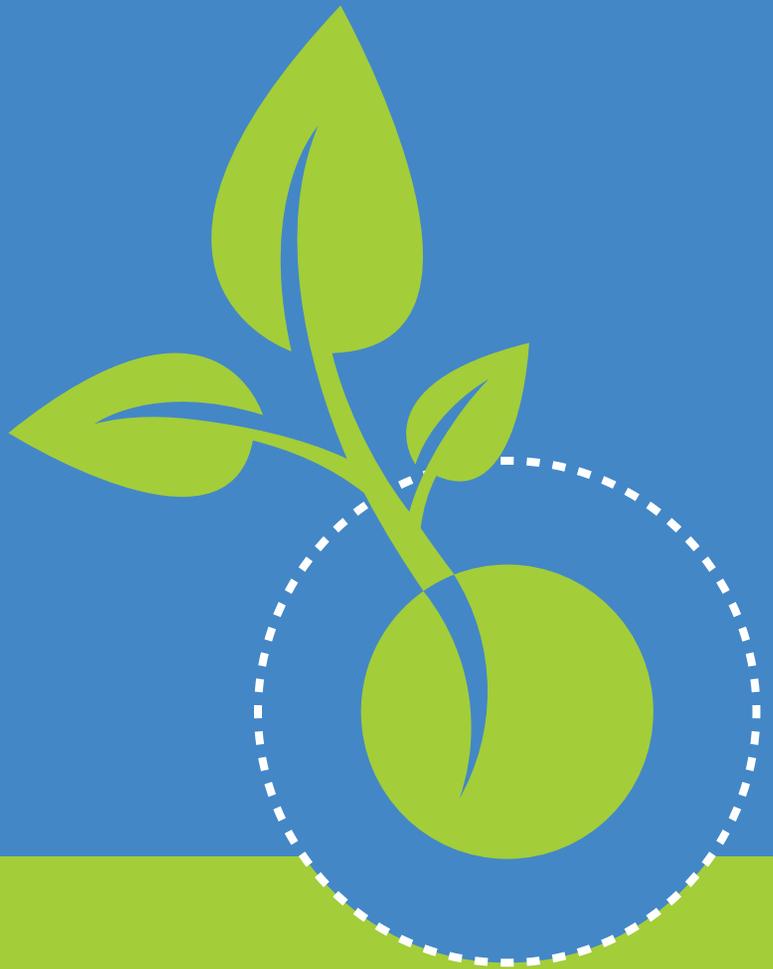


THE SEED TREATMENT BOOK



Ultrastrike[®]

Superstrike[®]

Prillcote[®]

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.

SEED TREATMENT AT PGG WRIGHTSON SEEDS LIMITED

PGG Wrightson Seeds Limited 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 perennial ryegrass and white clover in Canterbury.

THE PRODUCT DEVELOPMENT CYCLE



At PGG Wrightson Seeds Limited, 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

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 below).

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) were 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 two to four 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/m ² 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 [‡] | - |

*Days after sowing

[†]Feed value of the winter feed crop valued at \$0.20/kgDM.

[‡]Estimated retail cost of the Ultrastrike seed treatment is \$60/ha.



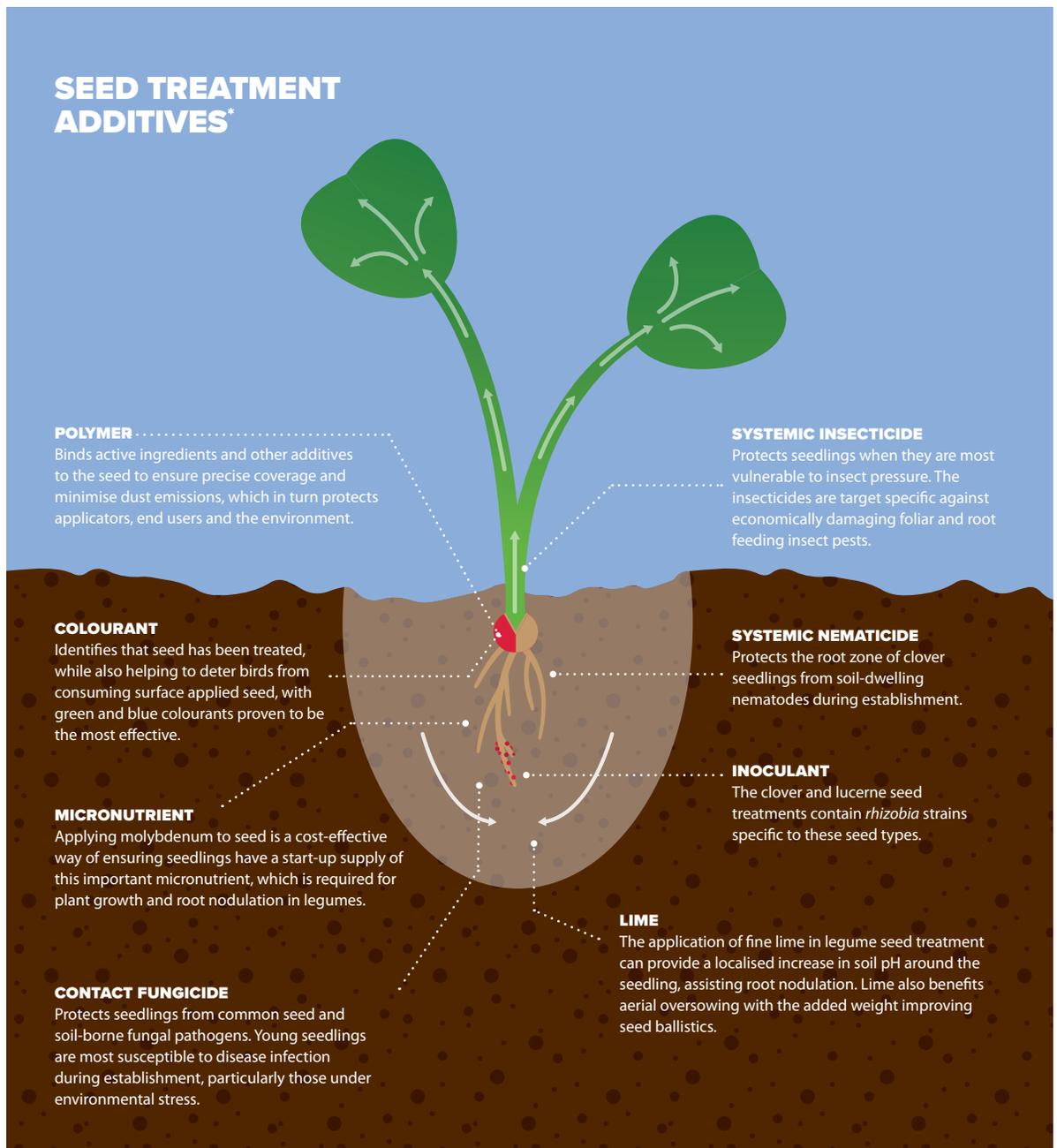
Argentine Stem Weevil larvae in a damaged ryegrass tiller.



