FUNGICIDE SEED TREATMENT TO IMPROVE ESTABLISHMENT OF RYEGRASSES AND OTHER FORAGE PLANTS

R.E. FALLOON

Plant Diseases Division, DSIR, Palmerston North

SUMMARY

The fungicides captan, drazoxolon or thiram, applied as seed treatments (at 3.0 g/kg seed) to the Grasslands ryegrass cultivars Ruanui, Manawa, Paroa and Moata (*Lolium* spp), gave increased seedling emergence at eight sites throughout New Zealand. Increases in numbers of seedlings ranged from 0 to 62% depending on fungicide, cultivar and site. Fungicide seed treatment of ryegrasses is strongly advocated. Literature on seed treatment of other forage plants is reviewed, and this suggests that the addition of fungicides to seed could give general improvements in forage establishment.

INTRODUCTION

Young seedlings of many plants are susceptible to seed- and soil-borne pathogenic fungi. These fungi can either kill or drastically reduce the growth of seedlings, and thus adversely affect seedling establishment. Fungal pathogens can attack seedlings before or after they appear above the soil surface. Pre- and post-emergence pathogens may differ both in identity and importance, depending upon the host plant in question and environmental conditions that occur during the establishment phase of seedling growth.

Fungicides are routinely applied to seed of many horticultural and agricultural crop plants to control pathogenic fungi and improve seedling establishment (Rodriguez-Kabana *et al* 1977). With these crops, where plant yield is directly utilised, the benefits of improved plant populations are measured directly at the time of harvest. Forage crops are different. They are utilized by grazing animals, and yield is determined indirectly in terms of animal production some time after 'harvest'. It is likely that for this reason, the effects of seedling diseases on forage plants have been given scant attention.

Recent glasshouse and field experiments (Falloon 1980b and c) have demonstrated that fungicide seed treatments of ryegrasses (*Lolium* spp.) can considerably increase numbers of seedlings that emerge from field soils. Increased emergence of seedlings and forage yields during the 3 months subsequent to sowing were closely correlated, and varied between 29 and 107% depending on fungicide and cultivar. In light of these results, field trials were carried out at sites throughout New Zealand to determine if improvements in ryegrass establishment could be obtained at a number of different sites. Results of these trials are reported in this paper, and the value of seed treatment to improve seedling establishment of ryegrasses and other forage plants is discussed.

MATERIALS AND METHODS

Field trials were carried out during the autumn of 1980 at the eight sites listed below. Trial areas were prepared, using normal cultivation for pasture establishment, from clover swards (Lincoln and Pukekohe) or from pasture containing ryegrass (all other sites).

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Seed Production

<i>Location</i>	<i>Date sown</i>	<i>Soil type</i>
Gore (DSIR)	11 March	Waimumu silt loam
Lincoln (DSIR)	17 March	Wakanui silt loam
Palmerston North (DSIR)	25 March	Karapoti brown sandy loam
Kairanga (DSIR)	27 March	Te Arakura sandy loam
Flock House (MAF)	1 April	Himitangi black sand
Takapau (MAF)	2 April	Takapau silt loam-Takapau mottled silt loam intergrade
Pukekohe (DSIR)	15 April	Patumahoe clay loam
Kaikohe (DSIR)	16 April	Wairoro clay loam

Seed of the ryegrass cultivars 'Grasslands Ruanui' (*Lolium perenne*), 'Grasslands Paroa' (*L. multiflorum*) 'Grasslands Moata' (tetraploid *L. multiflorum*) and 'Grasslands Manawa' (*L. [(multiflorum x perenne) x perenne]*) was used for these trials.

The fungicides captan, thiram or drazoxolon were applied to seed of each ryegrass cultivar as slurries at the rate of 3.0 g/kg seed. These fungicides had been shown in a previous glasshouse test to increase numbers of ryegrass seedlings emerging from field soil (Falloon 1980b).

