 250).

Ultrastrike® pelleted turnip seed can be evenly distributed, as shown in this established paddock of Cleancrop™ bulb turnip in Waikato, allowing crop yield to be maximised.

SPLITKOTE PELLET

The size specification for pelleted swede seed is 3.25-4.00 mm. The pelleting material increases the weight of the seed by approximately 500-700%. The pellet is hard and robust enough to avoid physical damage during transportation and sowing.

After sowing, oxygen and moisture from the soil penetrate the seed pellet, initiating germination. The pellet then splits open as the seed expands and begins to sprout. The seed pellet does not require any more soil moisture than what would be required to germinate non-pelleted brassica seed. The pellet does not persist in the soil and will break down completely over time.

WHERE SHOULD ULTRASTRIKE PELLETED SEED BE USED?

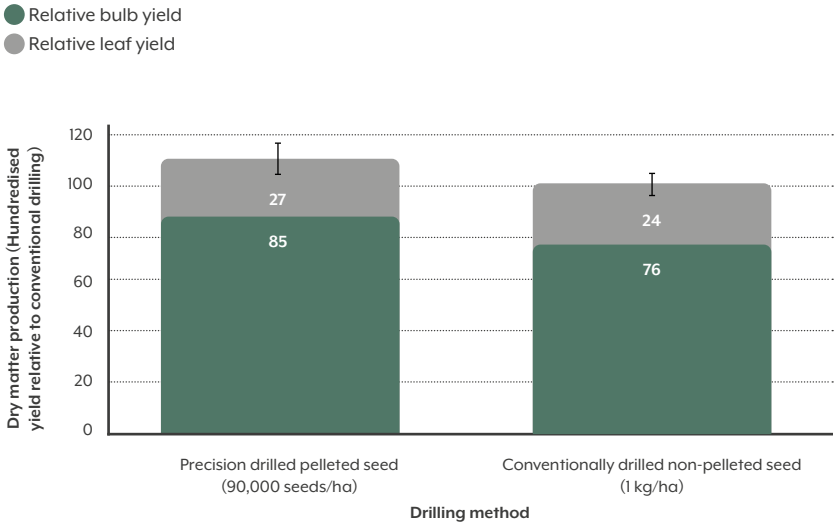
Ultrastrike pelleted swede has an optimum sowing rate of 90,000 seeds/ha or 22 cm seed spacing in 50 cm rows. It is critical that a fine, firm seedbed is prepared prior to precision planting. Livestock should not graze Ultrastrike® pelleted seed crops in the first 6 weeks after sowing.

TRIAL RESULTS

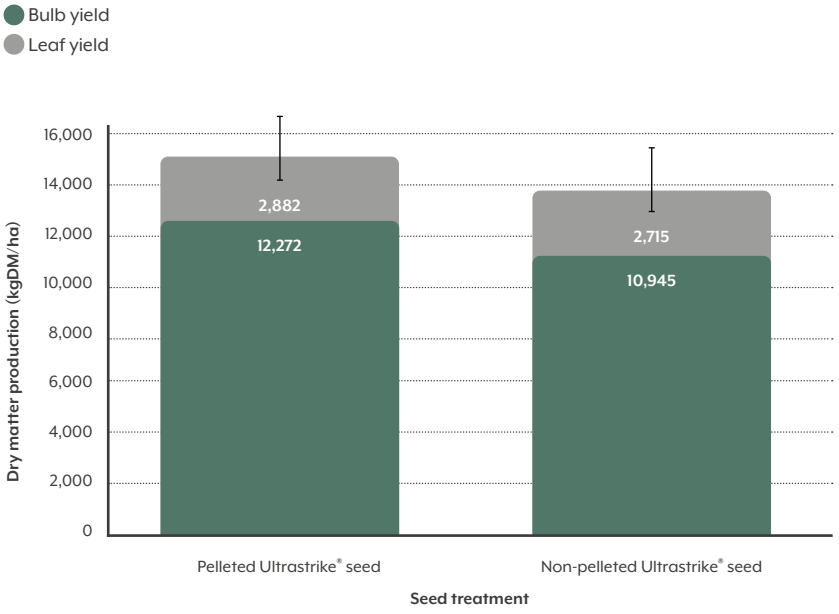
Brassica crop yield of precision planted swede seed in Canterbury