A Canterbury replicated trial showing the impact of insect pests on plant establishment for Ultrastrike® treated versus untreated kale seed.

BUILDING BETTER SEEDS: WHAT'S IN SEED TREATMENT PRODUCTS?

The seed treatment formulations developed by PGG Wrightson Seeds Limited 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.



*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

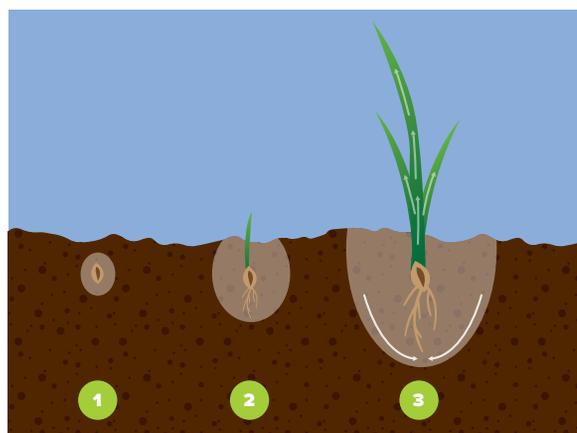
Insecticides included in seed treatment products are typically systemic in terms of their transmission, where chemical active ingredient is taken up by the young roots and distributed throughout the developing plant. Seedlings are protected during the first six weeks of establishment to the point where plants are in a much better position to withstand pest attack.

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 (see diagram below).

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 gradually 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 is also effective against fungal pathogens that are present on the seed.

BEST PRACTICE GUIDELINES AND PRODUCT STEWARDSHIP

The successful establishment of forage seed is dependent on good planning and management. Some key aspects to address prior to and after planting include soil fertility, weed control, seedbed preparation and pest management.

There are generally no 'silver bullet' solutions associated with pest management. There can be large variations in specific pest populations across seasons, regions and even within different paddocks on farm. The best approach is to implement a programme that utilises different pest management tools such as seed treatment, 'broadacre' spray application, slug bait application and, in pasture, novel endophyte (e.g., AR1 or AR37).

PEST MANAGEMENT UNDER NO-TILLAGE

Under a no-tillage system the pest burden can be very high due to the existing plant matter acting as a host for insects, therefore good pest management practices are critical. Applying contact insecticide with the last glyphosate spray will reduce the adult populations of pests, such as Argentine Stem Weevil and Springtail. Sowing treated seed will protect the pasture or forage crop against eggs, larvae and adults that are present at the seedling stage. Slug bait should be applied if there is a risk of Slug damage to seedlings.

PEST MANAGEMENT UNDER CULTIVATION

With intensive farm systems the time frame from cultivation to sowing is generally quite short, and therefore it is good practice to apply a contact insecticide if an old pasture is being sprayed out prior to cultivation to help reduce the pest burden. Cultivation can help reduce populations of soil dwelling pests such as Grass Grub. Sowing treated seed will protect the pasture or forage crop against insect pests that are present at the seedling stage.

SEED DRILLING

The application of chemicals on seed can change the flow rate of seed passing through a drill, so it is important to calibrate the planting equipment before sowing. The optimal sowing depth for forage seed ranges between 10-25 mm below the soil surface, depending on the species. Treated seed should be sown into a fine, firm and moist seedbed.



POLLINATORS

Be aware of the presence of bee hives or crops in the flowering stage adjacent to the field which could attract pollinators during planting.

POST SOWING

Newly sown pastures and forage crops need to be regularly monitored in the first few weeks after sowing and if necessary an application of contact insecticide may be required if pest populations are high.

AGRICULTURAL CHEMICALS

All agricultural chemicals registered in New Zealand, including seed applied chemicals, are rigorously assessed and have ACVM and HSNO/EPA controls applied to ensure they do not present unacceptable risk to humans, animals, bird life or the environment.

HANDLING TREATED SEED

Precautions should be taken when handling seed treated with chemicals. Treated seed can cause allergic reactions for some individuals. Gloves and a mask are recommended. Avoid contact with skin and eyes and wash hands thoroughly before meals.

SEED STORAGE

Treated seed should be stored in a cool, dry environment away from direct sunlight. Keep out of reach of children, livestock, birds and the general public. For best results, treated seed should be sown in the season of purchase.

LIVESTOCK WITHHOLDING PERIOD

Livestock should not graze insecticide treated forage crops and pasture for a period of six weeks after sowing. For grass seed undersown into an existing pasture sward, the withholding period is three weeks after sowing due to the dilution effect from existing plant material which is pesticide free.



Ultrastrike® treated Pallaton Raphno®.



Cows grazing Platform AR37 perennial ryegrass that has been treated with Superstrike®.



Gloves should be worn when handling treated seed.

*For further information refer to the following publication:
'Stewardship Guide, Handling and Planting Treated Seed' on <http://agcarm.co.nz/news-and-resources/>
For urgent medical advice 24 hours a day, 7 days a week, call the National Poisons Centre (NZ) 0800 POISON, 0800 764 766.*

BRASSICA SEED TREATMENT

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 | PESTS AND DISEASE PROTECTION/NUTRIENTS | BENEFIT |
|----------------------|---|--|
| Systemic insecticide | Springtail, Aphid, Argentine Stem Weevil (adults and larvae), <i>Nysius</i> * | Above and below ground protection during the first six weeks after planting against economically damaging insect pests. Trials have shown protection against Aphids extending out to eight weeks after planting. |
| Contact fungicide | 'Damping off' (<i>Pythium, Fusarium, Rhizoctonia solani</i>) | Protects the root zone from 'Damping off' fungal pathogens in the first three to four weeks of establishment. |
| Nutrient | Molybdenum | Molybdenum is distributed evenly around the seed and available for fast uptake by the germinating seedling. |

**Note: 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 protection.*

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 six weeks after sowing.



