

ESTABLISHING HELICROPPED COVER CROPS MID WINTER BY SURFACE SOWING BIRD REPELLENT TREATED SEED.

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Abstract

Loss of soil from the farm into rivers costs everyone. Cover crops sown after grazing winter forage crops, have been shown to reduce nitrogen loss and soil loss. The challenge is how to establish these after grazing, in cold wet conditions of mid-winter, when it is difficult to operate machinery on the saturated soil.

We know how to Helicrop, we can establish small seeded crops on any terrain. With that comes the responsibility to manage and prevent soil loss. To find solutions the “Helicropping – Protecting our soils” MPI Sustainable Farming Fund project was initiated in winter 2018 with financial support from Ministry for Primary Industries, Beef & Lamb, Ballance Agri-Nutrients, PGGWrightson Seeds, Agricom and Nufarm, plus in kind support from the BOP Regional Council.

Many means of establishing cover/catch crops were investigated. Results were variable until we started using Avipel (Anthraquinone) bird repellent treated seed. In the winter of 2020 excellent establishment of annual ryegrass was demonstrated with the treated seed compared to bare seed and Prilcote treated seed.

These early results were expanded on in the winter of 2021 evaluating treated and untreated oat, ryecorn and annual ryegrass seeds. Large scale trials were sown in June/July in both Taupo and Southland regions. Results were similar in both locations, with Avipel treated ryecorn and ryegrass seed successfully establishing into a cover crop. Untreated seed was largely a failed treatment.

Oat seed was not so successful. With feeding trays of dry seed, birds were not interested in the Avipel treated oats. However in the wet winter paddock conditions, the oat husk softens and birds appear to be able to pry the treated husk open and remove the untreated seed, resulting in less than acceptable results. Ryecorn, like wheat and triticale has no husk on the seed.

Taupo field trial results were as follows: established seedlings/m², treated v untreated: Ryecorn 90 v 20; Ryegrass 180 v 30; Oats 40 v 5. In the dry tray feeding studies bare ryecorn seed was the least palatable to the birds, oat seed was the most preferred.

The use of Avipel treated seed is set to revolutionize the establishment of both pasture and cover crops by broadcast seed, reinforcing the value of Helicropping.

Introduction

The most important asset on a farm is its topsoil, not only to the farmer for its long-term productive potential, but also to the community, who are likely affected by muddied streams and flooding due to mis-management.

To feed animals through the winter requires good quantities of winter forage crops such as swede, kale or fodder beet. These crops are generally rationed with electric break fencing, resulting in hoof concentration and soil damage, the extent of which depends on soil type, slope, rainfall, crop establishment technique and animal class.

Numerous options are available to reduce soil damage. Multiday block grazing has the effect of dispersing hooves, and settling stock down. Companion planting with for example plantain fills in bare ground between swede bulbs, securing the soil with roots and with good grazing management surviving the grazing to become a ready-made cover crop. Then there is no-tillage cropping. By leaving the soil structure intact when growing crops, the soil structure is more resilient, soil water infiltration is unaffected, reducing the risk of pugging. Then there is the option of establishing cover crops after grazing. (Lane, 2022)

This Sustainable Farming Fund (SFF) project evaluated techniques to establish cover crops by surface applying seed in the cold wet conditions of winter (June/July) after grazing swede forage crops. Work was carried out in both the central North Island (CNI) and in sites around Southland.

Brendon Malcolm and his team from Plant and Food Research, Christchurch were at the same time working to identify the value of cover/catch crops at preventing nitrogen loss from the topsoil following grazing (Malcolm *et al.*, 2018). Their very specific trials required machinery to sow and establish standardized seed rates of various selected cover crop species. Their work is invaluable to identify the role of cover crops in nitrogen retention.

This project accepts that a cover crop will enable retention of nitrogen, relative to the amount of dry matter grown. The primary goal of this project was to identify a means of establishing a cover crop regardless of terrain and soil conditions, in the middle of winter, plus also to assess its ability to prevent soil loss.

Along with the large scale broadcast seeding trials, bird feeding studies were conducted with seed in trays to evaluate bird preference to the various seeds and seed treatments being evaluated.

