VG105
Management of seedling establishment problems in processing vegetable crops

Ron McMahon
Queensland Department of Primary Industries

Know-how for Horticulture™

VG105

This report is published by the Horticultural Research and Development Corporation to pass on information concerning horticultural research and development undertaken for the vegetable industry.

The research contained in this report was funded by the Horticultural Research and Development Corporation with the financial support of the Rhone-Poulenc, Shell Chemicals Australia, Golden Circle and Edgell Birdseye.

Cover Price $20.00

HRDC ISBN 1 86423 322 2

Published and Distributed by:

Horticultural Research and Development Corporation
Level 6
7 Merriwa Street
Gordon NSW 2072

Telephone: (02) 9418 2200
Fax: (02) 9418 1352

MANAGEMENT OF SEEDLING ESTABLISHMENT PROBLEMS IN PROCESSING VEGETABLE CROPS

HRDC REF.NO VG105

FINAL REPORT

INTRODUCTION

In wet seasons, seedling establishment is the major problem of the Queensland processing vegetable industry with average seedling losses as high as 70%. The fungal diseases involved are *Pythium*, *Rhizoctonia* and *Aphenomyces*. All seed sown is presently chemically treated, but chemicals being used are ineffective, even at high rates. An industry seminar was held in 1990 to review seedling survival techniques being used in other industries. This seminar identified new, environmentally friendly chemical which were highly effective when used as seed dressings to control *Pythium* and *Rhizoctonia*. No chemical seed dressings were identified for the control of *Aphenomyces*, but biological control methods utilising a bio-assay soil test to measure soil disease levels was found to be widely used in the U.S. and in Europe. This project examined the use of seed chemicals to reduce seedling losses from *Rhizoctonia* and *Pythium* and the biological control of *Aphenomyces*.

It was unfortunate for this project that Queensland experienced the longest drought ever, lasting for the whole of the project period. Despite these uncharacteristic weather conditions, a wide range of trials have been conducted producing valuable results.

RESULTS

Details of each trial conducted by Rob O'Brien are contained in separate experiment reports attached as Attachments 1 to 9. Mr O'Brien is a Principal Plant Pathologist with the QDPI at Indooroopilly.

DISCUSSION INCLUDING RECOMMENDATIONS

(i) Extension/adoption by industry of research findings.

This project was initiated by a producer/processor organisation - The Processing Vegetable Technical Discussion Group (PVTDG) following an appreciation that in wet periods, seedling establishment was the major problem facing the processing vegetable industry in Queensland. The project was formulated after a major review including a one day industry seminar at which experts from the cotton and grain industries outlined successful advances in seedling establishment in these industries.

The PVTDG worked with the project team throughout this project supplying resources as required including trial sites and machine harvesting. There has been some frustration caused by the prolonged drought but general enthusiasm for the project was ongoing. Industry representatives have inspected trials at critical periods and have discussed results.

(ii) Directions for future research and/or activities supported by HRDC.

Pythium spp and *Rhizoctonia solani* were found to affect stands of carrots, beetroot, peas and beans. The fungicides metalaxyl (Apron®) and tolclofos methyl (Rizolex®) were highly effective as a seed dressing and also as an in-furrow soil drench. In most cases, seed dressings were easy and economical to use and have a low impact on the environment.

Where vacuum seeds are used, treating seed is not practical. In these cases, in-furrow drenching is the best alternative. Seed dressing rates were determined at 1.5 g (Apron®) plus 10 g of (Rizolex®) per kilogram of seed. Soil drench rates were determined at 36g of Apron® plus 500 g of tolclofos-methyl active ingredient per 2000 m of row (approximately 1 ha for vegetable crops). Note that the commercial preparation of Rizolex® is not soluble so a soluble form of this chemical will be required.

Future research for *Pythium* spp. and *Rhizoctonia solani* control in seedlings will involve encouraging the relevant chemical companies to extend registered use as described on labels. The results of this project should be adequate for registration purposes.

Aphenomyces euteiches causes root rot in peas while *Aphenomyces cochlioides* causes seedling death in beetroot. No fungicides were effective against these diseases. Soil indexing to identify soils with high inoculum levels are used overseas but in this project there was a lack of correlation between test results and field observations. Future work involving HRDC will be required to further refine *Aphenomyces* bio-assay tests as fungicidal control is unlikely and industry losses remain very significant.