Steers grazing Ultrastrike treated Pallaton Raphno®.



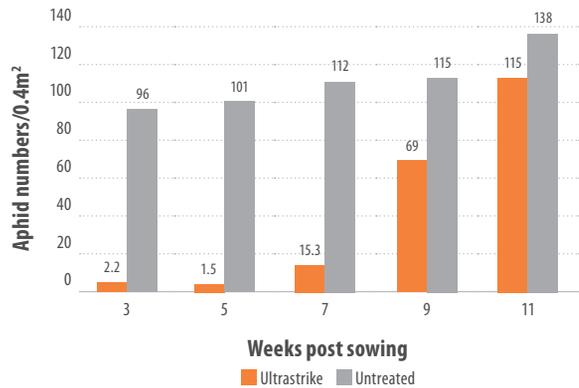
Ultrastrike treated Cleancrop™ Toto turnip.

TRIAL RESULTS

APHID PROTECTION EFFECT OF ULTRA STRIKE® 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.

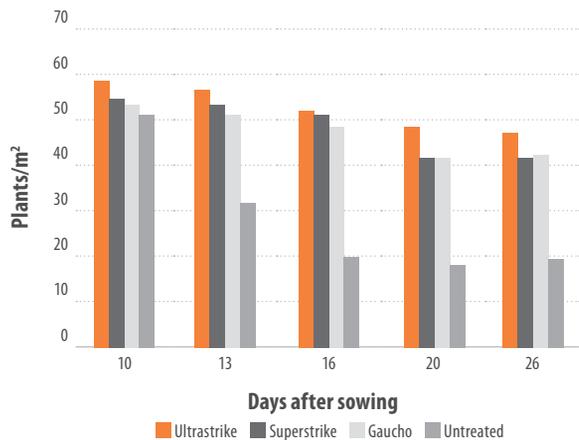
Trial conducted by PGG Wrightson Seeds, Kimihia Research Centre, Lincoln



BRASSICA 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 five 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.

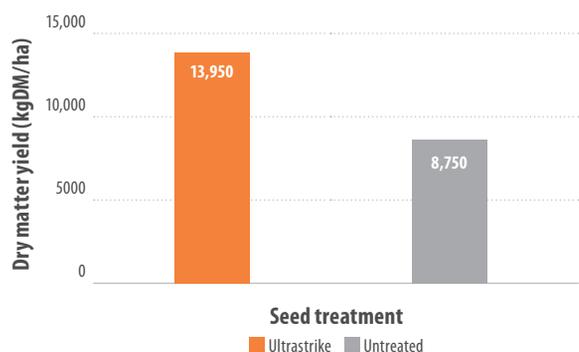
Trial conducted by PGG Wrightson Seeds



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 | PEST AND DISEASE PROTECTION/ NUTRIENTS | BENEFIT |
|----------------------|--|---|
| Systemic insecticide | Springtail | Above and below ground protection during the first six weeks after planting against New Zealand's most prevalent brassica establishment pest. |
| Contact fungicide | 'Damping off' (<i>Pythium, Fusarium, Rhizoctonia solani</i>) | Protects the root zone from 'Damping off' fungal pathogens in the first three to four 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?

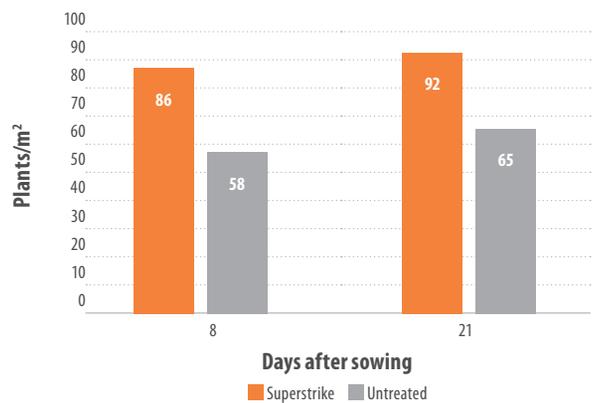
Superstrike brassica seed treatment is recommended for spring-sown forage brassica seed including rape or turnips, where Springtail is the main insect threat at establishment. Superstrike is a filmcote seed treatment with no weight gain, therefore seed should be sown at the same rate as untreated seed. Livestock should not graze Superstrike treated brassica crops in the first six weeks after sowing.

TRIAL RESULTS

BRASSICA ESTABLISHMENT UNDER SPRINGTAIL PRESSURE

This replicated field trial in Southland measured the plant establishment and crop yield of Superstrike treated and untreated kale seed. The trial was sown following cultivation and it was established under Springtail pressure. At 8 and 21 days after sowing (DAS) the Superstrike treated seed showed a significant increase in plant numbers at establishment in comparison to untreated seed.

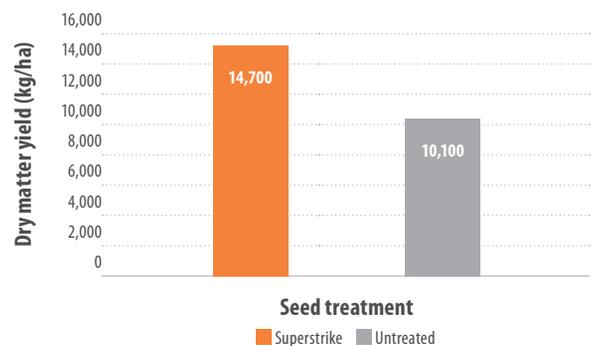
Trial conducted by Plant and Food Research, Gore



BRASSICA CROP YIELD

The resulting crop yield in the Southland trial was measured 207 DAS. The Superstrike treated kale seed showed a significant increase in crop yield in comparison to the untreated kale seed, with an increase of 4,600 kg/ha (+46%).

