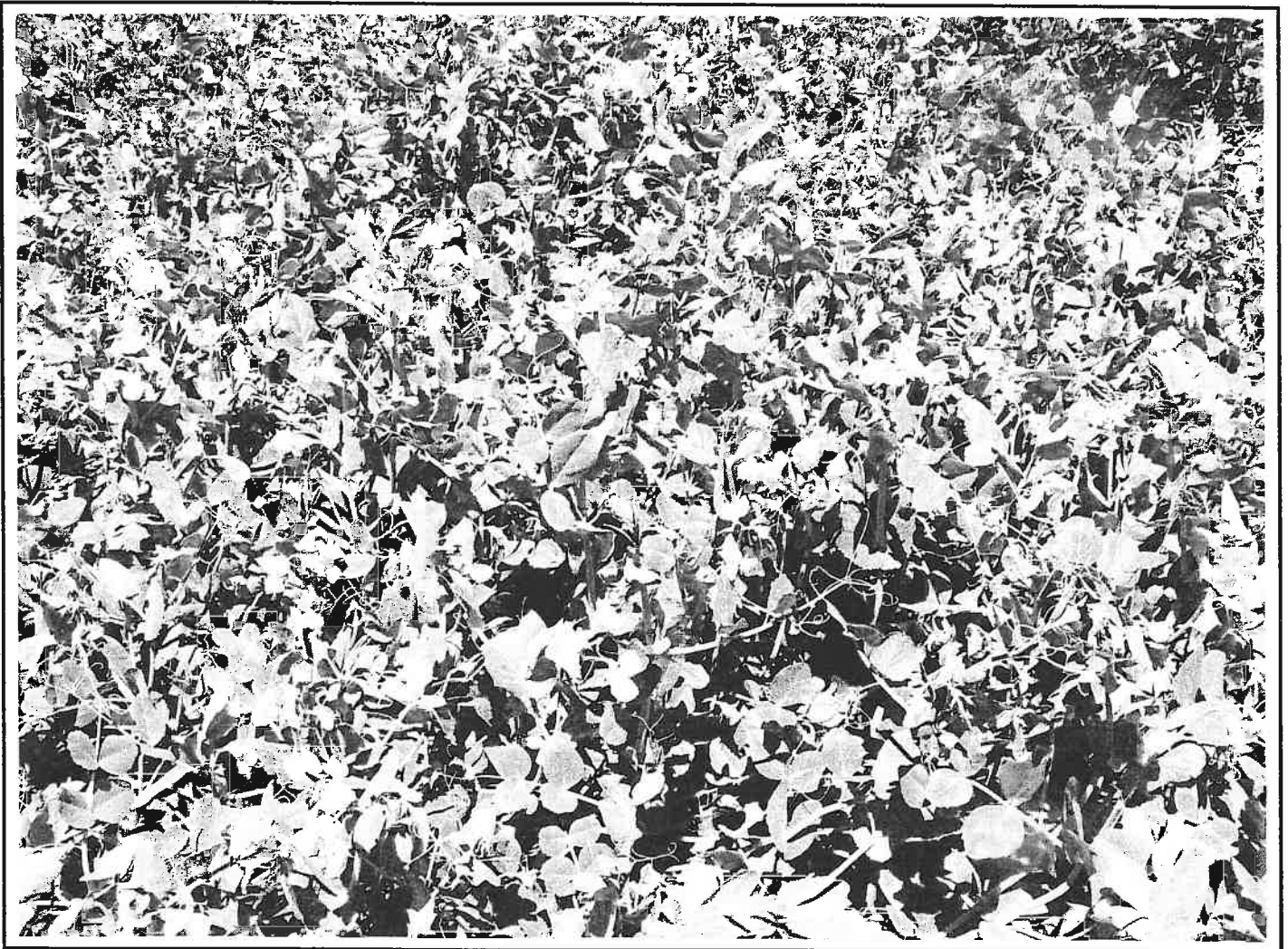


The Effect of Foliage-applied Fungicides on Peas

A report to The Foundation for Arable Research
Trials no. P02 / 02 and 03



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Summary:

