The effect of seed treatment and depth of sowing on forage brassica crop establishment in no-tillage situations

R.W. SALMON[1] and A.J. DUMBLETON[2]
[1]*Wrightson Seeds, 15 Stewart Rd, Mount Stewart, RD9 Palmerston North*
[2]*PGG Wrightson Seeds, PO Box 939, Christchurch*
rsalmon@wrightsonseeds.co.nz

Abstract

Unreliable establishment of brassica forage crops prompted an investigation into the effect of sowing depth and current commercial seed treatments on rates of emergence and total emerged seedling numbers. Three trials using Barkant forage turnip were sown by no-tillage in conditions managed to minimise invertebrate pressure. Rate of emergence was measured by seedling counts taken at multiple stages over the first 24 days after sowing. Trial A tested the effect of seed treatment (SuperStrike®, UltraStrike™, Gaucho® 600 FS 24 ml/kg (14.4 g a.i imidacloprid/kg seed), Gaucho® 600FS 12 ml/kg (7.2 g a.i imidacloprid/kg seed) and untreated control) on seed sown at 10 mm depth, with no significant difference in the rate of emergence of any seed treatment and the untreated control (bare seed). Trial B tested the effect of seed treatment (SuperStrike® and untreated control) on seed sown on the soil surface (0 mm), with no difference in rate of emergence being found. Trial C tested the effect of sowing depth (surface (0 mm), 10, 25, 50 mm) on rate of emergence, and found that seed sown at 10 mm depth was initially faster to emerge (7 days after sowing). Subsequent counts established that 10 and 25 mm depths had equivalent rates of emergence and had reached the highest total number of seedlings emerged by 15 days after sowing. In contrast, seed sown on the surface (0 mm) or at 50 mm depth had a lower total emergence count. Trial C also found that subsurface sown seed (10, 25 and 50 mm depths) reached peak number of emerged seedlings faster (15 days after sowing) than seed sown on the soil surface (0 mm).

Keywords: brassica, forage crop, seed treatment, sowing depth, emergence, agronomy

Introduction

Summer and winter forage brassica crops are fed to livestock as a supplement when pasture is slow growing and/or of low quality. Forage brassicas are the most widely used cultivated crop in New Zealand, providing a range of benefits such as feed quantity and quality, improved animal health and providing a break crop during a pasture renewal programme (Hamilton-Manns & Lane 2002). Too often brassica forage crops do not reach their maximum yield potential, reducing or altogether eliminating crop profitability. Management practices at establishment, including paddock preparation, sowing and post-emergence management have contributed to poor crop yield.

Brassica forage crop seed is most commonly sown in treated form. The three main seed treatments available in New Zealand are SuperStrike®, UltraStrike™ and Gaucho® 600FS (registered in two application rates, 12 ml and 24 ml product/kg seed). Table 1 details the product claims for these products. The benefits of seed treatment in terms of protecting seedlings against pests are well documented (Addison & Fisher 2002). However, the effect of seed treatment on rate of emergence is often questioned, particularly in dry soil conditions where

Table 1 Registrations for seed treatments available in NZ for brassica forage crops.

Activity	SuperStrike®	UltraStrike™	Gaucho® 24 ml/kg*	Gaucho® 12 ml/kg*
Springtails	Y	Y	Y	Y
Argentine stem weevil	-	Y**	Y	Y
Aphids	-	Y	Y	Y
Nysius spp. wheat bug.	-	Y**	Y	Y
Fusarium spp.	Y	Y	-	-
Pythium spp.	Y	Y	-	-
Rhizoctonia spp.	Y	Y	-	-
Nutrients	Molybdenum	Molybdenum	-	-
Sowing Rate	As for untreated seed			

*product label contains two application rates, 24 ml/kg (14.4 g ai/kg) & 12 ml/kg (7.2 g ai/kg), stating the higher rate will increase the period of protection against aphids.
**UltraStrike™ registrations pending at time of publication.
Y = confers control

undocumented observations attribute seed treatment as the main cause of poor seed emergence.

Apart from accurate spatial spread of seed (i.e. uniform seed numbers/m^2), one of the most important factors to be controlled during planting is seed depth. The operator who is sowing the seed has a direct influence on sowing depth but there are also additional external factors that can influence depth of sowing such as the condition of the seedbed: fine & firm versus cloddy or fluffy, or undulations in the seedbed, particularly in no-tillage.

The objective of this research was to investigate if current commercially used brassica seed treatments or depth of seed placement at sowing affected the rate of emergence of establishing forage brassica crops.

Methods

Trial design and treatments

A single line of turnip seed (*Brassica campestris* sp. *rapa* cv. Barkant) was sown in three trials on the 12 November 2004. All trials were randomised block design with four replicates.