Trial conducted by Plant and Food Research, Gore



GAUCHO® BRASSICA

Gaucho® brassica is a filmcote seed treatment that provides brassica crops with protection against common insect pests during plant establishment.

| ADDITIVE | PEST PROTECTION | BENEFIT |
|----------------------|---|--|
| Systemic insecticide | Springtail, Aphid, Argentine Stem Weevil (adults and larvae), <i>Nysius</i> * | Above and below ground protection during the first six weeks after planting. |

**Note: 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 protection.*

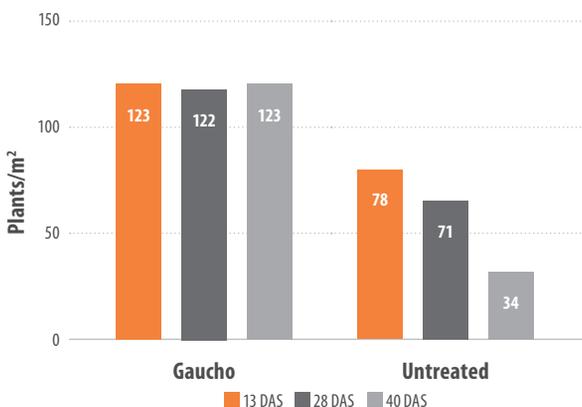
WHERE SHOULD GAUCHO BRASSICA BE USED?

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 six weeks after sowing.

BRASSICA ESTABLISHMENT UNDER SPRINGTAIL PRESSURE

This replicated field trial was sown in Canterbury in November 2016 following cultivation. The trial compared the establishment of Gaucho treated kale with untreated kale seed in the presence of Springtail. Plant counts were taken at 13, 28 and 40 days after sowing (DAS), with the Gaucho treated kale showing significantly increased plant numbers and plant survival over the course of the trial.

Trial conducted by PGG Wrightson Seeds



Gaucho treated Spitfire rape 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 10 and 11). The pelleted seed coating is currently available for swede and turnip 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 (see trial results on page 15).



Ultrastrike[®] pelleted brassica seed can be evenly distributed, as shown in this established paddock of Cleancrop[™] bulb turnip in Waikato, allowing crop yield to be maximised.



SPLITKOTE PELLETT

The seed pellet is uniform in size (3.25-4.00 mm) and shape, similar to a fodder beet pellet. 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 planting.

After sowing, oxygen and moisture from the soil penetrate the seed pellet, initiating germination. As the seed expands, this forces the pellet to split before the seed 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 PELLETTED SEED BE USED?

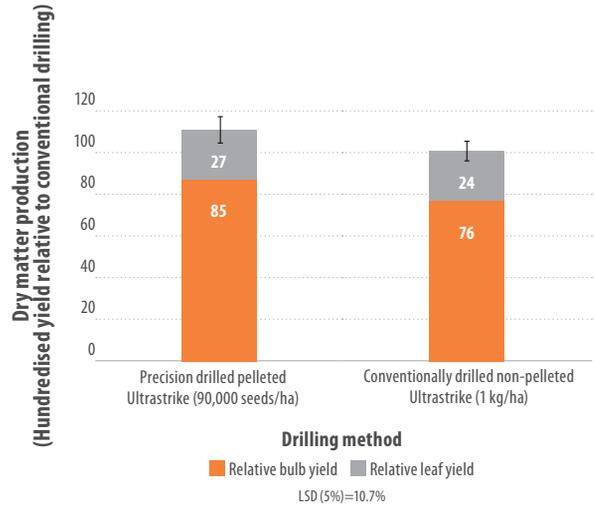
Ultrastrike pelleted seed coating is recommended for the precision planting of bulb crops, including swedes and turnips. The optimal sowing rate for swedes is 90,000 seeds/ha and 140,000 seeds/ha for turnips, planted in 50 cm rows. It is critical that a fine, firm seedbed is prepared prior to precision planting. Livestock should not graze Ultrastrike pelleted seed crops in the first six 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

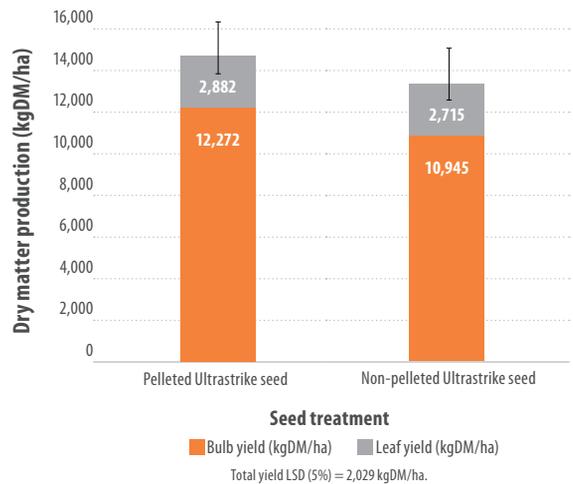


BRASSICA CROP YIELD OF PRECISION PLANTED SWEDE SEED IN SOUTHLAND

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 planting non-pelleted seed.

Trial conducted by PGG Wrightson Seeds



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 six weeks after planting. |
| Contact fungicide | 'Damping off' (<i>Pythium, Fusarium</i>) | Protects the root zone from 'Damping off' fungal pathogens in the first three to four 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 such as insect attack, as well as situations where growing conditions are favourable.

WHERE SHOULD SUPERSTRIKE GRASS BE USED?

Superstrike grass seed treatment is recommended for all spring and autumn sown grass seed, including 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 varieties delivers long-term protection after it becomes fully expressed within the plant at four to six 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 six weeks after sowing. When Superstrike treated seed is undersown or 'stitched' into an existing pasture sward, the withholding period for grazing is three 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.