A trial evaluating precision planting of Cleancrop™ Hawkestone pelleted swede (90,000 seeds/ha) compared to conventional sowing (1 kg/ha) was established in Oxford, Canterbury on 17 November 2018. Prior to grazing on 20 May 2019 (184 days after sowing), yield assessments demonstrated precision sown pelleted seed provided a statistically significant 12% increase in yield relative to conventional sowing.

Trial conducted by PGG Wrightson Seeds



LSD (5%)=10.7%



Total yield LSD (5%) = 2,029 kgDM/ha.

Brassica crop yield of precision planted swede seed in Southland

Ultrastrike® pelleted Clutha Gold swede seed was trialled against non-pelleted Ultrastrike Clutha Gold seed in three Southland trials (Wyndham, Tapanui and Ohai) in 2016/17. In these trials, Ultrastrike pelleted and Ultrastrike non-pelleted seed were drilled with a precision planter. The non-pelleted seed was sown using a precision planter set up for drilling filmcote seed.

Ultrastrike pelleted seed was more uniformly distributed with minimal 'missed seeds' or 'double ups', which helped maximise bulb yield. Although not statistically significant, in all three trial sites Ultrastrike pelleted seed demonstrated an average yield increase of 1,433 kgDM/ha (+ 10.5%). The trial results demonstrated the advantage pelleted seed can provide over precision sown non-pelleted seed.

Trial conducted by PGG Wrightson Seeds

Cleancrop™ Hawkestone pelleted swede providing high yielding winter feed in Southland.

Ultrastrike® pelleted Major Plus swede.

Grass seed treatment

Regrassing is important for increasing pasture productivity and farm profitability. It is a process that requires thorough planning to achieve a successful outcome. Seed treatment has an important role to play in this process, helping protect young seedlings against invasive insect pests and diseases when they are at their most vulnerable stage. The successful establishment of forage grass is the critical first step in achieving a high yielding pasture.

SUPERSTRIKE® GRASS

Superstrike® grass is a filmcote seed treatment that combines insecticide, fungicide and plant nutrition additives.

ADDITIVE	PEST AND DISEASE PROTECTION/ NUTRIENTS	BENEFIT
SYSTEMIC INSECTICIDE	Argentine Stem Weevil (adults and larvae), Black Beetle (adults), Grass Grub (larvae)	Above and below ground protection against economically damaging insect pests, during the first 6 weeks after sowing.
CONTACT FUNGICIDE	'Damping off' *(Pythium, Fusarium)*	Protects the root zone from 'Damping off' fungal pathogens in the first 3-4 weeks of establishment.
NUTRIENT	Zinc, Molybdenum, Manganese	Nutrients are distributed evenly around the seed and available for fast uptake by the germinating seedling.
BIRD REPELLENT		The green coloured treatment and the fungicide component have properties that help deter birds from eating surface-applied seed.

Plant growth response

Superstrike grass treatment has a positive effect on seedling vigour and early growth through the chemical and micronutrient additives, which can result in first grazing occurring earlier. The boost to seedling growth has been shown to occur in situations where plants are under pressure from an external stress (e.g. insect attack) and when growing conditions are favourable.

Where should Superstrike grass be used?

Superstrike grass seed treatment is recommended for all spring and autumn sown grass seed (e.g. ryegrass, fescue and cocksfoot), where Argentine Stem Weevil, Black Beetle or Grass Grub are active. The presence of these harmful insect pests during pasture establishment can result in significant losses ranging from a partial to a total resow if the seed is unprotected. Grass seed sown in northern regions of New Zealand (where Black Beetle is active), in a no-tillage programme or undersown into an existing pasture are all high risk situations, which should be mitigated by the use of Superstrike grass seed treatment. The early growth of slow establishing species such as fescue and cocksfoot is also enhanced by seed treatment through the positive effect on plant vigour.