Method

Avipel bird repellent seed treatment came to our attention following discussions with Department of Conservation (DOC), who had moved on from using carrot segments treated with 1080 for rodent control baits, to using compressed cereal grain baits. DOC had evaluated use of anthraquinone (marketed as AvipelTM) (Clapperton *et al.*, 2013) to prevent native birds taking the cereal bait.

This was good news following two winters with variable annual ryegrass establishment results (2018 & 2019). The project developed renewed vigour when in the autumn of 2020, annual ryegrass (Winter Star) seed was treated with Avipel for field evaluation. The treatment rate was 12.0 ml Avipel product/kg seed, (6.0 gm anthraquinone/kg seed).

Along with bird feeding studies in dry seed trays, large scale field trials were conducted both in the CNI and in the Southland regions during the winter of 2020, following swede forage crop grazing. These trials compared annual ryegrass establishment using bare seed, Prillcote™ treated seed and Avipel treated seed. Prillcote seed treatment is a lime coating, doubling the seed weight to improve ballistics when sown from an aircraft. A blue/green dye is added because this colour makes it less visible to birds (Mastrota & Mench 1994). Avipel treated seed had the same blue/green colour, but had almost no increase in weight. Both treatments included a fungicide for damping off disease control.

Bird populations were unknown, so trials were conducted in various locations, hoping to find a site with good bird activity. The Taupo trials in CNI were carried out at various locations on Waihora Farm, Tihoi. In Southland the sites ranged from Te Anau to Clinton to Millers Flat.

Seedling establishment counts were taken at 6-7 weeks after the June/July sowing dates. No dry matter yield data was able to be gathered from these trials.

In the 2021 winter season a second series of trials were conducted in the same geographical areas. The treatment species were expanded seeking an answer to whether Avipel would protect larger surface sown seeds from birds. Along with annual ryegrass, the winter active species, oats and ryecorn were evaluated. Oats was a primary candidate being known to be very winter active, however with a reputation for not establishing as a broadcast seed. Ryecorn was suggested by Brendon Malcolm, based on observations in one of their sloping nitrogen loss trials, that it was more effective at arresting overland sediment flow because of its prostrate growth form, especially in comparison to the more erect growth form of oats. Annual ryegrass was included to build on the success of the 2020 season results. Avipel treatment rate remained the same.

Both Avipel treated and bare seed treatments were broadcast at eight sites in each region, using a standardized plot size of 15m x 30m. The seven treatments in each trial being each species with and without Avipel, and then a “wild card” combination treatment with lower seed rates of all three species, (TABLE 1). Bare seed treatments had no dye colour, whereas all Avipel treatments were coloured (as per NZ law) either blue/green (ryegrass) or red (for oats & ryecorn). Seed was broadcast by hand using chest mounted 5 kg “Solo” seed spinners, covering each plot 3-4 times depending on how the seed flowed, to ensure even coverage.

TABLE 1: Seed treatments used in winter 2021 trials.

Treatment Number	Seed Variety	Seed Treatment and dye colour	Application rate (kg seed/ha)
1	Winter Star annual ryegrass	Bare	25
2	Winter Star annual ryegrass	Avipel (blue)	25
3	Milton Oats	Bare	80
4	Milton Oats	Avipel (red)	80
5	Rahu Ryecorn	Bare	80
6	Rahu Ryecorn	Avipel (red)	80
7	<u>Rye+Oats+Ryecorn</u>	Avipel	15 + 40 + 30

The Taupo trials were all in one paddock on Waihora farm, adjacent to Puketapu road. They were sown progressively over a three week period from 22nd June to 9th July 2021, as the

farmer grazed the swedes making more of the paddock available, and the soil dried sufficiently for the seed treatment to be made to the firm surface. As such all eight trials had a similar bird population. No fertilizer was applied to support establishment. Conditions were difficult, it being cold and wet, with snow on one day, and muddied but dry soil underfoot.

Southland trials were established in a range of locations across the Southland region by a contractor using the same protocol as used in Taupo. Along with the muddied ground, he had to contend with some frozen ground! Treatment dates revolved around when the farmer got to graze the targeted swede paddock. With frozen ground and very wet conditions seed sowing was delayed until conditions improved. We wanted the seed to be on the surface to test the bird repellency treatment, not buried in mud.

