THE EFFECTS OF SEED TREATMENT ON PLANT ESTABLISHMENT, DOWNY MILDEW AND YIELD OF PEAS

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SUMMARY

Two main trials and two subtrials assessed the effects of seed treatment with systemic and non-systemic fungicides on seedling emergence, and downy mildew *(Peronospora viciae)* of peas *(Pisum sativum)*. Analysis of the components of yield indicated that, loss in yield was due to reduced plant density, while yield increases after seed treatment with the systemic fungicide metalaxyl were due both to increased plant population and to reduction of downy mildew inoculum in the early stages of growth.

INTRODUCTION

The main aim of seed treatment is to protect the seed and seedlings and the subsequent crop from soil-borne, seed-borne and air-borne pathogens. The mechanisms of protection may vary, as the inoculum in or on the seed may be killed directly by the treatment itself or later during the germination of the seed (Neegard 1977). Crop losses in peas due to soil-borne pathogens arise from infections through seed or developing radicle leading to seedrot or pre-and-post-emergence death (Dixon 1981a). Downy mildew causes losses by reduction in initial plant stand by 'systemic' infections and later by severe plant infections. Foliar infections are generally insufficient to reduce yields significantly (Pegg and Mence 1972).

MATERIALS AND METHODS

The pea seed used, cv Piri, was tested by the Seed Testing Station, Palmerston North, and the seed rate adjusted, on the basis of the expected field emergence, to 230 kg/ha. Fungicides were applied to the seeds at the rates indicated in Table 1.

Two main trials and two subtrials planted at two sowing dates each, were established at Lincoln College in the spring of the 1983-84 season. The main trials were designed to investigate the effects of seed treatments on plant density, and downy mildew development. The subtrials were aimed at monitoring actual plant establishment of a known number of seeds sown and the subsequent yield.

Main Trials

The two trials were sown on 21 September and 2 December 1983. Both sowing times and treatments were randomised with each trial being of 30 plots, 3 x 12 m each in a completely randomized block design with six replications. Untreated seed was sown as a buffer alongside each plot covering 1.5 x 12 m.

In all trials no inoculum was added either to the seed, seedlings or soil, and assessment was based on the effect of soil and air-borne inoculum present during the season. This site was chosen because it was under peas in 1982.

Subtrials

The two subtrials were sown on 23 September and 7 November 1983. Within each replicate of the main trials, two plots were randomly allocated to the subtrials and hence a 24 x 3 m plot was created. These were then subdivided into 10 small plots of 1 x 1.5 m. Five plots within the 10 plots were then randomly selected for the first sowing date and the rest for the second.

Special equipment was designed so that the depth of sowing, seed-to-seed distance and row-to-row distance were kept constant. For each treatment within each replicate 200 seeds were sown 5 cm deep, at 5 cm seed-to-seed distance and 15 cm row-to-row distance. This reduced variation due to such inconsistencies as the rate of seeding, and the depth of planting (Pinckard and Ivey 1971; Neegard 1977).

To create an ideal environment for the pathogens such as species of *Pythium, Fusarium,* and *Peronospora,* a special irrigation network was installed. Nine 63 m plastic pipes, each fitted with 30 microjet nozzles were placed at 0.5 m above the ground transversely along the plots.

In this way a longer wet period was created, ideal for soil-borne pathogens and downy mildew development. Because of the wet conditions this system was not used for the second sowing.

Disease Assessment

In the main trials, population counts were made in each plot by randomly selecting 10 sites per plot, of 0.1 m^2 and counting the number of plants.

In the subtrials the actual number of emerging seedlings was counted at intervals and the emergence percentage obtained.

For downy mildew assessment, 10 plants were randomly selected from each plot at each sampling date; hence 60 plants from each treatment were assessed. Downy mildew severity was determined by scoring the amount of disease on the leaflets at each node of each plant using leaf area diagrams (Dixon 1981b).

Yields

In the main trials, yields were obtained by marking out an area of 7 x 1.5 m within each plot to avoid edge effects. Within this area, ten 0.1 m^2 quadrats were obtained and pooled to give the quadrat yield, while the remainder of area was harvested to give the bulk yield.

RESULTS AND DISCUSSION

In the main trials (Table 1) each of the seed treatments provided protection for the seed and seedlings and hence improved emergence. In the early-sown trial the metalaxyl + captan treatments improved plant establishments significantly over untreated seed.

In the first subtrial (Table 2) all treatments gave greater numbers of seedlings than the untreated seeds but in the second, only the metalaxyl + captan and the captan treatments were better than untreated. Yields from the first subtrial showed that three of the seed treatments gave significantly higher yields than the untreated, but there were no signifiant differences in yields in the second subtrial.

TABLE 1: Plant density in main trials from pea seed with different fungicides before sowing.

Treatment	Rate g ai/100kg seed	Plants/m^2 sown on 21.9.83	Plants/m^2 sown on 2.12.83
metalaxyl + captan(Apron SD 70 WP)	70 + 70 g	112 a	100 a
metalaxyl (Apron SD 35 WP)	70 g	109 ab	99 a
captan (Orthocide 65)	70 g	107 ab	94 a
drazoxolon (Milcol)	48 ml	103 b	96 a
untreated	-	83 c	80 b
CV%		2.0	2.5

TABLE 2: Numbers of seedlings and yield of peas in subtrials from seed treated with different fungicides before sowing.