(iii) Financial/commercial benefits of adoption of research findings

Fungicidal control of *Pythium* spp. and *Rhizoctonia solani* once registered and in general use will reduce seedling losses in prolonged periods by an estimated more than 70%. If this estimate is correct, production gaps caused by the need to re-sow areas with unacceptable plant stands will be eliminated. This could represent savings of between two and three million dollars annually to the processing industry in Queensland alone. All other vegetable production areas in Australia would benefit from this initiative.

The development of an acceptable bio-assay test to manage problems in peas and beetroot caused by *Aphenomyces* spp. would save the Queensland processing industry an estimated $3 to $5 million in wet years. If this pea technology could be extended to Tasmania, there may also be industry benefits.

ATTACHMENT 1

Indexing beetroot soils for seedling diseases

R.G. O'Brien 7/10/92

Summary. Ten beetroot soils from the Lockyer Valley were used to develop a testing procedure for beetroot seedling disease potential. This was achieved by comparing germination rates in natural and sterilised soil samples. Of the ten soils tested, three showed low disease potential with a seedling stand of >80% of that in sterile soil, five showed moderate disease potential (germination >50% <80% c.f. sterile soil) and two showed high disease potential (<50%). *Aphanomyces cochlioides* and *Pythium* spp. were the major incitants of seedling disease.

Introduction. Emergence of beetroot is often less than satisfactory in many Lockyer Valley crops. This is particularly so during early season sowings (Feb-April) which often receive high rainfall with temporary water logging which predisposes to *Pythium* spp. and *Aphanomyces cochlioides*.

The identification of fields or areas within fields which have high disease potential is important so that these can be avoided during the early season, high risk period. In this study, a simple procedure was tested on ten soil samples collected late in the 1992 season from beetroot farms in the Lockyer Valley.

Experimental

Representative soil samples (approx 10 L) were collected from 10 sites where beetroot crops were being grown. Large soil clods were broken up and each sample was divided into two, one of which was autoclaved.

Five pots (10 cm diam) were filled with soil from each subsample and 10 beetroot seed (cv. Derwent Globe) placed on the surface. A 1 cm layer of vermiculite was placed on the soil and the pots brought to field capacity.

One week after seed had germinated, saucers were placed under pots and filled with water over a 24h period. One week later, stand counts were taken and isolations made from diseased plants.

Results and Discussion

In sterile soil, there were no statistical differences in plant stand between different soil sampling sites. In non sterile soil, while all samples showed fewer plants than in sterile soil, there were statistical differences. Beetroot seed is polyembryonic which resulted in more than 10 seedlings from the 10 seed sown in each pot.

As a simple method of expressing the relationship between plant survival in non sterile Vs sterile soil, results were expressed as a survival index.

$$\text{Survival Index} = \frac{\text{no. of plants in non sterile soil}}{\text{no. of plants in sterile soil}} \times 100$$

Thus sites 1, 5 and 7 were ranked highly (>80), while sites 6, 9 and 10 were low (<50) with the remainder between 50 and 80.

The most commonly isolated pathogens were *Aphanomyces cochlioides* and *Pythium* spp.

The technique appears to be suitable for both indexing soils and testing seed fungicide treatments.

Table 1. The effect of soil sterilisation on the survival of beetroot seedlings in ten soil samples

Site	Seedling stand per 10 seeds		Survival Index (Sterile = 100)	[+] Pathogens isolated
	Sterile soil	Natural soil		
1. L. Jackwitz	18.2	15.8	87	F* A P
2. T. Schultz	19.4	13.4	69	F A*
3. E. Litzow	19.0	12.6	66	A P*
4. Hawley Bros.	18.4	10.6	58	P*
5. K. Lerch	19.6	16.4	84	F* P
6. T. Schultz	18.8	7.6	40	F A* P
7. C. Lerch	18.2	15.8	87	F A*
8. R. Hawley	17.6	11.8	67	F A* P*
9. D. Lerch (a)	19.2	5.0	26	A* P
10. D. Lerch (b)	19.6	6.2	32	P*
P = 0.05	NS	3.7		
0.01		4.8		

[+] F = *Fusarium* spp.; A = *Aphanomyces cochlioides*; P = *Pythium* spp.

* Most frequently isolated organism in the sample.

ATTACHMENT 2

Indexing pea soils for disease potential

R.G. O'Brien 6/11/92

Summary. Five soil samples from pea fields in the Lockyer and 5 from the Fassifern were used in an experiment to try to correlate field root rot severity with severity in a pot test. Although there were obvious differences between soils in the pot experiment these did not always correspond with the field incidence. Further studies are required.