Aerial demonstrations were established in CNI, with Avipel treated annual ryegrass, oats and ryecorn being flown onto approximately one hectare each on the 23rd July 2021 using a Robinson Helicopter and spreader bucket. Seeding rates were: Oats 80 kg/ha, ryecorn 80 kg/ha, and ryegrass 15, 20 and 25 kg seed/ha respectively to separate blocks.

In Southland a 0.8 ha large scale demonstration was established also on 23rd July, in a wet site at the Southern Dairy Hub near Invercargill. A “side by side” light four wheel drive vehicle was used, with one person driving and another using the Solo chest mounted seed spinner from the back of the vehicle. Seeding mix applied was the “combination” rate in the trials. Noting that application was difficult, the final seed rates were calculated as: Oats 50 kg/ha, ryecorn 38 kg/ha and annual ryegrass 13 kg/ha.

Seedling counts were carried out at 6-7 weeks after broadcasting. This was complicated by Government Covid-19 lockdown restrictions. Further assessments were made to gather Dry Matter yield data (Southland trials) using a rising plate meter. Lockdown restrictions prevented the gathering of DM data in CNI trials, however photographic evidence suggests significant groundcover (2500-3000 kg DM/ha cover) from successful treatments by 14 weeks after sowing. The farmer (David Briscoe) also did an “eye assessment” for us, confirming the trends.

Bird feeding studies were conducted near Hamilton over both seasons using standard amounts of each of the seeds in trays measuring 30 cm wide x 46 cm long x 12 cm deep. An initial starting weight sample of 500gm of each treatment, replicated three times, was made available for birds on fine days to keep the seed dry, for 10 days (year 1) and 20 days (year 2). Birds observed taking the seed were mainly sparrows and finches but also quail and pheasant. Birds were quick to indicate which species they preferred to eat (oats), which they didn't (ryecorn) and that anything treated with Avipel was not on the menu. (GRAPH 1).

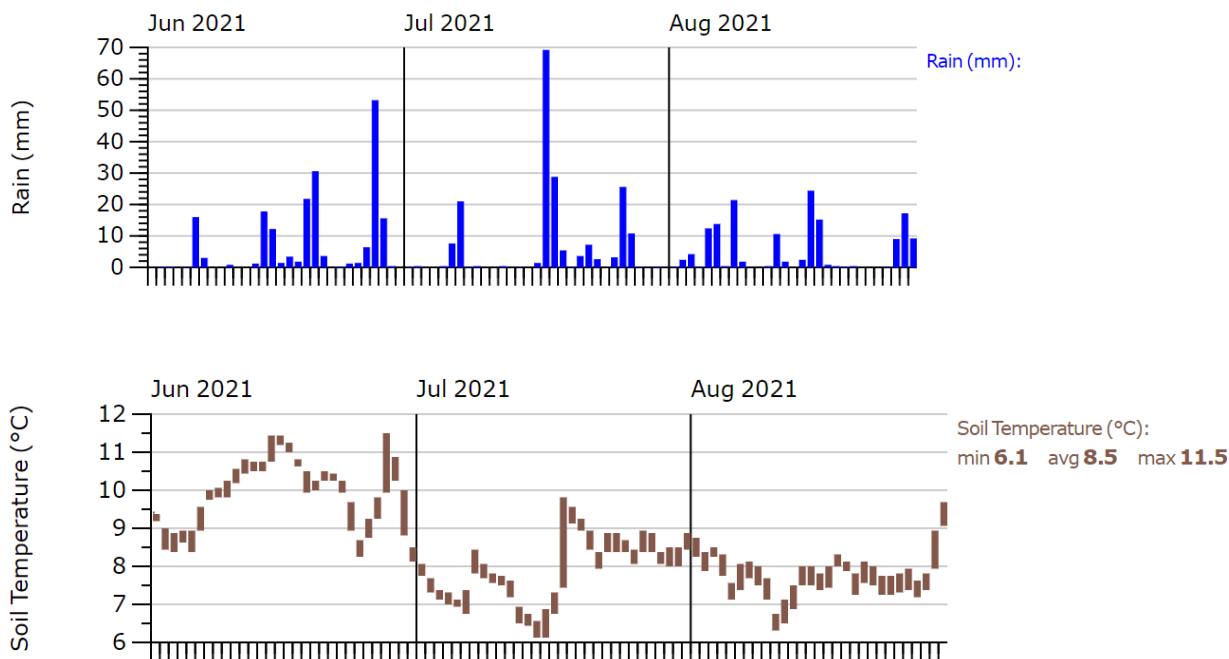
Soil temperature and rainfall data for the Tihoi trials for the period covering sowing to seedling count date for the 2021 season are detailed in Table 3.

