The effects of maize seed treatments on establishment and development

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Abstract

The aim of this research was to determine if agronomic benefits can be gained by using new seed treatment combinations in maize through the establishment phase. The potential for different maize seed treatments to influence plant establishment and development was assessed in spring 2015. Bare, Poncho/Vitaflo and H&T Optimised P8805 maize seed of the same line were obtained. Fresh, damp potting mix was added to 12 bins. Into each bin one six plant row of each treatment was sown. Each row was watered with 2 l water on a weekly basis plus natural rain. The seed was tested for germination and vigour with little difference between treatments. Measurements of plant emergence and colour were taken at five days after sowing (DAS) with Bare being slightly behind Poncho/Vitaflo and H&T Optimised. Plant Height was measured at 10, 17, 20 and 39 DAS. Poncho/Vitaflo and H&T Optimised had higher plant heights than Bare at all measurement points. H&T Optimised had a higher plant height than Poncho/Vitaflo at 39 DAS. Root and Shoot mass was measured at 39 DAS. The shoot mass differed between each treatment with H&T Optimised being 13% greater than Poncho/Vitaflo. Poncho/Vitaflo was greater than Bare. The root mass of H&T Optimised was four times greater than the other two treatments. Poncho/Vitaflo and Bare root masses were not different. Overall Poncho/Vitaflo and H&T Optimised were superior to Bare for emergence, plant colour and height compared to Bare. H&T Optimised showed a 13% increase over Poncho/Vitaflo in shoot mass and a 400% increase in root mass over both Poncho/Vitaflo and Bare treatments at 39 DAS.

Additional keywords: Poncho®, Vitaflo®, H&T Optimised®, germination, vigour, root, shoot, height

Introduction

Maize (*Zea mays* L.) crops are utilised on a large scale in New Zealand agriculture as a supplementary feed in both silage and feed grain form (Booker, 2009). These crops are often grown under contract by a cropping farmers for end users. A large component of this is utilised in the dairy industry and is grown by cropping farmers for this target market. A wide variety of seed treatments are used internationally to promote the establishment of maize plants (SA Grain, 2016). These include treatment with fungicides, insecticides, bio-stimulants (Záborsky *et al*., 2002; Vinković *et al*., 2007; Hameeda *et al*., 2008), plant growth regulators and micro-nutrients (SA Grain, 2016). In New Zealand Vitaflo (200 g/l Thiram and 200 g/l Carboxin) fungicide and Poncho (600 g/l clothianidin) insecticide are the standard maize seed treatments

(Genetic. Technologies Limited, 2016) for disease and insect protection in maize crops. The addition of further seed treatments such as bio stimulants and micro nutrients have the potential to improve the establishment vigour, subsequent growth, yield and therefore gross margins of maize crops for both grain and silage. The aim of this establishment trial was to identify if the addition of a biostimulant and trace elements in H&T optimised seed treatment do influence the early establishment growth characteristics of maize seedlings.

Materials and Methods

A pot trial was conducted at 69 Kawakawa Road, Feilding (40° 14' S, 175° 33' E) The experiment was a 3x4 split plot design trial with three different seed treatments sown in three bins and was replicated four times. Each pot contained six seeds of the same line of P8805 maize which were treated with three different seed treatments, Bare, Poncho/Vitaflo and H&T Optimised. H&T Optimised contained Poncho, Kinto Duo, Picassa and Genius and L552 applied sequentially. The trial was sown on 27 November 2015. The seeds were buried at a depth of 30 mm in standard potting mix and watered to field capacity at the time of sowing. Potting mix was used as this was deemed most likely to give a medium of homogenous fertility and physical structure. Each bin was watered again with three x 2 l of water weekly and stored outdoors subject to local climate conditions. A natural rainfall event of 25 mm occurred on 1 December 2015. The plants were harvested on 5 January 2016 (39 DAS) due to space and moisture becoming limiting.

Statistical analysis

The data was analysed through the Genstat version 17 (VSN International Ltd, UK). A one way ANOVA was performed on fresh root weight, fresh shoot weight and plant height. Root:shoot ratios were also calculated. Visual assessment of germination, emergence and plant colour were conducted. In addition a Fishers protected LSD test was performed to differentiate means. Bin three did not have bare seed sown so was treated as a missing value in the statistical analysis.