Seed treatment and novel endophyte protection

Seed treatment and novel endophyte technologies complement each other in the field, helping protect the host plant from target insect pests over the life of that plant. The seed treatment provides early plant protection and the novel endophyte in ryegrass or fescue products delivers long-term protection after it becomes fully expressed within the plant at 4-6 weeks.

Sowing rate

Superstrike is a filmcote seed treatment, therefore seed should be sown at the same rate as untreated seed. The one exception relates to Grass Grub protection, where Superstrike treated seed should be sown at a minimum of 15 kg/ha.

Livestock withholding period

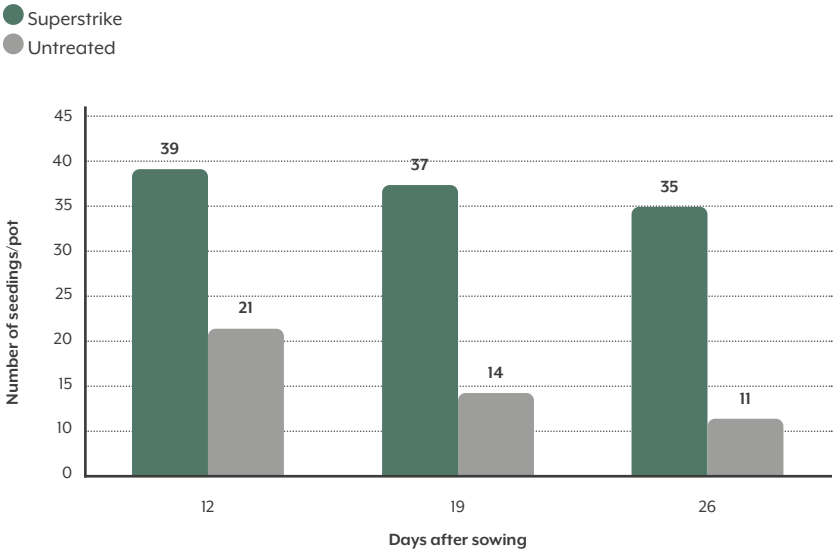
Under full pasture renovation livestock should not graze Superstrike treated grass seed in the first 6 weeks after sowing. When Superstrike treated seed is undersown or 'stitched' into an existing pasture sward, the withholding period for grazing is 3 weeks after sowing, due to the dilution effect from existing plant material, which is pesticide free.

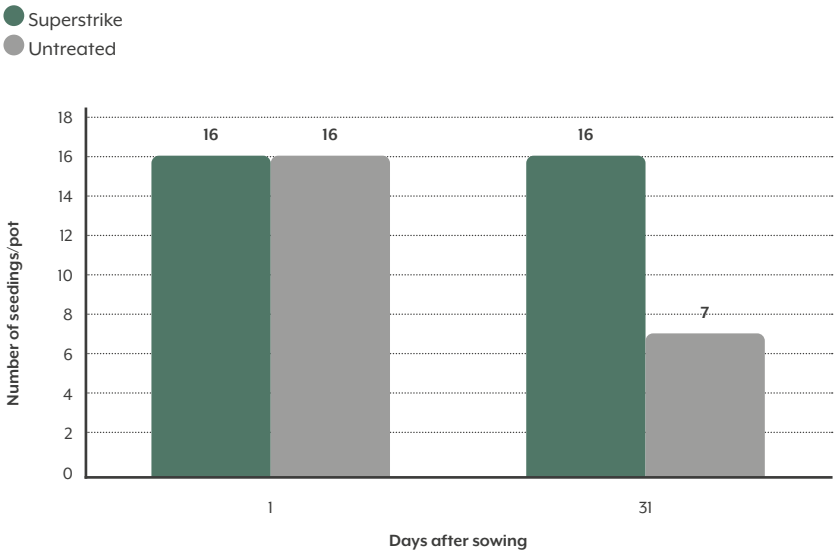
TRIAL RESULTS

Annual ryegrass establishment under Argentine Stem Weevil (ASW) larvae pressure

This replicated trial measured the number of Superstrike® treated and untreated annual ryegrass seedlings establishing under ASW larvae pressure at 12, 19 and 26 days after sowing (DAS). The Superstrike treated seed showed a significant increase in plant establishment in comparison to untreated seed.