Along with some ground frosts of minus 4-5 degrees Celsius, soil temperature at the CNI site dropped to 6-8 degrees during the first two weeks of July soon after the seed treatments had been broadcast, and remained largely below 8 degrees Celsius for the remainder of July and August. Seedling counts were carried out early September. Rainfall was sporadic with numerous showers of 5-10 mm through this period, and one very heavy rainfall event (100+ mm) over 2-3 days around the middle of July.

TABLE 2: Seedling counts (per m²) at Tihoi trials 6-7 weeks after late June/early July 2021 sowing.

Seedling Counts (Tihoi) 6-7 weeks after broadcast									
Seed variety	Ryegrass	Ryegrass	Oats	Oats	Ryecorn	Ryecorn	Ryegrass	Oats	Ryecorn
Seed treatment	Bare	Avipel	Bare	Avipel	Bare	Avipel	Avipel	Avipel	Avipel
Sowing rate (kg/ha)	25	25	80	80	80	80	10	40	30
Trial Number	SEEDLINGS / m2								
1	17	153	9	29	20	214	69	7	59
2	42	207	7	24	18	136	85	21	56
3	15	56	1	48	11	170	72	24	51
4	22	134	5	31	21	170	110	16	38
5	16	143	2	20	11	245	107	25	66
6	50	271	4	83	38	200	106	34	60
7	29	268	6	45	23	205	103	34	48
8	63	237	8	58	28	189	96	24	54
Sum	254	1468	40	338	169	1528	749	183	431
Mean seedlings / m2	32	183	5	42	21	191	94	23	54

TABLE 3: Climatic conditions from sowing to seedling counts (at 6-7 weeks)