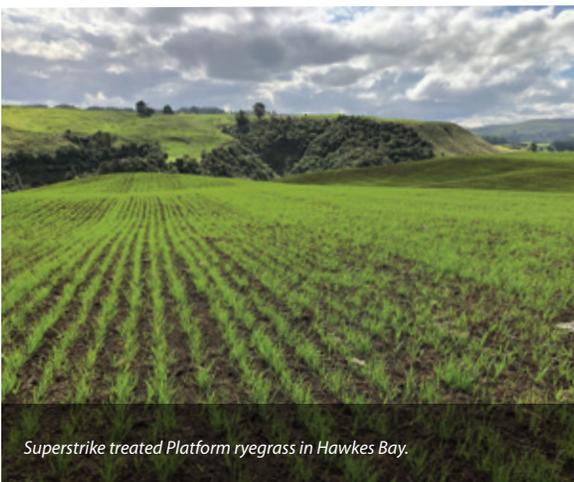
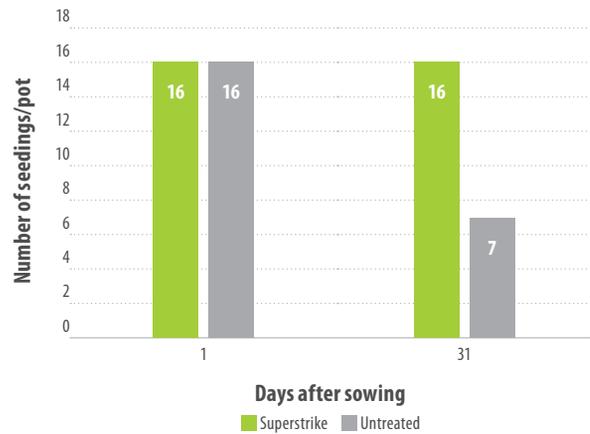
Trial conducted by AgResearch, Ruakura



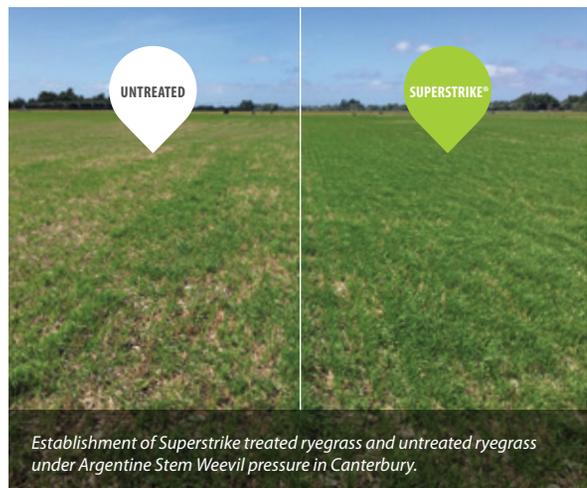
PERENNIAL RYEGRASS ESTABLISHMENT UNDER BLACK BEETLE PRESSURE

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 ryegrass in Hawkes 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' (<i>Pythium, Fusarium</i>) | Protects the root zone from 'Damping off' fungal pathogens in the first three to four 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?

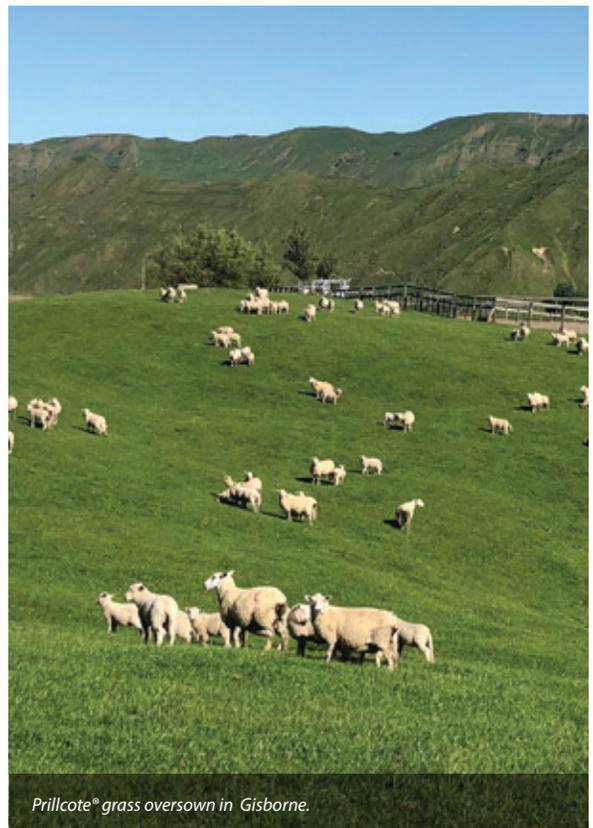
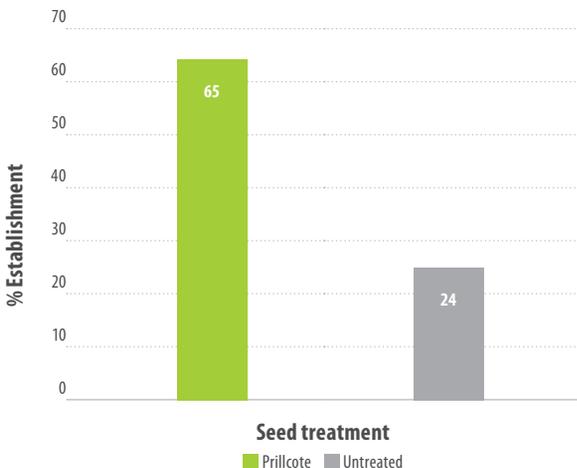
Prillcote grass seed treatment is recommended for all grass seed applied in an aerial oversowing programme. With the seed coat increasing the weight of the seed by 100%, the sowing rate of Prillcote grass seed should be increased by 100% in comparison to untreated seed.

TRIAL RESULTS

ESTABLISHMENT OF RYEGRASS THROUGH AERIAL OVERSOWING

This field trial measured the establishment of Prillcote and untreated ryegrass seed through an oversowing process, eight weeks after sowing. A higher proportion of Prillcote seed established in comparison to untreated seed.

Trial conducted by Grasslands Division, DSIR, Lincoln



Prillcote[®] grass oversown in Gisborne.

LEGUME SEED TREATMENT

The application of plant protection and plant nutrition agents, in addition to *rhizobia* to clover and lucerne seed, is 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. |
| <i>Rhizobia*</i> | | Seed inoculated with nitrogen-fixing bacteria specific to clover. |

**Note: Continued presence of rhizobia after inoculation and establishment of rhizobia in pasture depends on many things and is not guaranteed.*

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.