Trial conducted by AgResearch, Ruakura





Perennial ryegrass establishment under Black Beetle pressure

This replicated trial measured the effect of Black Beetle on the establishment of Superstrike treated and untreated perennial ryegrass seed. The Superstrike treated seed showed a significant increase in plant establishment in comparison to untreated seed at 31 DAS. 16 seeds were sown per pot.

Trial conducted by AgResearch, Ruakura

Superstrike treated Platform perennial ryegrass in Hawke's Bay.

Establishment of Superstrike treated ryegrass and untreated ryegrass under Argentine Stem Weevil pressure in Canterbury.

PRILLCOTE® GRASS

Prillcote® grass is a seed treatment developed for oversowing. It provides plant protection, plant nutrition and weight build-up additives formulated to improve the physical application of seed and the subsequent establishment and growth of grass seedlings in hill and high country environments.

ADDITIVE	DISEASE PROTECTION/ NUTRIENTS	BENEFIT
CONTACT FUNGICIDE	'Damping off' *(Pythium, Fusarium)*	Protects the root zone from 'Damping off' fungal pathogens in the first 3-4 weeks of establishment.
NUTRIENT	Lime	Provides the weight increase for improved ballistics, helping ensure more seed reaches its target on the soil surface. Also helps provide a localised pH correction around the seedling.
BIRD REPELLENT		The green coloured treatment and the fungicide component have properties that help deter birds from eating surface-applied seed.

WHERE SHOULD PRILLCOTE GRASS BE USED?

Prillcote grass seed treatment is recommended for all grass seed applied in an aerial oversowing programme. With the seed coat increasing the weight of the seed by 100%, the sowing rate of Prillcote grass seed should be increased by 100% in comparison to untreated seed.

Prillcote® grass oversown in Gisborne.

Legume seed treatment

Superstrike® clover

The application of plant protection and plant nutrition agents, in addition to rhizobia to clover and lucerne seed, are a very cost-effective means of delivering these additives to the soil to enhance the establishment and growth of seedlings. The successful establishment of clover seed is an important step in setting up a high producing pasture sward.

SUPERSTRIKE® CLOVER

Superstrike® clover is a seed treatment that combines plant protection and plant nutrition additives. The application of pesticide on clover seed is one of the few means by which seedlings can be protected against invasive and costly root-feeding nematodes during early plant development.

ADDITIVE	PEST PROTECTION/ NUTRIENTS	BENEFIT
SYSTEMIC NEMATICIDE	Clover Root Nematodes	Protects the root zone during plant establishment.
NUTRIENT	Lime	Helps provide a localised pH correction around the seedling and assists root development.
NUTRIENT	Molybdenum	Provides a start-up supply of this important micronutrient, which is required for root nodulation and seedling growth. Molybdenum is distributed evenly around the seed and available for fast uptake by the germinating seedling.
RHIZOBIA*		Seed inoculated with nitrogen-fixing bacteria specific to clover.

WHERE SHOULD SUPERSTRIKE CLOVER BE USED?

Superstrike clover seed treatment is recommended for all clover seed sown in pasture mixes or specialist herb mixes including white, red, subterranean and annual clovers. With the seed coat increasing the weight of the seed by 75%, the sowing rate of Superstrike clover seed should be increased by 75% in comparison to untreated seed. Superstrike treated white and red clover seed products are generally sown in the range of 4-6 kg/ha, respectively in pasture seed mixes.