Treatment	Mean No. of seedlings out of 200 seeds sown on		Mean yield g/1.5 m² of plots sown on	
	23.9.83	7.11.83	23.9.83	7.11.83
metalaxyl + captan	185 a	168 a	686 a	406 a
metalaxyl	183 a	157 ab	667 a	404 a
captan	185 a	169 a	606 ab	388 a
drazoxolon	186 a	160 ab	671 a	385 a
untreated	175 b	139 b	510 b	382 a
CV %	1.4	9.8	22.3	17.8

TABLE 3: Severity of *Peronospora viciae* infection and plant dry weights for pea plants grown in the two main trials from seed treated with different fungicides before sowing.

Treatment	Leaf number (LN) from base of plant				Mean* dry weight
	LN1	LN2	LN3	LN4	g
Trial I sown 21 September 1983, assessed at 47 days after sowing					
metalaxyl + captan	16.0‡c	8.8 c	3.8 b	2.8 c	0.68 ab
metalaxyl	24.3 bc	10.9 c	3.8 b	4.3 bc	0.68 ab
captan	49.7 a	38.7 a	17.2 a	8.0 abc	0.70 ab
drazoxolon	36.1 abc	24.0 abc	10.3 ab	12.2 a	0.70 ab
untreated	27.4 bc	24.3 abc	10.7 ab	5.1 bc	0.67 ab
CV %	22.0	29.3	27.2	21.7	4.6
Trial II sown 2 December 1983, assessed at 33 days after sowing					
metalaxyl + captan	2.49 b	11.1 b	5.6 b	1.2 a	0.61 a
metalaxyl	28.4 b	9.3 b	7.1 b	1.0 a	0.58 a
captan	66.8 a	60.6 a	21.9 a	2.8 a	0.41 b
drazoxolon	66.0 a	58.3 a	17.6 a	2.3 a	0.43 b
untreated	70.0 a	50.2 a	17.1 a	2.0 a	0.41 b
CV %	22.0	27.5	27.4	46.4	9.5

* Mean plant dry weight (based on 60 plants, 10 per rep).
‡ Mean disease severity of 60 leaves, 10 per rep.

Table 3 provides the mean downy mildew severity data for each of four leaves at one time of assessment in each main trial. In the second main trial the data clearly shows the effect of the systemic fungicide metalaxyl in controlling downy mildew on leaves 1, 2 and 3 at 33 days after sowing.

In the first trial, at 47 days after sowing, the data indicate that metalaxyl seed treatment inhibited the development of downy mildew on leaves 2 and 3.

TABLE 4: Dry pea yields from plots sown with seed treated with different fungicides in the two main trials.

Treatment	Trial sown 21.9.83 Quadrat g/m²	Bulk g/ 9.5m²	Yields kg/ha +	Trial sown 2.12.83 Quadrat g/m²	Bulk g/ 9.5m²	Yields kg/ha +
metalaxyl + captan	449 a	4210 a	3578 a	251 a	1893 a	2042 a
metalaxyl	440 a	3860 a	3227 a	244 a	1950 a	2089 a
captan	422 a	3793 a	3240 a	176 b	843 b	970 b
drazoxolon	386 a	4165 a	3372 a	163 b	1006 b	1113 b
untreated	376 a	3640 a	3081 a	94 c	955 b	1000 b
CV %	10.5	10.2	8.8	11.2	27.4	25.2

\+ Yield/hectare derived from quadrat and bulk data.

The mean dry weight of plants showed no significant differences in the first trial, but, in the second, plants from the metalaxyl + captan treatments were significantly heavier than plants from the other treatments. In the trial sown on 21 September (Table 4), although there were no significant differences in yield, the overall highest yield was from the plots sown with metalaxyl + captan treated seed. In the trial sown on 2 December, the yields from the metalaxyl + captan and the metalaxyl treatments were significantly greater than yields from the other treatments. In this trial there were no differences between the fungicide treatments in terms of plants/m², so it can be concluded that the increased yield was derived from the control of downy mildew during early crop growth. Other data from this trial showed that at 47 days after sowing, the severity of downy mildew on untreated leaf 1 was 91% and leaf 2 was 78%, whereas in the first trial the equivalent data were 27% and 24% respectively. Warm, moist conditions during mid-summer were better for downy mildew development and there was more inoculum for the epidemic to proceed.

The trials reported here have shown that fungicide seed treatments containing metalaxyl gave increased seedling establishment of garden peas. Furthermore, these treatments inhibit the development of *P. viciae* on plants for about 6 weeks after sowing. Both of these effects can lead to increased yields. These results emphasise that seed treatment of peas with metalaxyl plus protectant fungicide should be routinely carried out to help maximise crop yields.

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REFERENCES

Dixon, G.R., 1981a. Downy mildews of peas and beans p. 487-514. *In* :D.M. Spencer (ed) The Downy Mildew. Academic Press. London, New York, 636pp.

Dixon, G.R., 1981b. Vegetable Crop Diseases. Macmillan Publishers Ltd, London, 404pp.

Neegard, P., 1977. Seed Pathology. Vol. I and Vol. II Macmillan Publishers Ltd, London.

Pegg, G.F. and Mence, M.J., 1972. The biology of *Peronospora viciae* on pea: Laboratory experiments on the effects of temperature, relative humidity and light on the production, germination and infectivity of sporangia. Annals of Applied Biology 66 : 417-428.

Pinckard, J.A. and Ivey, J., 1971. Chemical treatments for cotton seed. Louisana State University Agricultural Experimental Station Bulletin 655, 36 pp.