1. Two disease control trials were conducted on peas in Canterbury in the 2002 / 3 season. One on a seed crop - cv. Mara and the other on a fresh process crop - cv. Prolific
2. In the seed crop, attempts were made to control early downy mildew and late Ascochyta complex infections.
3. In the process crop, only the Ascochyta complex of diseases was targeted.
4. Downy mildew incidence was high in the seed crop and the Ascochyta complex low at the time of the first fungicide applications.
5. There was no significant ($P < 0.05$) effect of the treatments on the range of disease and yield parameters measures on either crop.
6. The seed crop grew away from the downy mildew infection and there was only a trace of infection at harvest from the Ascochyta complex.
7. In the process crop, there was early herbicide damage at the time of the first application of fungicides. Ascochyta infection was advancing up the plants, but the disease had not progressed up the plants by the time the second fungicide treatments were applied 18 days later. Disease increase was minimal between final fungicide treatment and harvest.
8. No treatment significantly increased the fresh weight yield or influenced the final disease status of the plants at harvest.

Introduction:

Pea crops can be attacked by a range of leaf, pod, stem and root diseases. There are some that are well recognised as causing severe damage, such as bacterial blight caused by the *Pseudomonas syringae* complex and *Aphanomyces* root rot. However, there are many others that are very common on pea crops such as downy mildew, powdery mildew, the *Ascochyta* leaf and stem disease complex and *Septoria* leaf blight that appear to affect crops. There is little evidence as to the actual amount of infection by the diseases that will lead to an economic yield or quality loss.

Work in the 2001 - 2002 season on downy mildew showed that although the disease appeared to be well established in a crop before flowering, there was no build-up over flowering and pod fill which would affect yield. However, it was noted that there was a build up of stem and leaf diseases during the latter part of the season, but no treatments were applied in an attempt to control these infections.

The aim of the trials described here was to select two crops, one processing and one seed, which had early initial levels of diseases that could, if conditions were favourable, increase and affect crop yield. A range of treatments applied mainly protected the crop from two diseases - downy mildew and the *Ascochyta* complex.

Methods:

Cultivar and site selection:

1. "Mara" red peas grown for seed on Marshes Road, Prebbleton on PGG Ceres Farm (soil type - Waimakariri silt loam). The cultivar was introduced from Japan 6 years ago. Last season the area was in barley, while the previous season in forage ryegrass. The last pea crop was in 1995 / 96. The seeds were treated with Aliette Super at 2.9 g/kg. The crop was sown on 30 September at 250g / ha. At sowing, the area received Triflur 480 (trifluralin) at 1.7 l/ha and then Tribunil (methabenzthiazuron) at 1.7 kg/ha. On the 30th January, the crop was sprayed off with Reglone at label rates (4 l/ha)

The crop was irrigated twice during the season: 24 October (15mm) and 12 November (25mm).

2. "Polific" processing peas grown for Heinz Wattie on the Lincoln University Cropping Unit - Shands Road (soil type as above). This crop was sown 2 October at 250 kg / ha out of barley last season and wheat before that. The paddock had not had peas for at least 5 years. The seed was treated with Wakil XL (metalaxyl M, fludioxonil and cymoxanil). The crop received a herbicide treatment on 27 November consisting of a mixture of Bladex (cyanazine) at 2.5 l/ha and Lexone (metribuzin) at 300 g/ha.

The crop was irrigated twice during the season: 20 December and 2 January (rate of application not known - one pass at each date).

Table 1: Fungicide treatments and rates used in trials

Product	Active ingredients (ai)	% ai	Rate of product application per ha
Amistar WG	Azoxystrobin	50	0.250 kg
Comet	Pyraclostrobin	25	1000 ml
Foschek	Phosphorus acid	40	5 litres
Ridomil Gold EC	metalaxyl M	48	2.5 kg
Protek	Carbendazim	50	500 ml
Score 250 EC	Difenconazole	25	500 ml
Twist	Trifloxystrobin	12.5	1000 ml

All plot sizes were 10 m x 2.5 m.

Trial plots were laid out in a randomised block design; 4 replicates per treatment.