Trial A tested the effect on rate of emergence at 10 mm depth of the seed treatments SuperStrike®, UltraStrike™, Gaucho® 600 FS 24 ml/kg (14.4 g a.i imidacloprid/kg seed), Gaucho® 600FS 12 ml /kg (7.2 g a.i imidacloprid/ kg seed) and untreated control on rate of emergence of forage turnips sown at 10 mm depth; Trial B tested the effect on rate of emergence of sowing both SuperStrike® and untreated seed on the soil surface (0 mm). Trial C tested the effect of sowing depth (surface 0 mm, 10, 25, 50 mm) of Superstrike® seed on rate of emergence and total seedling emergence. Plots were 3 m wide, sown in 150 mm seed-drill row spacing; plot lengths were 100 m, 25 m and 25 m for Trials A, B and C respectively

Trial site and management

Trials were conducted at AgResearch Aorangi Research Station, Lockwood Rd, Kairanga, on Te Arakura silt loam. Trials were sown into sprayed-out paddocks that had been in permanent pasture. The trials were managed to minimise the incidence of invertebrate pest attack, isolating the effect of the seed treatment on rate of emergence. A spray in early October of chlorpyrifos 480 g/L a.i. (Chlorpyrifos 48EC) at 1.25 L/ha was applied for Argentine stem weevil control. The paddock was then desiccated with glyphosate 490g/L a.i. (Roundup® Renew Xtra) at 4 L/ha, dicamba 500 g/L a.i. (Kamba™ 500) at 600 ml/ha, chlorpyrifos 480 g/L a.i. (Chlorpyrifos 48EC) at 350 ml/ha and organosilicone penetrant (Pulse® Penetrant) at 100 ml/100 L water. Dicamba was included for broadleaf weed control and the chlorpyrifos for additional springtail control.

Turnips were sown at 3 kg/ha by no-tillage using a Cross-Slot® drill. The Cross-Slot® no-tillage system was selected for its accuracy of seed placement in a target depth, for its ability to tolerate the biological and physical risks of no-tillage, and its ability to handle residue (Baker *et al*. 1996.) Seed was sown on the surface in Trials B and C by tilting the drill chassis backwards using the drawbar hydraulic ram, lifting the blades out of the ground but retaining down force on the press-wheels; thus seed was dropped on the surface and pressed into the soil surface.

During drilling, 250 kg/ha Cropmaster 15 fertiliser (NPKS 15:10:10:7) was applied beside the sown seed and methiocarb slug bait (Mesurol®) was broadcast at 10 kg/ha. The contractor controlled timing of sowing so that in his opinion seedbed conditions were optimum, to minimise any negative seedbed influences on rate of emergence.

Measurements

Quantification of emerged seedlings were made using a linear quadrat, 1.66 m in length, with counts taken from drill rows on both sides of the quadrat, giving a quadrat area equivalent to 0.5 m^2. Ten counts were taken per plot from randomised positions that were marked so subsequent counts could be taken from the same area at each count date. In Trial A, counts were taken 7, 15 and 24 days after sowing. In Trials B and C, counts were taken 7, 9, 12, 15 and 24 days after sowing.

Results

In Trial A, total emerged seedling numbers of all seed treatments were not significantly different from the untreated control (Table 2), with all treatments within a range of 55-63 plants/m^2 by the final count taken 24 days after sowing. By contrast, SuperStrike® had a faster rate of emergence 7 days after sowing than either of the Gaucho® treatments, though not significantly higher than UltraStrike™. That initial advantage became insignificant in subsequent counts.

When seed was sown on the soil surface (0 mm) in Trial B (Table 3) Superstrike® initially had an advantage in rate of emergence (7 & 9 days after sowing) but by 12 days after sowing there was no significant differences in rate of emergence between SuperStrike® and untreated seed, nor was there a difference in total number of seedlings emerged at the final count, 24 days after sowing.

Trial C (Table 4) found that seed sown at 10 or 25 mm had the fastest overall rate of emergence and the highest total emerged numbers 24 days after sowing, except at the first count (7 days after sowing) when the 10 mm depth had a significantly higher count than the 25 mm. Seed sown on the surface (0 mm) and at 50 mm had significantly slower rates of emergence than seed sown at 10 or 25 mm depth. The 50 mm treatment was significantly faster than surface sown seed to emerge up

Table 2 Mean plant numbers/m^2 of Barkant forage turnip in Trial A treated with UltraStrike®, SuperStrike®, 12 ml Gaucho®, 24 ml Gaucho® and untreated control up to 24 days after sowing.

	Time after sowing (days) 7	12	24
Superstrike®	31.6^a	52.4^a	57.6^a
Ultrastrike™	29.0^{ab}	55.4^a	59.0^a
Gaucho® 12ml	26.6^b	51.2^a	58.4^a
Gaucho® 24ml	27.8^b	50.2^a	57.2^a
Untreated control	28.2^b	56.0^a	63.2^a
Significance	*	ns	ns
LSD 5%	2.8	6.0	8.0
Trial Mean	28.6	53	59
CV%	6.3	7.4	8.8

Table 3 Mean plant numbers/m^2 of Barkant forage turnip in Trial B treated with SuperStrike® and untreated control (bare seed) sown on the soil surface (0 mm) up to 24 days after sowing.