Beef cattle grazing Superstrike treated Relish red clover in Canterbury.



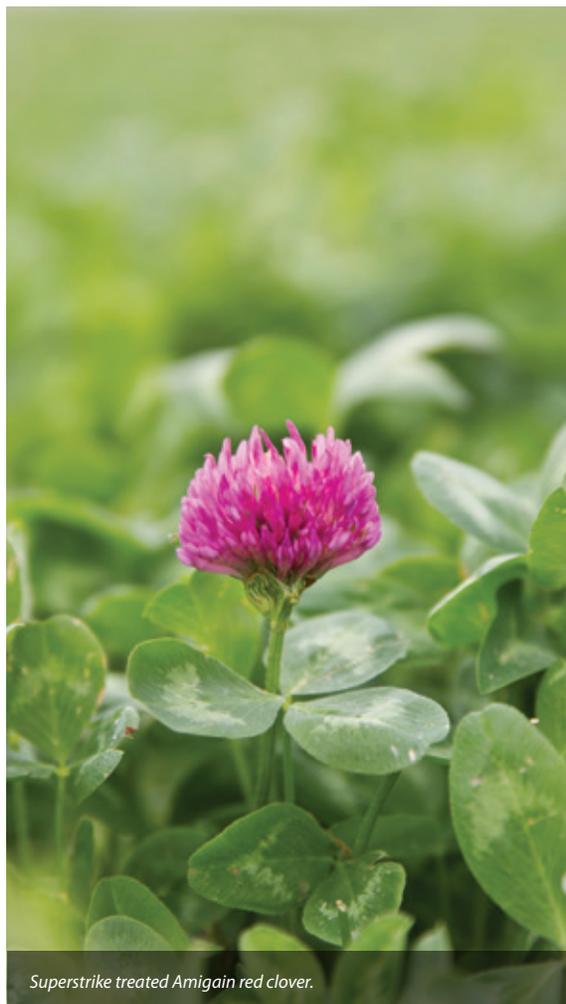
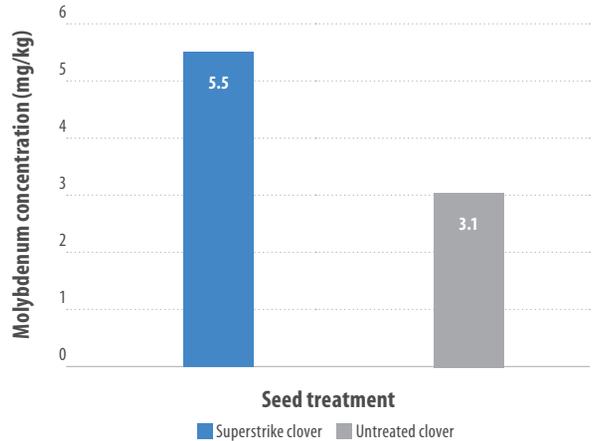
Superstrike treated Mainstay white clover in a mixed pasture sward with Legion perennial ryegrass.

TRIAL RESULTS

HERBAGE ANALYSIS OF MOLYBDENUM TRACE ELEMENT IN SUPERSTRIKE[®] AND UNTREATED CLOVER SEEDLINGS

This trial sown in autumn 2017 measured the uptake of molybdenum in Superstrike[®] and untreated clover seedlings in a controlled tunnel house environment. Herbage analysis was carried out five weeks after planting. The trial showed the benefit of including molybdenum in the Superstrike seed treatment.

Trial conducted by PGG Wrightson Seeds, Kimihia Research Centre, Lincoln



Superstrike treated Amigain red clover.

CLOVER ESTABLISHMENT

This trial measured the establishment and early plant growth of Superstrike treated and untreated white clover seed. The trial was undertaken in a controlled tunnel house environment, with the soil free of clover root nematodes and other pests. The trial was sown in February 2019, with 70 seeds sown into trays. There were six replicates of each treatment. Plant counts were undertaken 6 days after sowing (DAS) and the trial harvested after 7 weeks, with the herbage then weighed and dried. Superstrike treated seed showed an increase in plant numbers and seedling growth during plant emergence.

Trial conducted by PGG Wrightson Seeds, Kimihia Research Centre, Lincoln

| | SUPERSTRIKE | UNTREATED | % DIFFERENCE OVER UNTREATED SEED |
|--------------------------------|-------------|-----------|----------------------------------|
| Plant numbers (6 DAS) | 65 | 50 | +30 |
| Fresh weight yield (gm) | 53.6 | 44.9 | +19.4 |
| Dry weight yield (gm) | 5.8 | 5.1 | +13.7 |

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 noduleation and seedling growth. Molybdenum is distributed evenly around the seed and available for fast uptake by the germinating seedling. |
| <i>Rhizobia*</i> | | Seed inoculated with nitrogen-fixing bacteria specific to clover. |

**Note: 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?

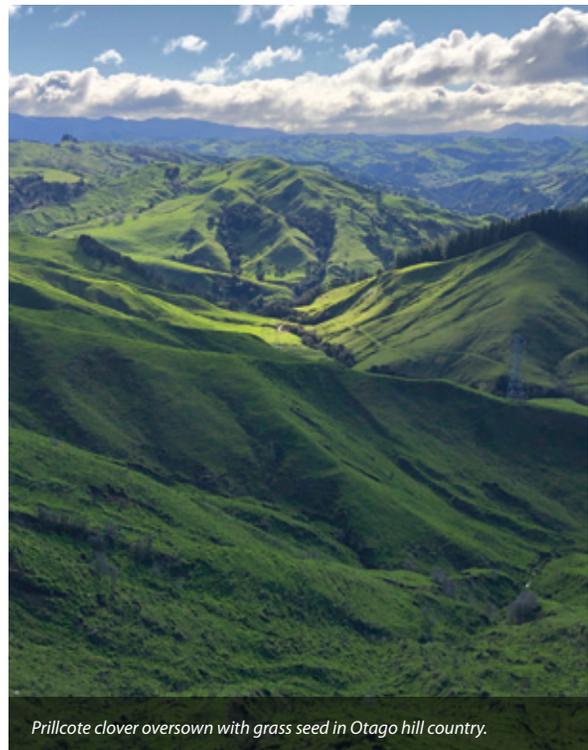
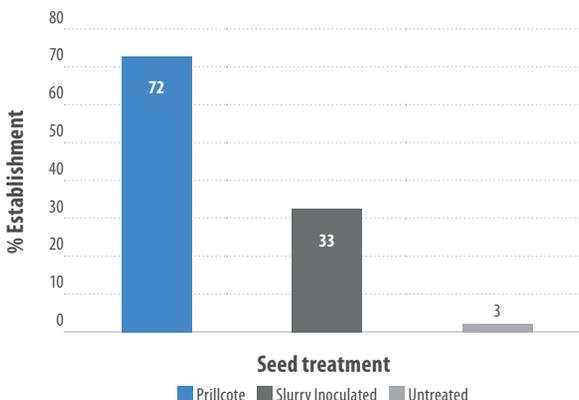
Prillcote clover seed treatment is recommended for all clover seed applied in an aerial oversowing programme. With the seed coat increasing the weight of the seed by 75%, the sowing rate of Prillcote clover seed should be increased by 75% in comparison to untreated seed. Prillcote clover seed products are generally sown in the range of 4-6 kg/ha.