Germination of untreated and fungicide treated seed of all cultivars was assessed prior to sowing by placing seeds on to moist filter paper in glass petri dishes. Numbers of germinated seeds were counted after 7 days incubation at 25°C

At each trial site, seeds were sown at 100 seeds per 27 x 27 cm plot on a 10 x 10 grid pattern at a depth of 2-3 cm. This gave sowing rates for the four cultivars as follows: Ruanui 17.5 kg/ha, Manawa 17.5 kg/ha, Paroa 23.4 kg/ha and Moata 46.6 kg/ha. Untreated seeds were sown as controls. Treatments (four cultivars x three fungicides plus controls) were completely randomised and replicated 5 times at each site. Numbers of seedlings growing in each plot were counted 4 weeks after sowing.

RESULTS

The three fungicides did not affect germination of the seed used in these trials. Seed germination was as follows: Raunui 83%, Manawa 78%, Paroa 74%, and Moata 87%.

Results of the field trials are summarised in Table 1. Fungicide seed treatments significantly ($P \leq 0.05$) increased numbers of seedlings of at least one cultivar at all of the trial sites, although different cultivars responded to seed treatment at different sites. Increases in numbers of seedlings were recorded for all four cultivars at Kairanga and Flock House, for three cultivars at Gore, Palmerston North and Takapau, for two cultivars at Lincoln, and for only one cultivar each at Pukekohe and Kaikohe.

Captan was the most effective of the fungicide seed treatments used, giving increased emergence for the greatest number of cultivars at the greatest number of sites. Where seed treated with drazoxolon or thiram gave more seedlings than untreated seed, emergence was not significantly different ($P \leq 0.01$) from that achieved with captan treated seed.

Significant ($P \leq 0.05$) increases in numbers of seedlings varied from 17% for Paroa at Takapau to 62% for Manawa at Kairanga and Moata at Flock House. Increases in numbers of seedlings were consistently high in the Kairanga trial being 50-62% for all cultivars.

DISCUSSION

The field trials reported here indicate that suitable fungicide seed treatments can improve establishment of ryegrass seedlings at sites throughout New Zealand. Improvements in establishment differed at different sites, however. At each of two sites in the north of the North Island (Pukekohe and Kaikohe) increased numbers of seedlings from treated seed were recorded for only one cultivar. In contrast, at two other sites (Kairanga and Flock House) seed treatment increased numbers of seedlings of all four cultivars sown, and at one of these sites numbers of seedlings were over 50% more from fungicide treated seed than from untreated seed.

Seed Production

TABLE 1: Mean numbers of seedlings of ryegrass cultivars in plots 4 weeks after sowing untreated and fungicide treated seed (3.0 g/kg seed) at eight different trial sites. One hundred seeds were sown in each plot.

Cultivar Seed treatment	Gore	Lincoln	Palmerston North	Kairanga	Flock House	Takapau	Pukekohe	Kaikohe
Ruanui								
untreated	60	60	46	47	57	60	64	72
captan	74 **	77 **	63 **	74 **	73 **	62	58	75
drazoxolon	77 **	68	50	65 **	66	66	57	80
thiram	75 **	73 **	63 **	69 **	66	56	68	76
Manawa								
untreated	56	60	51	43	57	46	57	61
captan	68 *	60	53	69 **	71 **	66 **	55	66
drazoxolon	72 **	63	53	65 **	57	66 **	58	66
thiram	65	64	58	54 *	64	60 **	54	68
Paroa								
untreated	63	61	44	41	56	60	45	63
captan	64	61	58 **	65 **	68 *	70 *	58 **	68
drazoxolon	66	60	59 **	64 **	56	54	55 *	67
thiram	63	64	47	66 **	62	56	55 *	66
Moata								
untreated	55	60	50	49	49	62	59	61
captan	72 **	75 **	72 **	73 **	79 **	76 **	60	73 *
drazoxolon	69 **	67	63 **	67 **	72 **	65	62	70
thiram	77 **	68	63 *	69 **	73 **	65	66	73 *

* and ** indicate means for each cultivar at each site that are significantly different from untreated seed ($P \leq 0.05$ and 0.01 respectively) as determined by LSD tests.