Experimental. Soil samples and approximately 10 plant samples were collected from five pea fields in the Lockyer Valley and 5 from the Fassifern. Soil samples (10L) were halved and one half autoclaved. Five 12cm pots were filled with soil from each sub sample to 2cm below the top and brought to field capacity. Five surface sterilised pea seed (cv. S.S.F.) were placed on the soil and covered with a 1cm layer of vermiculite.

Pots were watered daily. After 4 weeks, saucers were placed under the pots and kept filled with water for 48h. One week later, stand counts were made and roots washed and rated for disease severity.

Plants were rated for root rot as follows:

0 - no disease. Roots white and fibrous.
1 - slight. Large root mass slight discolouration of some roots.
2 - most roots discoloured and root volume less (up to 25%) than in sterilised checks.
3 - few fibrous roots. Tap roots discoloured > 25% < 50% loss of root system.
4 - Severe root rot. All roots discoloured/rotted > 50% < 75% loss of root system.
5 - plant dead>75% root system rotted.

Results/Discussion. Practically all seed emerged in the sterilised soil. Emergence in the unsterilised sub sample was converted to a percentage of that in the corresponding sterilised sample. This reflects the activity of pre-emergence pathogens (*Pythium, Rhizoctonia*). In 7 of the samples, less than 50% emerged. The sample from Stradling was the only one with high germination (95%) in the unsterile subsample. This was the first pea crop in this field.

The examination of roots showed samples from Whitehouse and Lerch had typical Aphanomyces symptoms. In other cases, e.g. Bourne & Jackwitz crown lesions were the primary cause of damage. Isolations from crown lesions gave *Pythium* sp. and *Rhizoctonia* sp. Isolations from brown roots gave *Aphanomyces euteiches*.

It may be possible to get a closer correlation between the pot test and field plants if some of the variability due to pre-emergence damping-off was removed. It is suggested that future samples be split into 4 sub-samples: sterilised/untreated seed
sterilised/seed treated with P-Pickel-T + Apron
unsterilised/untreated seed
unsterilised/treated seed

Table 1. The severity of root and crown rot in peas grown in different soil samples.

Site	Emergence %[2]	Disease Severity[3]		
		Glasshouse plants		Field plants
		Crown	Roots	Roots
Lerch (L)[1]	43	3.5	2.2	3.5
Bourne & Jackwitz (L)	11	4.7	0	3.5
Whitehouse (L)	14	5.0	4.5	4.2
Stradling (L)	95	3.2	2.1	1.3
Sutton (L)	44	0.6	0.5	1.7
Westfarms (F)	18	2.0	0.5	1.8
Kenny (F)	9	1.5	1.0	2.0
Moore (F)	25	2.2	0.8	2.0
Parcell (F)	58	1.2	0.1	2.9
Hines (F)	52	1.1	0	2.4

[1] L = Lockyer Valley F = Fassifern Valley

[2] Emergence % - the emergence in non sterile soil compared with that in autoclaved soil.

[3] Disease severity 0-5 where 0 = no disease; 5 = severe disease, plant dead

ATTACHMENT 3

Fungicide seed treatment of beans and carrots to control damping-off.

(R.G. O'Brien) 26/8/92

Experiments were conducted in seedbeds sterilised then infested with (i) *Pythium* sp. (ii) *Rhizoctonia solani* and (iii) *Pythium* + *Rhizoctonia*. Fungicide seed treatments were applied to bean and carrots although germination problems with the carrot seed prevented data collection for this species. Most fungicide treatments improved germination counts in beans. Combinations of Apron + Rizolex, Apron + CGA 173506 Apron + CGA 142705 and Aliette + Rovral significantly improved plant stands in the presence of both pathogens.

Poor emergence is a problem in several processing vegetable crops. Damping-off fungi including *Pythium* spp. and *Rhizoctonia solani* are often responsible.

In order to screen several new fungicidal seed treatments, a technique of infesting seed beds with *Pythium* and *Rhizoctonia* was developed. Experiments with bean and carrots were conducted at Gatton Research Station in mid 1992.

METHODS

Isolates of *Pythium* sp. and *Rhizoctonia solani* from bean were cultured in a perlite, corn meal, potato dextrose agar medium (Miles and Wilcoxson, 1984).

75g perlite
150g corn meal autoclaved, inoculated + 50ml water.
300ml PDA (1% Difco)

This was used to infest seed beds at the rate of 200ml/m^2 following sterilisation with methyl bromide.

Bean and carrot seed were treated with slurries of fungicides. Seed was moistened with water (5-7ml/kg) before fungicide was added. The fungicide rate of application for carrot seed was double that for bean. Seed was sown in rows 1m long which was regarded as a plot. Beans were spaced 5cm apart while 200 carrot seed were mixed with a small quantity of sterile sand and spread evenly along the row.