	Time after sowing (days) 7	9	12	15	24
Superstrike®	8.6^a	12.2^a	21.3^a	32.9^a	37.1^a
Untreated	5.6^b	8.1^b	20.5^a	30.7^a	36.5^b
Significance	*	*	ns	ns	ns
LSD 5%	2.2	3.5	9.9	15.5	14.6
CV%	13.9	15.5	20.9	21.7	17.6
Mean	7.1	10.2	20.9	31.8	36.8

Table 4 Mean plant numbers/m^2 of Barkant forage turnip in Trial C treated with SuperStrike® and sown at four different depths up to 24 days after sowing

	Time after sowing (days) 7	9	12	15	24
10 mm	37.2^a	40.4^a	49.6^a	57.0^a	53.4^a
25 mm	31.8^b	35.4^a	47.2^a	52.2^a	49.0^a
50 mm	21.4^c	24.2^b	34.0^b	40.0^b	40.0^b
0 mm	8.6^d	12.2^c	21.4^c	32.8^b	37.0^b
Significance	***	***	***	***	***
LSD 5%	4.4	5.2	9.2	7.6	6.6
Trial Mean	24.6	28.0	38.0	45.4	44.8
CV%	11.1	11.4	14.9	10.3	9.1

until 12 days after sowing, after which the difference became insignificant. Surface (0 mm) and 50 mm sowing depths also had lower total emerged numbers than the 10 or 25 mm treatments at 24 days after sowing. Trial C also found that subsurface sown seed (10, 25 and 50 mm) reached its maximum number of emerged seedlings faster (15 days after sowing) than seed sown on the soil surface (0 mm).

Discussion

Seed treatment

The results from Trial A showed that although there were slight differences in early rates of emergence (7 days after sowing), there was no difference in total number of seedlings emerged between any of the seed treatments and the untreated control of turnip seed sown into a seed bed free from invertebrate pests (Table 2). Had the trials not been managed to minimise risk of invertebrate attack, the results may have favoured the treated seeds over the untreated control since, as shown in Table 1, each of the seed treatments are registered to control a variety of insects.

Trial B (Table 3) clearly shows that treatment of seed with SuperStrike® had no effect on total seedling numbers emerging relative to the untreated control 24 days after sowing. Though there was a significant initial advantage to using treated seed, this suggests that Superstrike® treated seed, which utilises filmcoat technology, emerges at the same rate as untreated seed even when sitting on the soil surface, in conditions that are considered relatively dry and less than ideal for crop establishment. Thus, seed treatments can confidently be used for the benefit of their registrations (Table 1) without reducing the rate of emergence or total numbers of plants emerging.

Sowing depth

Previous research has shown the importance of consistent, shallow seed placement to obtain optimum seedling numbers and subsequent growth of pasture seeds (Brock 1973; Brougham 1969; Charles *et al*. 1991; Woodman *et al*. 1990). This research clearly shows that sowing depth is an important factor in determining optimal seedling emergence in brassica forage crops. Trial C has shown that the optimum sowing depth for Barkant turnip in a no-tillage situation is 10 mm, with seedling emergence substantially reduced once sowing depth is greater than 25 mm (Table 4). It should be noted that maximum numbers of emerged seedlings were individually reached by 10, 25 and 50 mm depth treatments 15 days after sowing, while seed sown on the surface had not reached maximum emergence by 24 days after sowing when the trial was stopped. This may have been due to the surface sown seeds failing to germinate, or desiccating and perishing. In the field this appeared like a staggered emergence.

Implications for sowing rate

Having a uniform number of seedlings emerge will help to bring repeatability and reliability to brassica forage cropping. Different plant populations can cause plant structure to differ, specifically leaf-stem ratios, which affects quality of the feed on offer and can affect yield. If crops can be established more consistently, resulting in higher yields and more predictable quality, animal performance and profitability will improve.

Taking into account seed treatment and control over sowing depth, the method of sowing and seeding rates can be adjusted based on other paddock factors, e.g. condition of the seedbed, to reach maximum emergence and profitability.

Conclusions

In the absence of invertebrate pressure, brassica forage crop seeds treated with current commercial seed treatments emerge at the same rate as the untreated control. This appears to occur even when seed is sown on the soil surface in conditions considered to be less than ideal. Thus, the benefits of seed treatment using film-coat technology including insect and disease control are gained without reducing seedling emergence.

Seedling rate of emergence and total number of seedlings emerging for turnips is maximised at a 10 mm sowing depth, though statistically 25 mm had the same rate of emergence. Sowing seed on the surface gives a significantly slower rate of emergence than placing it under the soil surface, as does sowing deeper than 25 mm.

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