Results and Discussion

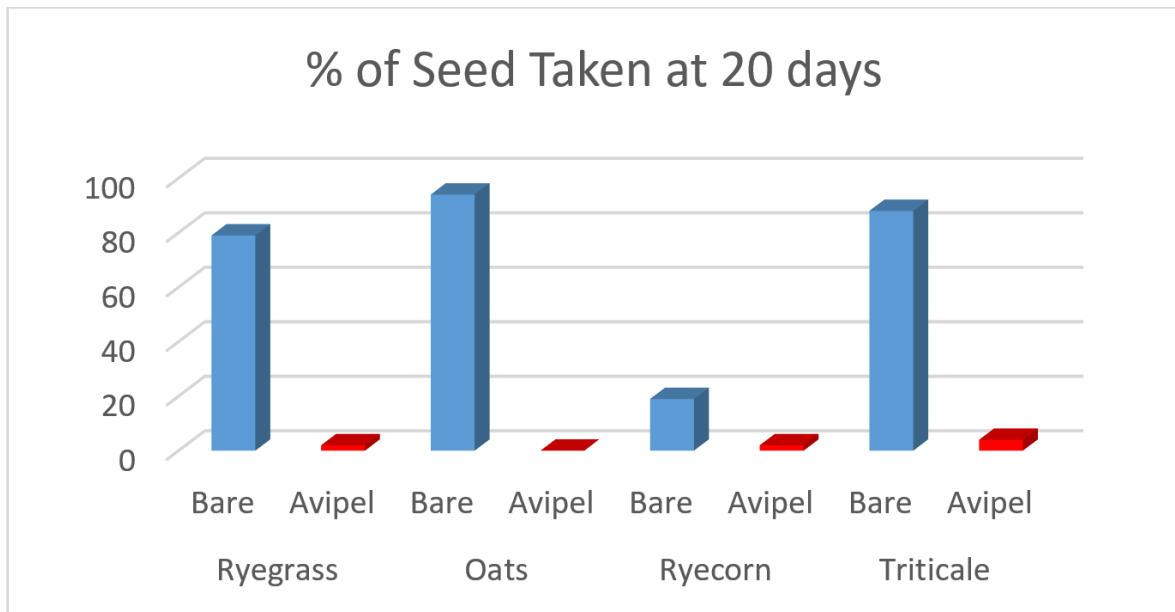
Bird feeding evaluation

Birds were quick to show that the preferred seed was untreated oats, with most bird feeding concentrated in these (randomly mixed) trays, until the oats had been consumed. Then attention shifted to annual ryegrass and triticale and finally least preferred ryecorn, was only

eaten if it was the only bare seed available, with around 80% of ryecorn seed still in the trays at 20 days.

Any seed that had Avipel treatment was largely rejected, (GRAPH 1) with only a small percentage of the dry seed being consumed (red bars). Colour preference was not evaluated.

All bare seed was natural colour. Treated seed was either blue/green or red. Mastrota & Mench demonstrated that seeds dyed with the blue/green colour are less likely to be consumed. The trials in the seasons prior to Avipel, deliberately used blue/green treated seed, but the winter broadcast paddock trials did not identify an advantage over bare.



GRAPH 1: Bird feeding tray results using DRY seed.

Seedling counts 6-7 weeks after broadcasting seed following swede grazing.

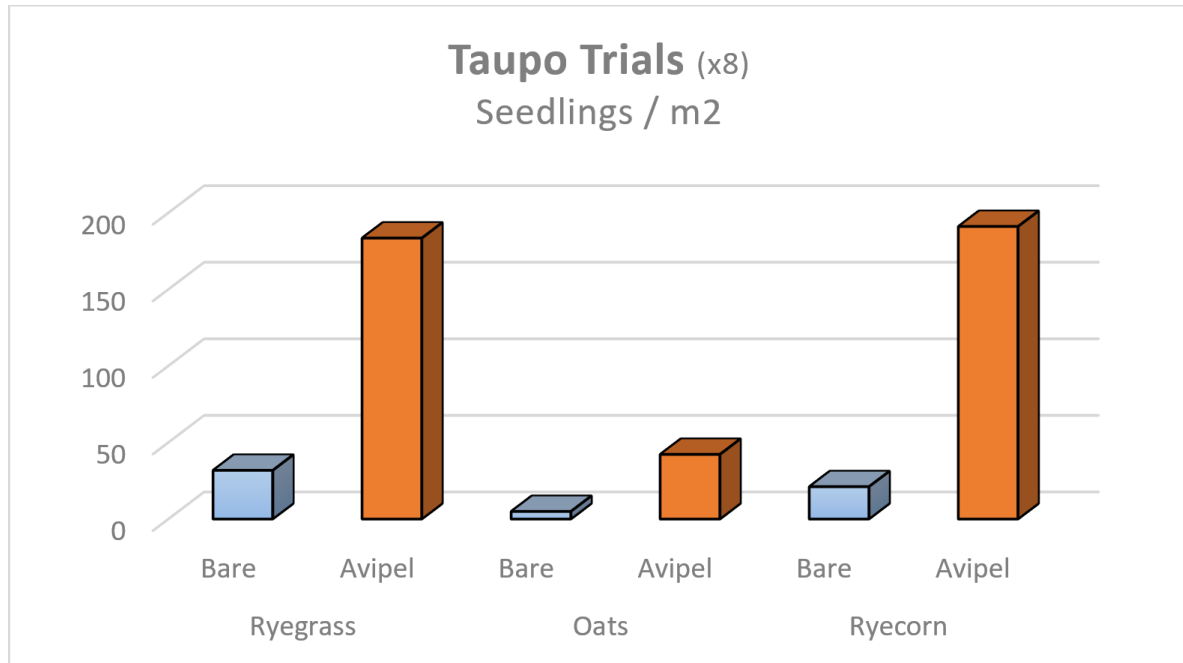
Bird activity had been observed on the Tihoi site while the seeds were broadcast, also at the three week visit and while the counts were being carried out at 6-7 weeks. Bird species observed were mainly sparrow and finch.