Since fungicides were predominantly active against either *Pythium* or *Rhizoctonia*, three experiments were conducted. The first was for fungicides active against *Pythium* (treatments in Table 1) the second was for efficacy against *R. solani* (treatments in Table 2) and thirdly, combinations of fungicides against both fungi (Table 3). There were three replications in experiments 1 and 2 and four in experiment 3.

Two weeks after sowing, counts of emergence were made. For beans, the number of plants in the central 40cm section of each plot were counted. For carrots, population counts were made in the central 30cm of each plot.

RESULTS

The germination of carrot seed was uneven in these experiments probably due to the shallow sown seed being dried out in sections of the beds. The deeper sown bean seed provide a more accurate indication of the efficacy of the treatments and are presented below.

All treatments, except two, gave significantly higher plant stands than the untreated in the *Pythium* test (Table 1). All treatments significantly improved emergence in the presence of *Rhizoctonia* (Table 2). In the combined (*Pythium/Rhizoctonia*) test, combinations of Apron with CGA 173506,

CGA 142705 and Rizolex as well as Aliette + Rovral gave high emergence. The combination of CME 15103 with Rizolex was ineffective (Table 3).

DISCUSSION

Several fungicides were effective in preventing damping-off in beans and would be suitable candidates for further testing in larger field experiments. In particular, combinations of Apron + Rizolex, Apron + CGA 173506, Apron + CGA 142705 and Aliette + Rovral improved emergence when both *Pythium* and *Rhizoctonia* were present.

CHRONOLOGICAL DATA

Seedbeds fumigated	6 March 1992
Plots infested	27 March 1992
Rhizoctonia + Pythium beds sown	31 March 1992
Rhizoctonia + Pythium beds rated	14 April 1992
Rhizoctonia + Pythium bed sown	15 May 1992
Rhizoctonia + Pythium bed rated	1 June 1992

REFERENCE

Miles, M.R. and Wilcoxson, R.D. (1984). Production of fungal inoculum using a substrate of perlite, corn meal and potato dextrose agar. Plant Disease 68:310.

Table 1 The effect of fungicide seed treatment on control of *Pythium* damping off in beans

Fungicide	Rate g per kg seed	Plants/40cm
Apron (350g/kg metalaxyl)	1	8.3
	2	7.7
	3	6.3
Aliette (800g/kg fosetyl-Al	2	6.7
	4	7.0
	6	8.0
CME15103 (500g/kg dimethomorph)	2	6.7
	4	5.3
	6	7.3
Untreated - infested soil	0	4.3
Untreated - sterile soil	0	7.5
LSD P = 0.05		2.25

Table 2 **The effect of fungicide seed treatment on control of *Rhizoctonia* damping-off in beans.**

Fungicide	Rate (g per kg seed)	Plants/40cm
CGA 173506	1	8.0
	2	6.7
	3	7.3
CGA 142705	1	7.3
	2	7.3
	3	7.3
Rizolex (500g/kg tolclofos - methyl	1	6.7
	2	7.7
	3	6.7
Rovral (500g/kg iprodione	2	7.3
	4	7.3
	6	6.7
Untreated - infested soil	0	4.3
Untreated - sterile soil	0	7.0
LSD (P = 0.05)		1.9

Table 3 **The effect of selected fungicide seed dressings on bean seed emergence in seed beds infested with *Pythium* sp. and *Rhizoctonia solani*.**

Fungicide treatment	Rate (g/kg seed)	Plants/40cm
Apron + Rizolex	2+2	6.5
Apron + CGA 173506	2+2	7.0
Apron + CGA 142705	2+2	7.2
Aliette + Rovral	4+4	5.7
CME 15103 + Rizolex	2+2	1.0
Untreated - infested soil	0	1.0
Untreated - sterile soil	0	6.0
LSD P = 0.05		2.1

ATTACHMENT 4

Effect of fungicide seed dressings on emergence of carrot seedlings in the presence of Rhizoctonia, Pythium, Macrophomina and Fusarium

R.G. O'Brien 20/11/92

Summary. A test conducted in Speedling trays filled with artificially infested soil showed isolates of *Fusarium* and *Macrophomina* did not cause damping off. *Rhizoctonia solani* and *Pythium* spp. reduced emergence of untreated seed to 11 and 20% respectively. High rates of Rizolex 18g/kg controlled *R. solani* and increased emergence to 92%. Both Recoil and Apron at standard rates (3.7g/kg) increased emergence to >80%.