All treatments were applied with a plot sprayer equipped with 5 x TP11002vp flat spray nozzles at 40cm spacings and applied at the rate of 300 litres of water / ha and at 250 kPa pressure.

Diary of events:

Trial 1 - "Mara" peas - PGG Ceres Farm

Treatments:

1. Nil
2. Metalaxyl T1; Metalaxyl T2; nil T3; nil T4
3. Phosphorus acid T1; phosphorus acid T2; nil T3; nil T4
4. Phosphorus acid T1; phosphorus acid T2; carbendazim T3; carbendazim T4
5. Phosphorus acid T1; phosphorus acid T2; azoxystrobin T3; azoxystrobin T4
6. Phosphorus acid T1; phosphorus acid T2; difenconazole T3; difenconazole T4
7. Nil T1; Nil T 2; carbendazim T3; carbendazim T4
8. Nil T1; Nil T 2; azoxystrobin T3; azoxystrobin T4
9. Nil T1; Nil T 2; difenconazole T3; difenconazole T4

T1 = 7 - 8 node stage; 26 November; 1034h; 18.5°C; NE 13 km/h; RH 59%; 7/8 cloud.

T2 = 10 -12 node stage; 6 December; 0820h; 20°C; NE 9 km/h; RH 60%; 8/9 cloud.

T3 = Early flowering; 12 December; 0730h; 21.5°C; NW 5 km/h; RH 40%; 3/8 cloud.

T4 = End of flowering; 31 December; 0845h; 20°C; 0 km/h; RH 60%; 0/8 cloud.

Assessments:

Disease assessments were made (or notes taken) at each time of application and at 2 - 3 week intervals after the final application. The different methods of assessment are given with the results below.

The plots were harvested on 5 February 2003 by taking a 1.5m swath through each 10m long plot. Seed weights were adjusted to 12% moisture and estimated as tonnes per hectare.

All results were subjected to ANOVA where appropriate.

Trial 2 - "Prolific" peas - Lincoln University

Treatments:

1. Nil
2. Carbendazim
3. Difenconazole
4. Azoxystrobin
5. Trifloxystrobin
6. Pyraclostrobin

There were two application times:

T1 = 8 - 9 node stage; 19 December; 1500h; 25°C; NE 8 km/h; RH 51%; 3/8 cloud.

T2 = Late flowering / mid pod fill; 6 January; 0930h; 18°C; NE 12 km/h; RH 64%; 3/8 cloud.

Assessments:

Disease and damage assessments were made on randomly selected, untreated plants at each time of application.

Just prior to harvest as fresh processed peas (14 January), 10 plants were removed from a transect across each plot and returned to the laboratory. Disease and damage assessments were made and fresh pod weights measured. The crop was harvested for processing on 16 January.

All results were subjected to ANOVA where appropriate.

Results and Discussion:

Trial 1 - "Mara" peas for seed.

At the time of first application of fungicides (26 Nov.), 30 plants from within the trial area were collected in a pattern that represented plants within the whole area. The number of nodes were counted and percentage area of the leaves up the plants infected with downy mildew was assessed. Also, the presence of any stem-base lesions caused by *Ascochyta* spp. was noted. No systemic infection with downy mildew was noted in the trial area. The results are given in Table 2.

Table 2: Disease status of peas (cv. Mara) at the time of first fungicide application (26 November 2002).

Mean no. nodes - 7.8; incidence of *Ascochyta* complex - 0%

Node	Downy mildew	
	Severity (% leaf area affected)	Incidence (%)
1	6.73	60
2	5.03	60
3	4.90	43
4	3.53	30
5	0.05	7
6	0.17	3
7	0.00	0
8	0.00	0

At the time of the second application (6 December), 24 representative plants were taken from four untreated plots only (six from each plot). They were assessed as above and the results given in Table 3 below.

