Effects of seed treatments on the establishment of direct drilled rape in the presence of slugs

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Abstract

The objective of this field trial was to establish whether new seed treatments improve plant population and growth of rape in the presence of slugs. The trial was carried out in autumn 2019. Spitfire rape seed from the same line was sown with RAPPEL® treatment, RAPPEL® UK, RAPPEL® BIO and untreated control. The seed was hand sown into a cultivated slot to replicate direct drilling in a Masterton paddock with five replicates and plant number was measured at 7,10,14,16,19 and 23 days after sowing (DAS). Slug populations were very low at sowing and increased steadily until 23 DAS. Plant number at the two true leaf stage was measured at 23 DAS. Differences in plant number between the treated treatments and untreated were observed at all measurements with RAPPEL® and RAPPEL® UK showing the greatest positive difference. Measurement 23 DAS showed a positive difference for all treated seed treatments in the number of plants reaching the two true leaf stage compared to untreated.

Additional keywords: Poncho®, Meta®, RAPPEL®, plant number, *Brassica napus* L.

Introduction

Internationally rape (*Brassica napus* L.) is mainly used for oil extraction. Although some rape is crushed for oil extraction, rape in New Zealand it is primarily used as forage for livestock producing green feed yields and high seed yield (Booker 2009).

Direct drilling is a common method of brassica establishment (Baker *et al*. 1996). Direct drilling creates greater pest challenges to plant establishment than cultivation with one of the most common pests of direct drilled brassica being slugs (Wilson & Baker 2010).

In New Zealand brassica seed treatments have become common practice as a means to combat disease, insects, pests and to improve early growth and establishment (Oliver *et al*. 2016). Seed treatments can be effective in helping protect plant populations through establishment and seedling growth whilst minimizing the requirements and impacts of broad acre sprays to animals, humans and the environment (Macfadyen *et al*. 2014).

Seed treatments contain a combination of products that are registered for use around the world. These often contain combinations of products that offer specific protection for that climate, environment or location. In New Zealand there is a range of brassica seed treatment options commercially available such as H&T OPTIMISED® (Poncho® + biostimulants), SUPERSTRIKE® (Thiamethoxam + Thiram® + Mo), ULTRASTRIKE® (Imidicloprid + Thiram® + Mo), GAUCHO®

(imidacloprid) and RAPPEL® a seed applied slug repellent (Poncho® + biostimulants + Meta®).

The use of additional seed treatment options, including biostimulants, have the potential to enhance crop establishment, growth and yield (Eyheraguibel *et al*. 2008). A biostimulant is a substance or micro-organism applied to plants to enhance nutrition efficiency, abiotic stress tolerance and crop quality traits (Du Jardin 2015).

Lee & Bartlett (1976) reported that the addition of biostimulants to maize seed treatments had additional benefit of improving the branching and root hair development when maize was grown in a biostimulant nutrient solution.

The purpose of this trial reported here was to gauge the additional benefit of seed treatments containing biostimulants on the establishment and speed of growth to the two true leaf stage of rape plants in the presence of slugs. The seeds were hand sown into a worked slot to replicate a direct drilled situation. This field trial follows on from previous work reported in Oliver *et al*. (2018) regarding biostimulant seed treatment options in maize with H&T Optimised® in a field situation.

Materials and Methods

Experimental details

A field trial was sown at Rathkeale College, Masterton (40° 53’ S, 175° 41’ E). The paddock had been in Italian ryegrass in the previous year. The existing pasture in the trial area was sprayed on 1 April 2019 with 3L/ha Weedmaster 540 (540g/L glyphosphate) and 500ml/100L EziCover oil (93% rapeseed oil + 7% surfactant).

The rape seed was hand-planted into a slot cut with a garden edger and ripped with the narrow back blade of a thistle grubber. The trial comprised five 3-metre long rows per treatment plot, with 30cm between rows, replicated five times in a randomized complete block design. Each row had 58 rape seeds spaced 5cm apart from the same cv. Spitfire line per row (equating to a sowing rate of 64.4 seeds per metre squared).

After sowing each plot had a slug mat placed within the plot.

The soil type was light river silt. No fertiliser was sown at planting, although 2.5t/ha lime was broadcast over the trial 5 days after sowing (DAS).

The seed sown had been treated with three differing treatments using a Cimbria Centricoater CC150 seed treatment machine using a layering process:

a. Poncho® + RAPPEL®,
b. Poncho® + RAPPEL® UK
c. RAPPEL® UK.