Introduction. *Rhizoctonia solani* and *Pythium* spp. are involved in a syndrome of pre-emergence seed decay, post emergence damping off, root forking and mature plant root necrosis. Seed dressings used at standard rates have not solved the problem. In this trial, fungicides with systemic activity were screened for activity against five fungi isolated from diseased carrot roots.

Materials and Methods. Five fungi were grown on corn meal sand for 3 weeks then mixed with standard UC potting mix at the rate of 60g CMS to 2.5L potting mix. The fungi had been isolated from field grown carrots from Kalbar. They were

2143-1 *Macrophomina phaseolina*
2207 *Fusarium solani*
2208-3 *Rhizoctonia solani*
2208-1 *Pythium* spp.
2208-2 *Pythium* spp.

The infested potting mix samples were allowed to stand for 24h before use. Speedling trays (60 cell) were filled as required with the 6 fungal treatments and sown with seed treated as per the Table. Twelve carrot seeds were sown in each cell. There were 3 replications. A final population count was made 18 days after sowing.

Results/Discussion. In the control of *Pythium* spp. there was no benefit in increasing the rates of metalaxyl or oxadixyl above the standard. With *R. solani* however, the higher rates of tolclofos methyl (Rizolex) and tebuconazole (Raxil) increased the stand. Quintozene was ineffective. There was evidence of phytotoxicity with the higher rates of tebuconazole. The isolates of *Marophomina phaseolina* and *Fusarium solani* were non pathogenic.

Chronological Data: Experiment sown 30/3/89
Experiment concluded 18/4/89

Table 1. Survival of carrot seedlings three weeks after sowing fungicide treated seed into soil infested with *Phizoctonia solani* or *Pythium* spp.

	TREATMENT	% SURVIVAL IN SOIL INFESTED WITH			
		R. solani	*Pythium* A	*Pythium* B	STERILE SOIL
1	Recoil[1] 3.7g/kg seed + Raxil 3.7g/kg seed	25	83	92	94
2	Recoil 11g/kg seed + Raxil 11g/kg seed	47	77	83	83
3	Recoil 18g/kg seed + Raxil 18g/kg seed	52	64	81	81
4	Apron 3.7g/kg seed + Terrachlor 3.7g/kg seed	0	72	86	86
5	Apron 11g/kg seed + Terrachlor 11g/kg seed	0	94	89	92
6	Apron 18g/kg seed + Terrachlor 18g/kg seed	6	83	92	86
7	Apron 3.7g/kg seed + Rizolex 3.7g/kg seed	8	77	81	86
8	Apron 11g/kg seed + Rizolex 11g/kg seed	58	92	97	92
9	Apron 18g/kg seed + Rizolex 18g/kg seed	72	77	81	92
10	Untreated seed	11	17	33	97
LSD P = 0.05		3.3	4.9	4.2	NS

[1] Recoil = 250g/kg oxadixyl
Raxil = 25g/kg tebuconazole
Apron = 350g/kg metalaxyl
Terrachlor = 750g/kg quintozene
Rizolex = 500g/kg tolclofos methyl

(v) Chemical control of soil borne diseases

Several fungicide seed dressing and soil application treatments to control *Pythium* spp and *Rhizoctonia solani* in beans were evaluated in a trial at Bundaberg in April 1992. Wet conditions soon after sowing severely reduced plant stands. Isolations from roots showed *Pythium spp* and *Fusarium* spp were present with recovery rates of 75% for each, on their respective selective media.

Plant stands were significantly increased by seed dressing with metalaxyl (Apron, 350 g/kg) + tolclofos-methyl (Rizolex, 500 g/kg). Although root rot severity at 4 weeks was generally low, shallow planting (25 mm) resulted in less damage than deep (50 mm). Soil application of nematicide and fungicides did not affect plant establishment or root rot severity in this trial. Although some plants showed symptoms of stem and root rot due to *R. solani*, the wet conditions were more favourable for *Pythium* spp.

Bean crops are affected by fungi which cause pre-and post-emergence seedling rots as well as root rots which reduce the potential of more mature plants. Several fungi and nematodes may be involved and different organisms often predominate under different environmental conditions.

A previous experiment in the Bundaberg district showed nematodes (both root lesion and root knot) and *Pythium* spp predominated in the root rot syndrome.
In the trial described below, fungicides active against *Pythium* spp and *Rhizoctonia solani* were employed as seed dressings and soil drenches. Other treatments included shallow and deep sowing and nematicide application.