Table 3: Disease status of peas (cv. Mara) at the time of second fungicide application (6 December 2002)

Mean no. nodes - 11; incidence of *Ascochyta* complex at stem base - 21%

Node	Downy mildew	
	Severity (% leaf area affected)	Incidence (%)
1	27.7	92
2	25.0	88
3	15.5	71
4	7.6	46
5	4.0	42
6	1.5	21
7	1.5	17
8	1.3	21
9	0.0	0

As can be seen from the two tables of results above, the severity and incidence of downy mildew increased on the nodes 8 and 9 up the plants in the 10 days between applications. However, this movement and disease increase was minimal.

At the time of each further treatment (12 Dec., 31 Dec), six plants were collected from each untreated plot, and assessed for disease above the first 10 nodes. All nodes scored zero for disease incidence and severity.

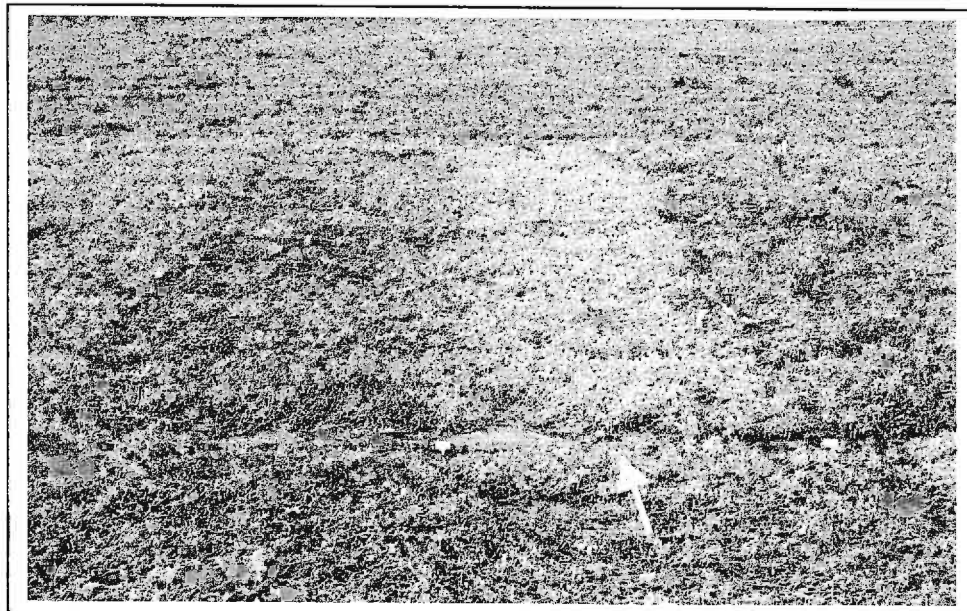


Figure 1: Colour retention in plot treated with triazole - difenconazole, the day before Reglone treatment (arrow).

Ascochyta complex was not assessed, as all plants in all plots showed only traces of the disease on stems, pods or leaves up until harvest, even though there was an assessed 21% incidence in disease symptoms on Dec. 6. The plants appeared to grow away from the infection.

Just before the crop was sprayed with Reglone the plots treated with Score (difenconazole - treatments 6 and 9) were observed to have retained green stem and leaf tissue better than all the other treatments (Figure 1).

Harvest yields are given in the Figure 2 and Table 4. There was no significant effect on yield of the treatments for either downy mildew or *Ascochyta* complex.