Superstrike treated Amigain red clover.

Superstrike treated Legacy white clover in a mixed pasture sward with Platform perennial ryegrass.

PRILLCOTE® CLOVER

Prillcote® clover is a seed treatment developed for oversowing. It includes plant nutrition and weight build-up additives formulated to improve the physical application of seed and the subsequent establishment and growth of clover seedlings in hill and high country environments.

ADDITIVE	NUTRIENTS	BENEFIT
NUTRIENT	*Lime*	Provides the weight increase for improved ballistics, helping ensure more seed reaches its target on the soil surface. Also helps provide a localised pH correction around the seedling and assists root development.
NUTRIENT	Molybdenum	Provides a start-up supply of this important micronutrient, which is required for root nodulation and seedling growth. Molybdenum is distributed evenly around the seed and available for fast uptake by the germinating seedling.
RHIZOBIA*		Seed inoculated with nitrogen-fixing bacteria specific to clover.

**Continued presence of rhizobia after inoculation and establishment of rhizobia in pasture depends on many things and is not guaranteed.*

WHERE SHOULD PRILLCOTE CLOVER BE USED?

Prillcote clover seed treatment is recommended for all clover seed applied in an aerial oversowing programme. With the seed coat increasing the weight of the seed by 75%, the sowing rate of Prillcote clover seed should be increased by 75% in comparison to untreated seed. Prillcote clover seed products are generally sown in the range of 4-6 kg/ha.

Prillcote clover oversown with grass seed in Otago hill country.

SUPERSTRIKE® LUCERNE

Superstrike® lucerne is a seed treatment that combines plant protection and plant nutrition additives. The seed treatment also provides a very cost-effective means of introducing rhizobia into the soil profile at sowing time. The rhizobia strain specific to lucerne is not widespread in New Zealand soils, hence the importance of sowing pre-inoculated seed.

ADDITIVE	DISEASE PROTECTION/ NUTRIENT	BENEFIT
CONTACT FUNGICIDE	'Damping off' *(Pythium)*	Protects the root zone from the 'Damping off' fungal pathogen in the first 3-4 weeks of establishment.
NUTRIENT	Lime	Helps provide a localised pH correction around the seedling and assists root development.
NUTRIENT	Molybdenum	Provides a start-up supply of this important micronutrient, which is required for root nodulation and seedling growth. Molybdenum is distributed evenly around the seed and available for fast uptake by the germinating seedling.
RHIZOBIA*		Seed inoculated with nitrogen-fixing bacteria specific to lucerne.

WHERE SHOULD SUPERSTRIKE LUCERNE BE USED?

Superstrike lucerne seed treatment is recommended for all lucerne seed. With the seed coat increasing the weight of the seed by 25%, the sowing rate of Superstrike lucerne seed should be increased by 25% in comparison to untreated seed. Superstrike lucerne seed products are generally sown in the range of 10-14 kg/ha.

Supertrike treated Stamina™ 5 lucerne.

Herb seed treatment

Forage herbs such as chicory and plantain are now widely utilised in pastoral farming systems. Protecting young vulnerable seedlings during the establishment phase with seed treatment is considered best practice to help maximise seedling emergence and survival.

SUPERSTRIKE® HERB

Superstrike® herb seed treatment is a filmcote treatment that combines insecticide and fungicide protection for establishing chicory and plantain seedlings.

ADDITIVE	PEST AND DISEASE PROTECTION	BENEFIT
SYSTEMIC INSECTICIDE	Springtail	Above and below ground protection during the first 6 weeks after planting.
CONTACT FUNGICIDE	'Damping off' *(Pythium, Fusarium)*	Protects the root zone from 'Damping off' fungal pathogens in the first 3-4 weeks of establishment.
BIRD REPELLENT		The green coloured treatment and the fungicide component have properties that help deter birds from eating surface-applied seed.

WHERE SHOULD SUPERSTRIKE HERBS BE USED?