METHODS

The trial site was on Mr David De Paoli's farm, Goodwood Road, Bundaberg. Soil was sandy and had been cropped previously to beans. A full list of treatments is shown in Table 1. The field layout was a split plot randomised blocks design with 3 replications. Main plots were 4 rows x 5 m with 1 m guard area at each end. Seed cv. was hand planted at the rate of 100 g/main plot (70 kg/ha).

Seed dressings were applied as slurries (fungicide + 5 ml water/kg seed) three days before sowing.

Soil applications of the fungicides Rovral (iprodione, 500 g/L), Aliette (fosetyl-Al, 720 g/kg) and Rizolex (tolclofos-methyl, 500 g/kg) were made by a constant pressure spray rig to a 25 cm band over the open seeded furrow at 1000 L per treated ha. Application of metalaxyl to soil was as a 25 cm band of Ridomil 50 g granules over the open seeded furrow. The granular nematicide Nemacur (fenamifos) was applied similarly.

Table 1. List of treatments

	Seed dressings	Soil application[x]	Sowing depth
[y]			
1	Aliette 6g/kg + Rovral 6mL/kg	-	25 mm
2	Aliette 6g/kg + Rovral 6mL/kg	-	50 mm
3	Aliette 6g/kg + Rovral 6mL/kg	A	25 mm
4	Aliette 6g/kg + Rovral 6mL/kg	A	50 mm
5	Apron 1.5g/kg + Rizolex 5 g/kg	-	25 mm
6	Apron 1.5g/kg + Rizolex 5 g/kg	-	50 mm
7	Apron 1.5g/kg + Rizolex 5 g/kg	B	25 mm
8	Apron 1.5g/kg + Rizolex 5 g/kg	B	50 mm
9	Nil	-	25 mm
10	Nil	-	50 mm

[x] Soil application A - Aliette + Rovral spray (675 g + 900 g/treated ha)
B - Rizolex spray + Ridomil granules (360 g/ha + 50 kg/ha)
(Application rates per crop hectare are approximately _ of the above).

[y] Each main treatment was split (± Nemacur 100 kg/treated ha)

Rain started falling as replication 3 was being sown and continued for several days. Stand counts and root rot ratings were made after 4 weeks. Since plant populations were low, total plant stands were taken. Root rot severity was judged by examining 10 root systems (where available) from each plot and rating on a 0-5 scale.

0 = no disease
1 = some feeder root damage
2 = severe feeder root damage
3 = main root affected
4 = main root severely affected
5 = plant dead

Isolations were made from a collection of 40 root systems taken from plants outside the trial area. Root and crown segments were shaken free of contaminants using tea infusers rapidly shaken in distilled water + Tween 80 and then plated onto a non selective medium (PDA + S) as well as media specific for certain pathogens viz. Nash Snyder medium (*Fusarium* spp), 3P (*Pythium*, *Phytophthora* spp) and MBV (*Aphanomyces* spp). These were examined after 3 days and positive isolations noted.

Due to the low plant populations, no yields were taken.

RESULTS

(i) Isolations: *Pythium* spp and *Fusarium* spp were detected on the non selective medium. No *Rhizoctonia* spp was recovered on this medium. A high recovery rate (75%) of *Pythium* spp. on their selective medium showed this pathogen was present in high populations. Similarly *Fusarium* spp were recovered at the rate of 76% on its selective medium (Table 2).

Table 2. Recovery rate (%) of pathogens on a range of media

Medium	Roots			Crowns		
	No. of isolations	+ Fus	+ Pyth	No. Isolations	+ Fus	+ Pyth
PDA + S	55	47	10	55	33	10
3P	35	-	22	25	-	22
Nash Snyder	55	47	-	50	33	-
MBV	35	-	-	25	-	-

(ii) Plant emergence: Plant stands were variable between replications. In Block 3 several plots had no plants surviving at 4 weeks. Although plant populations were overall very low, the seed dressing of Apron + Rizolex greatly improved survival when compared with the untreated plots or those treated with Aliette and Rovral. Soil application of fungicides or nematicides did not improve stands. Deeper sowing (50 mm) was slightly better than shallow sowing (25 mm). (Table 3 and 4)

(iii) Root rot severity: There was generally minor damage to roots when they were evaluated 4 weeks after sowing. Shallow sowing gave the greatest benefit with some improvement due to fungicide seed dressing. (Table 3 and 4)

Table 3. The effect of seed dressing, soil drenches and sowing depth on emergence and root rot severity

Treatment	No. of plants per plot	Root rot severity (0-5)
1	8.1	1.25
2	11.1	1.65
3	3.0	1.10
4	2.2	1.70
5	24.1	1.30