Previous glasshouse and laboratory experiments (Falloon 1980c) showed that different soils differed in the levels of increases in seedling emergence from fungicide treated seed, in the amount of fungicide required to give maximum increases in seedling establishment, and in the ryegrass cultivars which responded to seed treatment. Temperature and seed line also affected the response to seed treatment. Furthermore, different soils contain different fungi that are pathogenic to ryegrass seedlings (Falloon unpublished). Thus, several seed, soil and/or environmental factors can affect the response of ryegrass seedlings to fungicide seed treatments. These factors could explain the variation in the results recorded at different sites in this study.

REVIEW OF IMPROVED ESTABLISHMENT OF FORAGE PLANTS WITH FUNGICIDE SEED TREATMENTS

There is considerable evidence in the literature indicating that fungicide treatment of seed of forage plants (including grasses, forage legumes and brassicas) can lead to improved seedling establishment and increased forage yields.

Improved establishment of ryegrasses, due to reduction of pre-emergence death of seedlings, has been demonstrated in the present and previous (Falloon 1980b and c) studies. Increased numbers of seedlings led directly to improved forage yield from several ryegrass cultivars in the first 3 months of sward growth (Falloon 1980c), and for Ruanui during the first year after sowing (Falloon unpublished). Other grasses have also been shown to benefit from seed treatment. Bromes (*Bromus* spp.), cocksfoot (*Dactylis glomerata*), timothy (*Phleum pratense*) and fescues (*Festuca* spp.) are some of the grasses used in New Zealand for which improved establishment with seed treatment has been reported overseas (Krietlow *et al* 1950; Mead 1955; Neilson *et al* 1959; Michail and Carr 1966; Holmes 1977).

Seed Production

Prairie grass (*Bromus catharticus*) can benefit from seed treatment, but for reasons other than the control of soil-borne fungal pathogens. Head smut (caused by *Ustilago bullata*) is an important disease of prairie grass. Spores of *U. bullata* on the seed germinate and infect young seedlings soon after seed germination. This disease can kill seedlings before they emerge from the soil, or reduce forage yields from established plants by lowering plant production and eventually killing plants (Falloon 1976; 1979). Head smut is adequately controlled by treating prairie grass seed with the fungicides thiram, carboxin or benomyl (Latch 1965; Falloon 1980a).

Improved establishment of forage legumes has also been obtained with seed treatment. Lucerne (*Medicago sativa*) has been known for some time to benefit from fungicide seed treatment (Krietlow *et al* 1950; Mead 1955). Recent work in New Zealand (Sanderson and Crompton-Smith pers comm 1981; Falloon and Skipp unpublished) has shown that systemic fungicides active against phycomycetes (eg. *Pythium* spp.) can improve seedling establishment in the field. Other forage legumes shown to respond to seed treatment include red clover (*Trifolium pratense*) alsike clover (*T. hybridum*) and white clover (*T. repens*) (Krietlow *et al* 1950; Mead 1955).

Seedlings of forage brassicas (*Brassica* spp) are susceptible to soil-borne fungi at both pre- and post-emergence stages of growth. Fungicides can improve seedling emergence of kale, rape, swede and turnip cultivars (Richardson 1970; Falloon 1980d), and suitable systemic fungicides can protect seedlings at the post-emergence stage (Falloon 1980d).

In almost all cases where improved establishment of forage plants have been reported from seed treated with fungicides, the improvements under field conditions have been variable. In some cases seed treatment has failed to increase numbers of seedlings in particular instances (eg. Mead 1955; the present study) or more generally (Tyler *et al* 1956). Seed treatment should therefore be regarded as an insurance against attack from soil-borne pathogens that may, depending on soil, environmental or seedling factors, cause poor establishment.

The practice of seed treatment with fungicides is well established for horticultural and agricultural crop plants as a cheap and effective method of improving production. Evidence presented here and elsewhere suggests that adopting similar procedures with ryegrasses would be well justified. There are indications that seed treatment of other forage plants could lead to improved seedling establishment, and investigations to indicate the importance of seedling diseases of these crops in New Zealand should be pursued.

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