TRIAL RESULTS

ESTABLISHMENT OF CLOVER THROUGH AERIAL OVERSOWING

This field trial measured the establishment of Prillcote, slurry inoculated and untreated white clover through an oversowing process, with Prillcote seed showing a significant increase in the proportion of seedlings established.

Trial conducted by MAF, Invermay



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' (<i>Pythium</i>) | Protects the root zone from the 'Damping off' fungal pathogen in the first three to four 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. |
| <i>Rhizobia</i> | | 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.

TRIAL RESULTS

EFFECT OF SUPERSTRIKE SEED TREATMENT ON LUCERNE CROP YIELD

This field trial in Canterbury measured the forage yield of Superstrike and slurry inoculated lucerne seed. Over the 15 month period from establishment the Superstrike seed showed a 7% increase in yield.

Trial conducted by PGG Wrightson Seeds, Kimihia Research Centre, Lincoln

| TREATMENT | FORAGE YIELD/HA (OVER 15 MONTHS) |
|---------------------------|----------------------------------|
| Superstrike lucerne | 33,566 kg |
| Slurry inoculated lucerne | 31,315 kg |



Superstrike treated Titan 5 lucerne.

HERB SEED TREATMENT

Superstrike[®]
herb

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 six weeks after planting. |
| Contact fungicide | 'Damping off' (<i>Pythium, Fusarium</i>) | Protects the root zone from 'Damping off' fungal pathogens in the first three to four 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 six weeks after sowing.

TRIAL RESULTS

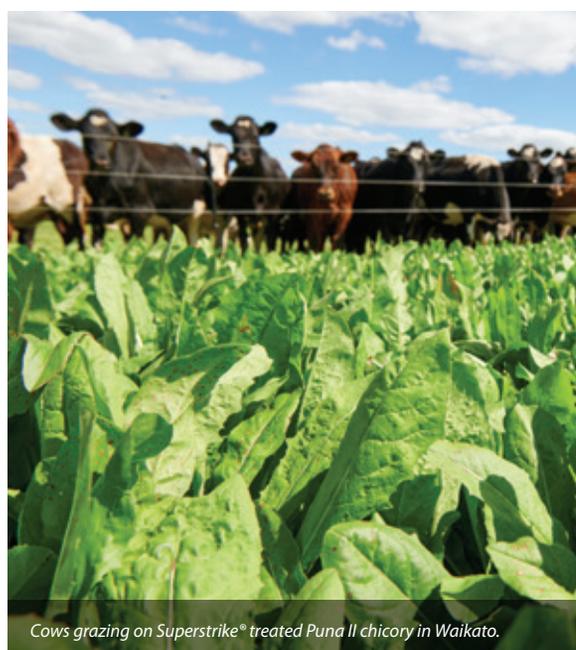
CHICORY SEEDLING DEVELOPMENT UNDER SPRINGTAIL PRESSURE

This trial measured the effect of Springtail on Superstrike treated and untreated chicory seed after Springtail were confined in cages for 5 days. Superstrike treated chicory seed showed a significant increase in plant dry matter, a significant decrease in plant damage and a significant decrease in the percentage of live Springtail remaining in comparison to untreated seed.

Trial conducted by AgResearch, Ruakura

| ASSESSMENT | SUPERSTRIKE | UNTREATED |
|-----------------------------|-------------|-----------|
| Plant dry matter (mg)/plant | 1.9 | 1.1 |
| Plant damage score* | 0.86 | 3.02 |
| % Live insects | 6 | 48 |

* 0= No damage; 4= Heavy feeding



Cows grazing on Superstrike[®] treated Puna II chicory in Waikato.

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/ NUTRIENTS | BENEFIT |
|-------------------|--|--|
| Contact fungicide | 'Damping off' (<i>Pythium, Fusarium</i>) | Protects the root zone from 'Damping off' fungal pathogens in the first three to four 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.



Prillcote treated Ecotain[®] environmental plantain in a ryegrass and clover sward.

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 | Fusarium Pythium Rhizoctonia solani | Molybdenum | - | 0% | Same as per untreated seed | 6 weeks |
| | | Argentine Stem Weevil Mysius (Wheat Bug) Springtail | | | | | | |
| SUPERSTRIKE® BRASSICA | Drill/Broadcast | Springtail | Fusarium Pythium Rhizoctonia solani | Molybdenum | - | 0% | Same as per untreated seed | 6 weeks |
| | | Aphid | | | | | | |
| GAUCHO® BRASSICA | Drill/Broadcast | Argentine Stem Weevil Mysius (Wheat Bug) Springtail | - | - | - | 0% | Same as per untreated seed | 6 weeks |
| | | Aphid | | | | | | |
| SUPERSTRIKE® GRASS | Drill/Broadcast | Argentine Stem Weevil (adults and larvae) Black Beetle (adults) Grass Grub (larvae) | Fusarium Pythium | Manganese Molybdenum Zinc | - | 0% | Same as per untreated seed ^a | 6 weeks ^c |
| | | - | | | | | | |
| PRILLCOTE® GRASS | Oversowing | - | Fusarium 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 | Fusarium Pythium | - | - | 0% | Same | 6 weeks |
| | | - | | | | | | |
| PRILLCOTE® HERB | Oversowing | - | Fusarium 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.