Results

There was no significant difference observed in plant height between H&T Optimised and Poncho/Vitaflo at 7, 8, 14 and 17 DAS. At 39DAS a significant difference was observed ($P<0.05$). Bare seed was shorter ($P<0.01$) than both other treatments across all measurements to harvest (Table 1). H&T Optimised had the highest root ($P<0.001$) and shoot ($P<0.01$) yield compared to Bare and Poncho/Vitaflo treatment at harvest (Table 2). Poncho/Vitaflo had a higher shoot yield ($P<0.05$) than Bare however there was no significant advantage ($P=0.561$) in root yield between these two treatments. H&T Optimised also had the highest root: shoot ratio of all three treatments (Table 2). At 5 DAS all emergence of seedlings were complete. This was shown via careful digging. The H&T Optimised and Poncho/Vitaflo treatment both had only one seed which did not emerge across the trial. The Bare seed treatment had five seeds which did not emerge and was also a lighter green colour than both other treatments.

Table 1: Average plant height (cm) over time after sowing for three different seed treatments. Values with different letters following them are significantly different (P<0.05) following a Fishers protected LSD analysis.

Treatment	10 DAS	17 DAS	20 DAS	39 DAS
H&T Optimised	10.83 a	28.10 a	38.22 a	72.70 a
Poncho/Vitaflo	10.85 a	27.17 a	37.17 a	68.72 b
Bare	9.11 b	24.18 b	33.13 b	63.66 c
Grand mean	10.27	26.48	36.17	68.36
SED	0.401	0.851	1.117	1.898
P	***	***	***	**

Table 2: Average wet weight of plant herbage accumulation (g) 39 days after sowing for three different seed treatments. Values with different letters following them are significantly different (P<0.01) following a Fishers protected LSD analysis.

Treatment	Root	Shoot	Root:Shoot Ratio
H&T Optimised	461 a	251.3 a	1.83
Poncho/Vitaflo	112 b	222.5 b	0.50
Bare	85 b	190.0 c	0.45
Grand mean	219	221.3	
SED	46.1	9.97	
P	***	***	

Discussion and Conclusions

It was surprising that the Bare seed treatment would perform at a reduced level compared with the other treatments in a low stress environment, particularly in the early establishment phase (Falloon, 1982). This was observed in the trial across the plant height measurements as the Bare seed was behind both other treatments at each measurement of plant height (Table 1). This translated to significantly lower root and shoot yields when compared to the H&T Optimised treatment and a lower shoot production than Poncho/Vitaflo treatment. The full benefits of the seed treatments over bare seed through the establishment phase may not have been fully realised in this trial due to the lack of disease and insect pressure which would be observed in the field (Kabaluk and Ericsson, 2007; Vinković *et al*., 2007).

The variation between the treatments was expressed most in the root yield, with H&T Optimised having over four times more root mass than either of the other treatments (Table 2). This additional accumulation of root mass observed in the H&T Optimised treatment did not occur as a result of a reduction in shoot growth as a significantly higher shoot yield was also observed. The higher root and shoot yield for H&T Optimised also resulted in an over three times higher root:shoot ratio (1.83) than both Poncho/Vitaflo (0.5) and Bare (0.45). This suggests that while H&T Optimised had a significantly higher shoot and root weight yield, the partitioning of this herbage accumulation was considerably different to the other two treatments, without

compromising overall plant yield. This result may be explained by the addition of the biostimulant and trace elements in the H&T Optimised treatment promoting superior root growth through the establishment phase without compromising shoot growth (Záborsky *et al*., 2002).

The improved root production of the H&T Optimised seed treatment could potentially offer crop advantages further through the plants life cycle. The plants ability to take up nutrients and water would be enhanced due to an improved root system which would be particularly advantageous in environments where crop stress is likely to occur (Vinković *et al*., 2007). The improved shoot weight of the H&T Optimised treatment may be as a result of the enhanced root growth promoting higher nutrient uptake allowing faster growth of the plant.

Future work should be focused on the different treatments under field conditions with disease and insect pressure. Further research should also investigate whether the enhanced root development of H&T Optimised seed treatment translates into improved grain and silage yields in maize crops and harvest.

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