Untreated seed was sown in the trial as a control.

RAPPEL® includes a proprietary blend of biostimulants and META® metaldehyde.

RAPPEL® UK includes the same proprietary blend of biostimulants.

Poncho® (600g/L clothianidin) is applied at 12ml/kg.

Measurements

Natural rainfall events occurred on 2 April (90mm), 10 April (9mm), 13 April (28mm) and 15 April (2.5mm) prior to the final plant establishment measurement. Measurements were taken in a rain gauge that was located at the trial site.

At 7, 10, 14, 16, 19 and 23 DAS the number of plants per plot was counted. The measurement dates were chosen to enable identification of any differences in establishment speed as a result of the seed treatments. The number of plants at the two true leaf stage was measured at 23 DAS. The number of slugs under each mat was counted at each measurement point.

Statistical analysis

The results were analysed using Minitab 18. A one-way ANOVA was completed on plant number at each measurement. The number of plants at the two true leaf stage was calculated at 23 DAS. A Fishers protected LSD test (P<0.05) was also performed on the data to determine significant differences between treatment means where the ANOVA indicated a treatment effect.

Results

Plant number

At each measurement point (DAS) there was a significant plant number advantage favouring the seeds that were treated with Poncho® + RAPPEL® and RAPPEL® UK (P<0.05) (Table 1).

At 7 and 10 DAS, there was a difference in plant number between the three seed treatments and control (P<0.05) (Table 1). RAPPEL® UK, Poncho®+ RAPPEL® and Poncho®+ RAPPEL® BIO showed not significant differences in plant number establishment.

At 14 DAS there was a significant difference in plant number among treatments; RAPPEL® + Poncho®, RAPPEL® UK had significantly more plants when compared with control (P<0.05) (Table1).

Poncho® + RAPPEL® BIO plant number was not significantly different to control or RAPPEL®+ Poncho®, RAPPEL® UK respectively (P<0.05) (Table1).

At 16 and 19 DAS, there was a significant difference in plant number favouring the three seed treatments (Poncho® + RAPPEL®, RAPPEL® UK Poncho® + RAPPEL® BIO) over control seed (P<0.05) (Table 1).

At 23 DAS Poncho® + RAPPEL®, RAPPEL® UK had the most plants establish over the trial period, although final establishment was not significantly different from RAPPEL® UK, it was from control (P<0.05) (Table 1). Poncho® + RAPPEL® was not significantly different to RAPPEL® UK or Poncho® + RAPPEL® BIO but was significantly different to the control (P<0.05) (Table 1).

Poncho® + RAPPEL® BIO was not significantly different to control, Poncho® + RAPPEL® or RAPPEL® UK.

Plants at two-leaf stage

At 23 DAS the number of plants at the two-leaf stage were also counted (Table 2). RAPPEL® UK recorded the highest number of plants at the two true leaf stage, but this was not significantly different to Poncho® + RAPPEL® or Poncho® + RAPPEL® BIO. All three treatments had significantly higher plant numbers than control (Table 2). RAPPEL® UK had 31.78% more plants at the two true leaf stage than untreated control. The three seed treatments had percentage of plants at two true leaf stage of greater than 92% of the total plant population while untreated was 87% respectively.

Table 1: Mean plant number over time after sowing for four different seed treatments. Total potential number of plants was 290. Means that do not share a letter are significantly different (P<0.05) using a Fishers protected LSD test.

Treatment	Days after Sowing					
	7	10	14	16	19	23
Untreated	83b	210b	224b	221b	221b	214b
Poncho® + RAPPEL®	132a	239a	249a	258a	257a	255a
Poncho® + RAPPEL® BIO	109a	233a	236ab	245a	249a	233ab
RAPPEL® UK	134a	241a	251a	260a	261a	258a
Mean of treatments	114	230	239	246	247	240
Standard deviation	16.40	16.83	15.71	12.02	12.09	19.05
P-value	0.00	0.04	0.05	0.00	0.00	0.01

Table 2: Mean number of plants per treatment at two true leaf stage at 23 DAS for four different seed treatments. Means that do not share a letter are significantly different (P<0.05) using a Fishers protected LSD test.

Treatment	Plant number	Two leaf n : total plant n
Untreated	186b	87%
Poncho® + RAPPEL®	242a	95%
Poncho® + RAPPEL® BIO	227a	92%
RAPPEL® UK	245a	97%
Mean of treatments	225	
Standard deviation	20.05	
P-value	0.001	

Table 3: Number of slugs per treatment over time after sowing for four different seed treatments.