^aFor Grass Grub protection a minimum sowing rate of 15 kg/ha is required.

^cFor Superstrike® treated grass seed undersown into an existing pasture sward, the livestock withholding period is three weeks from sowing.

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PESTS AND DISEASES

PLANT ESTABLISHMENT PESTS AND DISEASES

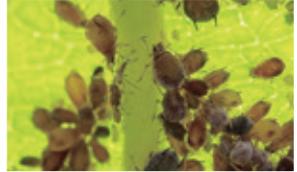
| PEST | DESCRIPTION | MAIN FEEDING PERIOD |
|------------------------------------|--|---|
| Aphid | A common pest to all forage brassica crops. | There are two dispersal flights per year, late spring/early summer and late summer/early autumn, where young nymphs are produced. Most feeding damage occurs during the nymph stage, where populations can increase rapidly under warm temperatures. |
| Argentine Stem Weevil (ASW) | A major pasture pest throughout New Zealand. | There are generally two generations per year, spring and mid-summer/early autumn. ASW can feed on ryegrass plants from October through to April in most regions. Egg laying starts in spring when the average daily temperature reaches 10 degrees and ceases around mid-March as day length reduces. |
| Black Beetle | A major pasture pest in northern regions, where average daily temperatures are above 15 degrees. | Black Beetle produce one generation per year. Larvae transition to adulthood over summer. Adults present the main threat to newly sown pastures during late summer and autumn. |
| Clover Root Nematode | These soil inhabiting micro-organisms are regarded as one of the most economically damaging pasture pests. There are three species that feed on clover plants in New Zealand – clover cyst, legion and root knot nematodes. | Feeding activity peaks in spring and autumn when pasture seed is sown. |
| Grass Grub | Grass Grub is a significant threat to newly sown pasture. They prefer environments with dry summers, cool winters and light soil types, such as East Coast regions and the Central Plateau. | Grass Grub feed on grass roots over three stages through late summer and autumn, with peak feeding occurring in the third instar stage prior to over-wintering. The development of the third instar stage coincides with the autumn pasture sow down. |
| Nysius (Wheat Bug) | <i>Nysius</i> is a major threat to forage brassica crops and are most prevalent and damaging in summer dry regions. <i>Nysius</i> prefer crops that are open with the ground exposed to sunlight. | The adults present the main threat to young crops, causing the most damage in the first four weeks after sowing. <i>Nysius</i> are highly mobile with populations peaking over late spring-early summer, which coincides with the planting of winter brassica crops such as swedes and kale. |
| Springtail | A major predator of establishing forage brassica crops throughout New Zealand. Springtails spend most of their lives under or on the soil surface. Often present in huge numbers, particularly where crops are established out of old pasture. | Springtail can feed on brassica seedlings from spring to autumn. Over this time several generations are produced. Development from egg to adulthood is very rapid under warm, moist conditions. |
| 'Damping off' Disease | 'Damping off' is a common seedling disease caused by soil-borne fungal pathogens, including <i>Pythium</i> , <i>Fusarium</i> and <i>Rhizoctonia</i> . The disease infects a wide range of species including forage brassicas and grasses. | Plants are most vulnerable to 'Damping off' disease during the establishment period, with weak or stressed seedlings at risk. Plant infection can occur over a wide range of soil conditions, although it is most prevalent in wet/cool soils. |

IMPACT

CONTROL

Nymphs suck sap from the plants, resulting in twisting and distortion of leaves and potential yield loss. Aphids also act as vectors for viral infections in brassicas such as Turnip Mosaic Virus.

Seed treatment, contact insecticide.



Both adults and larvae attack establishing ryegrass plants. Larvae cause the most damage by mining inside the stem of vegetative tillers, resulting in plants turning yellow, wilting and then dying. Adults feed on the foliage causing 'windowing' in the tips of leaves. Pasture damage during establishment can be significant, where a total resow or partial repair can be required.

Seed treatment, contact insecticide pre-sowing, AR37, AR1 endophytes (ryegrass).



Adults chew at the base of the newly emerged grass seedlings, causing yellowing of tillers and subsequent plant death. Pasture damage during establishment can be significant, where a total resow or partial repair can be required.

Seed treatment, AR37 endophyte (ryegrass).



Clover root nematodes attack root systems of newly sown and established clover plants. The invasion of young root systems and subsequent feeding reduces root mass, restricting the ability of plants to take up water and nutrients. Feeding damage is characterised by dwarfing, discolouration, wilting and plant death, resulting in reduced clover production.

Seed treatment, continuous cultivation over subsequent years.



Damage usually occurs in patches, with affected plants appearing yellow and easily pulled from the soil. At an average population of eight per spade square, pasture damage will be evident.

Seed treatment, granular insecticide, biopesticide, cultivation. Pesticide control is recommended when populations exceed three per spade square.



Nysiis chew at the base of the young stem, causing a 'ring barking' effect, which can destroy the plant and reduce crop yield. Wind also plays a part by knocking over weakened plants.

Seed treatment, contact insecticide pre and/or post-sowing. Control of host weeds such as Fathen and Shepherd's Purse around crop borders will help reduce localised numbers.



Springtail have mouthparts well adapted to chewing. Damage to plants can occur as soon as the cotyledon emerges from the seed shell, with the stem supporting the cotyledon often destroyed before it emerges above the soil surface. Damage to seedlings above ground appears as scalloping to leaf edges or small pin holes in young leaves.

Seed treatment, contact insecticide pre-sowing (following old pasture) and possibly post-sowing if populations are very high.



'Damping off' can occur at both the pre-emergence and post-emergence stages of plant development, which can result in a poor, uneven stand of seedlings. In the pre-emergent stage, seedlings fail to emerge above the soil surface. In the post-emergent stage, infected cotyledons may break the soil surface before shrivelling up, discolouring, toppling over and dying.

Seed treatment, contact fungicide.





Tim Redfern
Sales Manager
027 596 3567

**For more information, visit seedtreatment.co.nz
or freephone 0800 566 698**

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