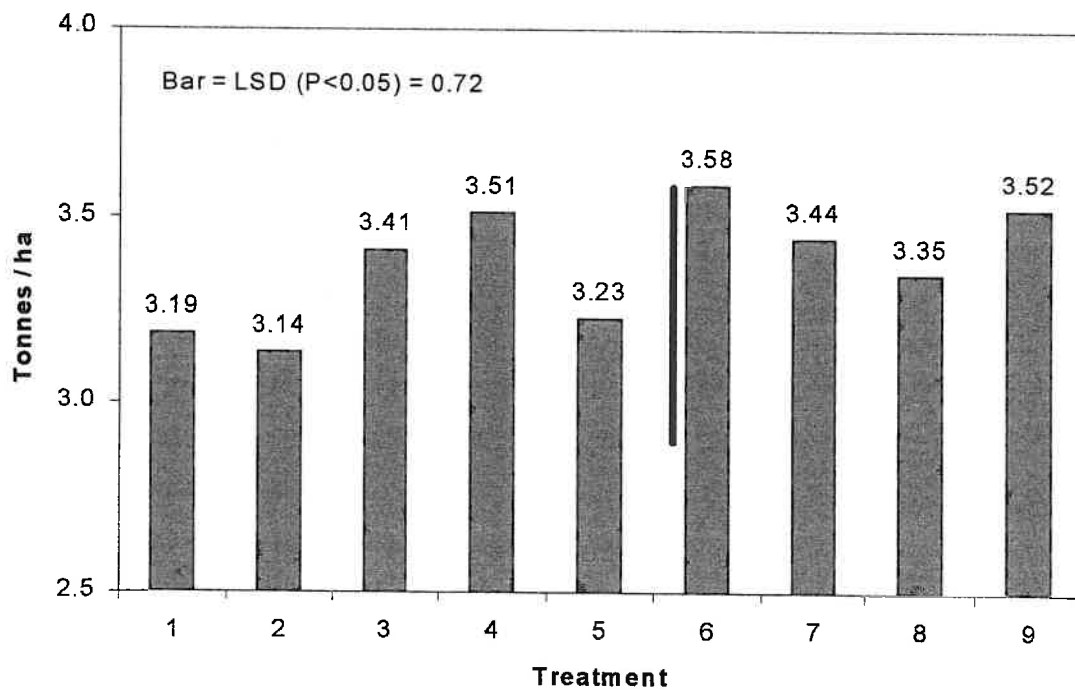


Figure 2: The effect of fungicide treatments on yields of peas (cv. Mara)

Table 4: Yield of pea seed (cv. Mara) in response to fungicide treatments

Treatment	Yield (T / ha)
1. Nil	3.19
2. Metalaxyl T1; Metalaxyl T2; nil T3; nil T4	3.14
3. Phosphorus acid T1; phosphorus acid T2; nil T3; nil T4	3.41
4. Phosphorus acid T1; phosphorus acid T2; carbendazim T3; carbendazim T4	3.51
5. Phosphorus acid T1; phosphorus acid T2; azoxystrobin T3; azoxystrobin T4	3.23
6. Phosphorus acid T1; phosphorus acid T2; difenconazole T3; difenconazole T4	3.58
7. Nil T1; Nil T2; carbendazim T3; carbendazim T4	3.44
8. Nil T1; Nil T2; azoxystrobin T3; azoxystrobin T4	3.35
9. Nil T1; Nil T2; difenconazole T3; difenconazole T4	3.52
LSD (5%)	0.72

There was no significant trends in the harvest results other than the two plots that received difenconazole (treatments 6 and 9) had the highest yields and the nil treatments and Ridomil only (treatments 1 and 2) had the lowest. There was a pattern in the results also that suggested that the strobilurin-treated plots gave lower yields (mean = 3.29) than those treated with triazoles (mean = 3.55). Carbendazim-treated plots were intermediate (mean = 3.48).

Trial 2: "Prolific" process peas

At the time of the first application of fungicide to this trial (19 December 2002), the first four nodes up the plant had 95 to 100% leaf area damaged through herbicide application and *Ascochyta* complex infection (Table 5).

Table 5: The combination of herbicide and *Ascochyta* complex damage to peas (cv. Prolific) at time of first fungicide treatment (19 December 2002).

Node	Herbicide + <i>Ascochyta</i> damage	
	Severity (% leaf area affected)	Incidence (%)
1	86.8	100
2	82.5	100
3	65.5	95
4	43.1	95
5	19.1	50
6	4.2	25
7	0.0	0

Ascochyta complex infection was confirmed as causing all leaf damage on leaves at nodes 5 and 6 up the plant.

At the time of the second application of fungicides (6 January 2003), there was no discernible difference in the level of leaf damage up the plants, and no assessment was carried out.

Just prior to harvest of the fresh peas for processing (14 January), the fresh pod weights from each treatment showed no significant ($P < 0.05$) differences (Fig. 3 and Table 6). Likewise, the disease status in the trial was very low and no treatments showed any significant differences ($P < 0.05$)(Table 6).