Treatment	No. of plants per plot	Root rot severity (0-5)
6	26.6	1.45
7	22.7	1.25
8	34.3	1.75
9	6.1	1.45
10	13.0	2.10
LSD (P = 0.05)	17.0	

Table 4. Analysis of main treatment effects

Treatment	Plants/plot	Root rot severity (0-5)
a) *Sowing depth*		
25 mm	12.8	1.28
50 mm	17.4	1.73
b) *Nematicide*		
+ Nematicide	14.4	1.56
- Nematicide	15.9	1.45
c) *Seed Dressing*		
Aliette + Rovral	6.1	1.42
Apron + Rizolex	26.9	1.44
Untreated	9.5	1.77
d) *Seed dressing + soil application*		
Aliette + Rovral	2.6	1.4
Ridomil + Rizolex	28.5	1.5
Untreated	9.5	1.77

DISCUSSION

Variability through the trial area led to few significant differences in the analysis of results. Much of the variability was due to rainfall while Block III was being sown. It is suspected seed dressings were removed before seed could be covered. The poor response to soil application of fungicides is probably also due to their dilution and movement out of the root zone before seed was germinated.

Isolations showed *Pythium* spp. *Fusarium* spp. were abundant in the trial area and with the wet conditions *Pythium* pre-emergence damping-off is suspected as the major fungal cause of poor stands. The improved stands in plots receiving Apron + Rizolex were almost certainly due to the Apron component. It is likely that the saturated soil conditions alone would have given reduced stands. The failure of Aliette to control *Pythium* damping-off may have been due to removal of this fungicide from the seed coat since it was not a seed dressing formulation and no stickers were added.

Although it is risky to rely on the results of a trial so badly affected by weather, the results indicate that Apron seed dressing will give good control of Pythium damping off.

CHRONOLOGICAL DATA

Trial sown - 2 April 1992

Stand counts, root rot ratings - 30 April 1992

ATTACHMENT 5

REPORT

Indexing five pea soils for root disease severity

R.G. O'Brien 10 March 1993

SUMMARY Soil was collected from five farms at the end of the 1992 pea season. Pea seed (± Apron) was sown in 12cm diameter pots containing sterilized and natural soil. Five plants (cv. Small Seive Freezer) were grown in each pot and rated for disease after 23 days. There were no differences due to Apron seed dressing but major differences between sampling sites. Three farms were rated < 1.0 on a 0-5 scale, while one showed high disease potential (4.8) and one was intermediate (3).

INTRODUCTION Root rot due principally to *Aphanomyces euteiches* is a problem on several farms in the Lockyer Valley. It is favoured by heavy soils and wet conditions. It is a debilitating disease which causes low vigour rather than plant death. No fungicidal treatment or genetic resistance is known but disease avoidance is an option through indexing soils for disease potential. The object of these experiments was to examine two methods of soil indexing using soils from five pea fields in the Lockyer Valley.

EXPERIMENTAL Soil samples from the top 15cm of the profile were collected from five sites. Half the sample was autoclaved on 3 occasions while the other half was in a natural condition. Two experiments were conducted to judge the disease potential of the five soils:

(a) direct comparison of natural and sterile soils
(b) a dilution series of natural and sterile soils mixed together.

(a) The experiment was conducted in a cooled glasshouse at DPI Indooroopilly. Treatments were 5 soils x ± sterilization x ± Apron treated seed x 6 replications. Eight seed (cv. Small Sieve Freezer) were sown in each 12.5cm diameter pot and thinned to 5 per pot after germination. Sowing was done by placing seed on top of the soil and covering with 1cm of vermiculite. Apron was slurry-applied to seed at the rate of 1.5g/kg. Pots were watered once per day and allowed to drain freely. The high moisture holding capacity of the soil obviated the need for saucers under the pots to promote water logged conditions.

After 23 days there were obvious differences in growth between treatments. Plants were washed free of soil and roots rated on a 0-5 scale: 0, no disease; 1, slight symptoms of root browning; 2, roots affected but < 25% damage; 3, 25-50% root loss; 4, 50-75% root loss; 5 > 75% root loss. Estimates of root loss were made by comparison with root systems grown in sterile soil.

Table 1 Severity of root rot in five soils sown with pea seed treated and untreated with Apron seed dressing

Site	Disease Severity (0-5)	
	+ Apron	- Apron
Lerch	0.2	0
Sutton	0.2	0.3
Bourne & Jackwitz	0.6	0.8
Whitehouse	2.7	3.1
Stradling	4.8	4.8
LSD (P = 0.05)	1.12	1.16

These results show the potential for root disease was low at 3 sites (Lerch, Sutton and Bourne & Jackwitz) moderate at Whitehouse and high at Stradling.