Seedling establishment counts were carried out weeks after broadcasting. The data for the CNI/Tihoi and Southland trials from the 2021 winter sowing are shown respectively in GRAPHS 2 & 3.

At the CNI trials the bare seed treatments had very low establishment counts with on average annual ryegrass around 30 plants/m², ryecorn at around 20/m² and oats even less at less than 5 plants/m², showing again the preference birds have for oats.

The broadcast Avipel treated seed treatments resulted in around 180 seedlings/m² for annual ryegrass and ryecorn. However, establishment was poor with Avipel treated oats. A large number of empty oat husks were observed in these plots. It is postulated that as the Avipel treatment is applied to the oat husk, not the seed as with ryegrass and ryecorn, birds were able to avoid the Avipel treatment on the wet (softened) husk and access the untreated oat seed inside.

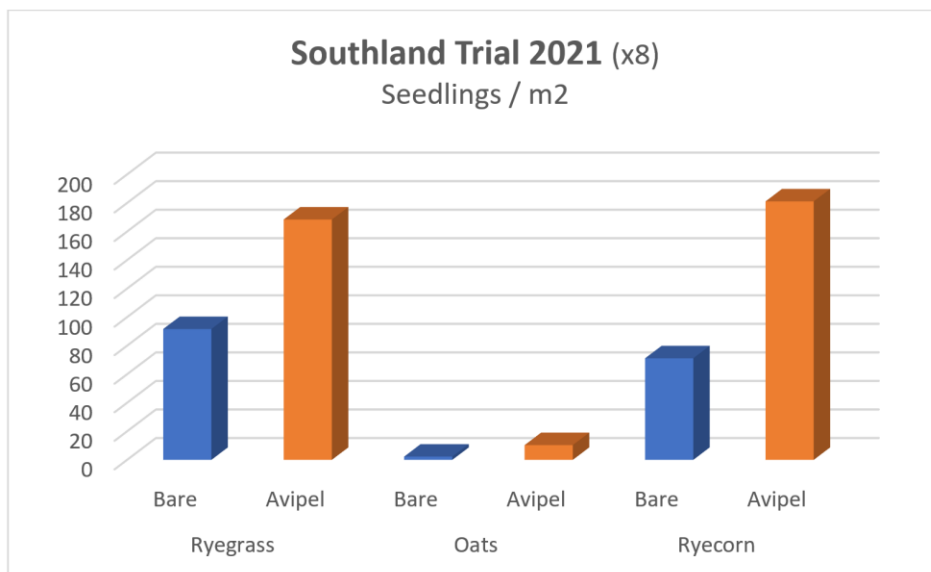
Unless oat seed is de-husked, allowing Avipel to be applied to the seed, broadcast oat seed treated with Avipel is unlikely to be a successful treatment. Triticale is a similarly winter active cereal but without a seed husk, further work is needed to prove its suitability.



GRAPH 2: Summary results from winter 2021 surface sown treatments at Tihoi (Taupo)

The Southland trial results were very similar to those in CNI. Avipel treated ryecorn and ryegrass resulted in on average 170 – 180 seedlings/m² at 6-7 weeks after broadcasting. Avipel treated oat seed was again a failed treatment, with around 10 seedlings/m².

Oat bare seed was similarly a failed treatment. However bare annual ryegrass with on average 90 seedlings/m² (range 15-193) and ryecorn at 70 seedlings/m² (range 2-250) gave moderate establishment. It was suggested that lower bird activity on some sites and/or buried seed in wet muddy sites may have been the reason for the enhanced establishment. Once the seed is buried, it is no longer part of the bird repellent trial as birds can no longer access it. Recall also that the CNI trials were all in one paddock with equal soil and bird activity, whereas in Southland the sites were widely spread with likely varying bird populations and soil conditions.



GRAPH 3: Summary results from winter 2021 surface sown treatments in Southland

Ground cover assessments at 12-14 weeks after sowing.