Treatment	7 DAS	10 DAS	14 DAS	16 DAS	19 DAS	23 DAS
Untreated	0	0	0	1	1	5
Poncho® + RAPPEL®	0	0	0	0	2	6
Poncho® + RAPPEL® BIO	1	0	2	2	4	4
RAPPEL® UK	0	0	2	3	4	6

Number of slugs

Table 3 shows the number of slugs over the period of the trial. Slug numbers increased in all treatments over the duration of the trial with no observable effect of treatment on slug number. At 23 DAS there were the greatest number of slugs present in the trial.

Discussion and Conclusions

In the field, plants are faced with environmental challenges throughout their growing lives. These include abiotic factors such as water, sunlight, oxygen, soil, temperature and biotic factors such as insects, pests and fungi. These factors influence the survivability and performance of the rape seedlings (Ashraf *et al*. 2018). Seed treatments are a way of delivering biological, physical and chemical agents to assist seedlings through establishment which enables the plants to better cope with these environmental challenges.

In this trial seeds that were treated with Poncho® + RAPPEL®, Poncho® + RAPPEL® BIO and RAPPEL® UK showed a significant advantage in speed of establishment, total plant population and speed to two true leaf stage of rape plants when compared with the untreated control.

By using any of these three seed treatments an improvement in establishment speed and total plant population was seen. Establishment speed and evenness of plant development can have a positive impact on agronomic outcomes. Crop inputs such as fertilisers, herbicides, irrigation and pesticide applications in practice often remain at a constant rate despite differences in establishment. By delivering an even plant population these inputs can be used more efficiently.

Seeding rates have been established to achieve desired plant populations to give the grower the best opportunity to reach the crop's yield potential (Houck 2009). An example of this is Oilseed rape for oil extraction targeting a plant population of 25-35 plants/m^2 (Berry *et al*. 2014). The use of these three seed treatments saw improved establishment speed and an increase in the establishment percentage when compared with control at 16 DAS (Table 1). Improving establishment in the field as shown in this trial gives us an opportunity to look into sowing rates per hectare. Being able to decrease sowing rates and maintain plant population would reduce seed cost per hectare.

Plant population and growth is a useful part of an integrated weed management plan where speed of growth and canopy closure suppress weeds through shading and competition (Beckie *et al*. 2008). At 23DAS the number of treated rape plants at two true leaf stage was significantly greater than that of the untreated control. These plants had a larger leaf area at this point. A larger leaf area is associated with an increased rate of photosynthesis (Richards 2000) in the plant which leads to further plant growth and development.

The trial focus was on plant establishment with no yield data taken. We saw a significant increase in the treated total number of plants established at 23DAS. The early advantage in germination and plant population of the three treatments was maintained at every measurement point throughout the trial when compared with the untreated control. We cannot claim any yield advantage or disadvantage associated to the seed treatments in this trial. Research has shown a relationship between the number of plants established and total yield (Houck 2009). If seedling emergence is inadequate or compromised, the amount of harvestable product is reduced. No amount of extra expense, inputs or abiotic stress resistance during later crop development will compensate for the lack of seedlings (Bleasdale 1967). In this case we cannot say that the significant difference in plant population at the end of the trial was going to correlate to an advantage in yield, but this would be interesting to trial in the future.

Slugs are a common pest in direct drilled situations and impact the survivability of the plants through seedling establishment and development. Slugs can play a major role in whether crop establishment is successful or not. Throughout the trial there was an increasing number of slugs present in each of the treatments with the slug population appearing to be transient between mats and not favouring any one particular treatment. The slug pressure in this trial was not high enough to have any impact on seedling establishment and development.

All of the seed treatment combinations applied contained a proprietary blend of biostimulants plus Meta®, Poncho® or both. The treatments all showed an advantage in speed of establishment, total plant population and speed to two true leaf of the rape plants in this trial. The addition of this biostimulant package had a beneficial effect on establishment. Biostimulants are becoming more common in the market as chemical companies offer new and different ways of promoting early growth of seedlings either through seed treatments or foliar applications (Du Jardin 2015).

Further trial work could look into the yield advantages of these treatments due to improved establishment and plant population. This could look at the differences in root and shoot mass between treatments or harvested for yields. It would be interesting to conduct this trial in a situation that has greater slug pressure to see if there were differences in activity amongst these seed treatments.

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