Superstrike herb seed treatment is recommended for all chicory and plantain seed sown in pasture mixes or specialist herb mixes. Superstrike treated seed should be sown at the same rate as untreated seed. Livestock should not graze Superstrike treated herbs in the first 6 weeks after sowing.

Cows grazing on Superstrike® treated Puna II chicory.

PRILLCOTE® HERB

Prillcote® herb seed treatment has been developed for oversowing. The product includes plant nutrition, plant protection and weight build-up additives.

ADDITIVE	DISEASE PROTECTION/ NUTRIENT	BENEFIT
CONTACT FUNGICIDE	'Damping off' *(Pythium, Fusarium)*	Protects the root zone from 'Damping off' fungal pathogens in the first 3-4 weeks of establishment.
NUTRIENT	Lime	Provides the weight increase for improved ballistics, helping ensure more seed reaches its target on the soil surface. Also helps provide a localised pH correction around the seedling.
BIRD REPELLENT		The green coloured treatment and the fungicide component have properties that help deter birds from eating surface-applied seed.

WHERE SHOULD PRILLCOTE HERBS BE USED?

Prillcote herb seed treatment is recommended for all chicory and plantain seed applied in an aerial oversowing programme. With the seed coat increasing the weight of the seed by 100%, the sowing rate of Prillcote herb seed should be increased by 100% in comparison to untreated seed.

Product profiles

SEED TREATMENT	USED IN	PEST PROTECTION	DISEASE PROTECTION	NUTRIENTS INCLUDED	RHIZOBIA	WEIGHTED BUILD-UP	SOWING RATES COMPARED TO UNTREATED SEED	WITHHOLDING PERIOD
ULTRASTRIKE® BRASSICA	Drill/Broadcast	Aphid Argentine Stem Weevil Nysius (Wheat Bug) Springtail	*Fusarium* *Pythium* *Rhizoctonia solani*	Molybdenum	-	0%	Same as per untreated seed	6 weeks
SUPERSTRIKE® BRASSICA	Drill/Broadcast	Springtail	*Fusarium* *Pythium* *Rhizoctonia solani*	Molybdenum	-	0%	Same as per untreated seed	6 weeks
GAUCHO® BRASSICA	Drill/Broadcast	Aphid Argentine Stem Weevil Nysius (Wheat Bug) Springtail	-	-	-	0%	Same as per untreated seed	6 weeks
SUPERSTRIKE® GRASS	Drill/Broadcast	Argentine Stem Weevil (adults and larvae) Black Bettle (adults) Grass Grub (larvae)	*Fusariam* *Pythium*	Manganese Molybdenum Zinc	-	0%	Same as per untreated seed#	6 weeks
PRILLCOTE® GRASS	Oversowing	-	*Fusariam* *Pythium*	Lime	-	100%	Increase by 100%	-
SUPERSTRIKE® CLOVER	Drill/Broadcast	Clover Root Nematode	-	Lime Molybdenum	Yes*	75%	Increase by 75%	6 weeks
PRILLCOTE® CLOVER	Oversowing	-	-	Lime Molybdenum	Yes*	75%	Increase by 75%	-
SUPERSTRIKE® LUCERNE	Drill	-	*Pythium*	Lime Molybdenum	Yes	25%	Increase by 25%	-
SUPERSTRIKE® HERB	Drill/Broadcast	Springtail	*Fusariam* *Pythium*	-	-	0%	Same as per untreated seed	6 weeks
PRILLCOTE® HERB	Oversowing	-	*Fusariam* *Pythium*	Lime	-	100%	Increase by 100%	-

**Continued presence of rhizobia after inoculation and establishment of rhizobia in pasture depends on many things and is not guaranteed.*

#For Grass Grub protection a minimum sowing rate of 15 kg/ha is required.

˜For Superstrike® treated grass seed undersown into an existing pasture sward, the livestock witholding period is 3 weeks from sowing.

Other publications

PGG Wrightson Seeds has developed a number of other publications to assist you. The following publications are available:

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PGG Wrightson Seeds

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