These assessments were made difficult by imposed Covid-19 movement restrictions. Ideally dry matter cuts would have been made to give definitive data, this was not possible.

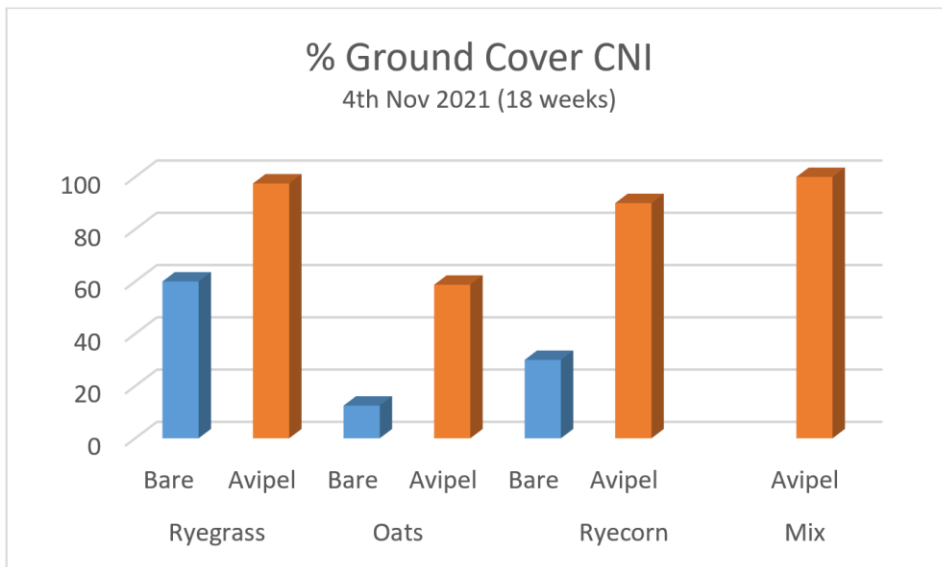
All treatments achieved some degree of vegetation ground cover, with low growing wild broadleaf species dominating in some plots. However the seedling plant counts taken at 6-7 weeks after sowing were a good indication of final vegetation ground cover with sown species.

An eye assessment score of ground cover was conducted for each of the 56 plots at the CNI site. (GRAPH 4). Avipel treated ryecorn, annual ryegrass and the combination mix were on average 90-100% ground cover with sown species. Avipel treated oat plots had on average 50% of the ground covered with oats.

In the bare seed plots, untreated oats were around 10% ground cover, with ryegrass and ryecorn varying between 30 and 50%.

The goal is to create plant cover as soon as possible after grazing to protect the soil. It takes time particularly in the middle of winter. These results are very promising, with Avipel treated ryecorn and annual ryegrass and the combination treatment giving good ground cover from around 6 weeks after broadcasting, developing to offer a grazing opportunity at around 12-14 weeks.

No work has been done on seeding rate, however the Avipel treated combination seed mix results suggest that seed rates could be further reduced over that evaluated. As almost no oats survived in the Avipel treated combination mix treatment, this treatment was essentially only annual ryegrass at 15 kg/ha plus ryecorn at 35 kg/ha. Together they resulted in full ground cover.



GRAPH 4: Mean % Ground Cover from “Eye assessment” at 12-14 weeks after sowing (late October) at Tihoi trials.

Conclusions

Avipel (anthraquinone 500 gm/lit) bird repellent seed treatment used at 12 ml product/kg seed successfully protected mid-winter, surface sown ryegrass and ryecorn from bird feeding, enabling the establishment of winter sown cover crops to protect the soil.

Mid-winter surface sown ryegrass and ryecorn cover crops have been shown to establish in both the Taupo and the Southland regions.

Avipel bird repellent was not as effective when applied to oats. It is proposed that this is likely due to the Avipel being applied to the oat seed husk, and not the seed as with ryegrass and ryecorn. Birds appear to be able to take the seed from within the husk after it softens due to exposure to moisture.

Triticale is another winter active cereal without a husk. It has been shown to survive bird predation when surface broadcast in early November. The work has yet to be done with a mid-winter sowing, but is expected to give similar results to ryecorn.

Acknowledgments

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