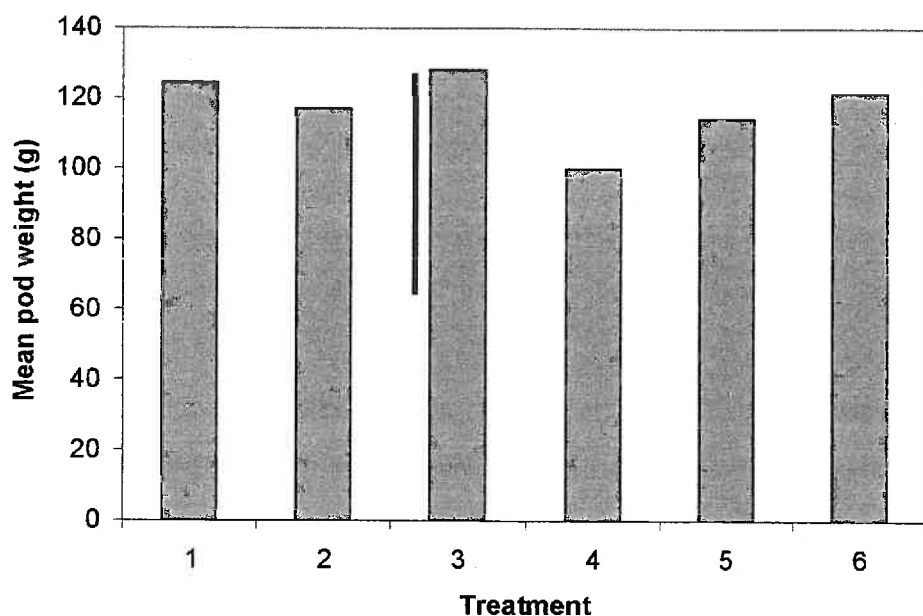


Figure 3: The effect of fungicide treatments on the fresh pod weight of process peas (cv. Prolific) assessed 14 January.

Table 6: The effect of fungicide treatments on fresh pod weight of peas (cv. Prolific) and number of nodes up the plant affected by disease (*Ascochyta* complex) - 14 January.

Treatment	Fresh pod weight - 10 plants (grams)	Number of nodes up the plant with disease
1 Nil	124.1	3.9
2 Carbendazim	117.2	3.7
3 Difconazole	127.9	3.7
4 Azoxystrobin	100.0	4.2
5 Trifloxystrobin	114.3	3.6
6 Pyraclostrobin	121.3	3.7
LSD (5%)	61.4	1.2

The *Ascochyta* complex did not advance up the plants in the untreated nor the treated plots (Table 6). The applied fungicides therefore had no effect on either the yield of fresh peas or the status of disease on the plants. It is of note, however, that again, the lowest (non-significant at $P < 0.05$) yield and highest disease rating was on the azoxystrobin-treated plots. Again, the difconazole-treated plots yielded the highest.

The disease pressure on the plants was very low throughout the season, even though there was 100% infection at the time of fungicide application. The main constraint on yield was the apparent herbicide damage to the lower leaves. However, although this appeared serious at the time of the first application of fungicides, the plants were able to recover and yield to near expectation (*pers. com.* LU crop unit Manager). Although the area of the trial

was irrigated twice, the applications were carried out in dry sunny conditions, that did not encourage disease build-up, as the plants were wet for only short periods of time.

The trial area was not harvested, and samples from each plot were taken just before harvest by Heinz Wattie staff for freezing and analysis of fungicide residues at a later date.

Conclusions:

At the times of first application of fungicides to the trial areas, levels of disease, especially downy mildew and Ascochyta complex were moderate to high.

The incidence and severity of all diseases in both trials reduced in incidence and severity as the plants matured and grew away from the infection. Diseases therefore had no influence on the final fresh or seed pea yield in the two trials.

Neither weather nor crop microclimate were conducive to disease development in the two trials, despite irrigation being applied at two times to one of the trial areas.

Acknowledgements:

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