(b) In this experiment, sterile soil was mixed with natural soil to give mixtures containing 0%, 25%, 50%, 75% and 100% sterile soil. The experiment was unreplicated. Each plot was a 12.5cm diameter pot with 5 plants of cv. Small Seive Freezer (Apron treated) as in experiment (a). The 2 experiments were run concurrently using similar methods for disease severity rating.

Table 2 Root disease severity in pea plants grown in mixtures of sterile and natural soil from 5 sites.

Site	Disease severity in soil mixtures				
	0% sterile	25% sterile	50% sterile	75% sterile	100% sterile
Lerch	0	0	0	0	0
Sutton	0	0	0	0	0
Bourne & Jackwitz	0.8	1	0	0.2	0
Whitehouse	4.8	4.4	1.8	1.4	0
Stradling	3.6	3.6	1.8	1.4	0

In this experiment there was a low disease index at 3 sites while 2 sites showed high potential. There was no difference in disease index between 0% sterile and 25% sterile and between 50% sterile and 75% sterile. There was less disease at 50 and 75% sterile than at 0 and 25% sterile.

DISCUSSION Both techniques for judging disease index showed promise although for simplicity, the technique in (a) is preferred. The dilution series (Expt b) showed that in soils with a high disease potential, high dilutions (50%) are needed to reduce the disease level. Isolations from dead or severely diseased plants at the end of the trial yielded *Fusarium oxysporum, Fusarium solani* and *Rhizoctonia solani.* Although *Aphanomyces* sp. was not recovered it is considered the late stage of isolations meant only secondary invading organisms were recovered. In future experiments, isolations should be made at an earlier stage from 1 replication to make recovery of *A. enteiches* possible. Rhizoctonia stem lesions were seen in plants from the Lerch and Bourne & Jackwitz sites.

The glasshouse technique needs field verification to ensure results of disease indexing have relevance to disease levels in pea fields. Soils should be indexed from fields where it is intended crops will be grown in 1993 and comparisons made.

ATTACHMENT 6

REPORT

Screening fungicides for control of *Rhizoctonia solani* in beans

R.G. O'Brien

(15 March 1993)

SUMMARY

Field plots with 3 levels of *Rhizoctonia solani* infestation were established at Gatton Research Station. The fungicides tolclofos-methyl (Rizolex) iprodione (Rovral) and CGA173506 were applied as seed dressing and in-furrow spray treatments. Quintozene was used as an in-furrow spray treatment only. A basal seed treatment of metalaxyl (Apron) was included in all treatments except the untreated control. There were few differences in emergence apart from the treatment without metalaxyl seed dressing where stands were greatly reduced, indicating the presence of Pythium damping off. Tolclofos methyl and CGA 173506 and iprodione as seed dressings were reasonably effective in controlling *R. solani*. When applied as in-furrow sprays, tolclofos methyl (250 & 500 g a.i./ha), CGA 173506 (250 g a.i./ha) and quintozene (5 kg a.i./ha) gave excellent control. Iprodione was less effective.

INTRODUCTION

Previous experiments have shown metalaxyl seed dressing (1.5 g/kg Apron 350 SD) gives excellent control of Pythium damping-off. Field experiments with fungicides for use against *R. solani* have been hampered by lack of disease. In this experiment, field plots at Gatton Research Station were infested with 3 levels of *R. solani* to ensure results.

METHODS

A preliminary experiment was conducted in the glasshouse to determine the infestation levels of *R. solani*-infested white millet seed which should be used. Flats containing soil

collected from Gatton Research Station were infested with grain inoculum at rates of 0, 0.5, 1, 2.5, 5 and 10 g/m^2. It was mixed into the top cm of the soil and bean seed sown. The results showed that at 0.5 g/m^2 approximately half the plants had lesions whilst at 1 g/m^2 almost all did. All were affected at 2.5 g/m^2 and above. Infestation rates of 0. 2.5 and 5.0 g/m^2 were selected as infestation rates for the field experiment.

Inoculum was prepared by soaking white millet seed for 16 h then autoclaving and inoculating with cubes of an agar culture of *R. solani* isolate collected from bean. After incubating for 14 days the grain was spread out to dry in a sterile cabinet then stored in a refrigerator until required.

Field plots (3 beds each 1.2 m x 30 m) were prepared 6 weeks before sowing. At infestation the required quantities of grain (0, 2.5 & 5.0 g/m^2) were spread over the surface. Irrigation was then applied. After one week plots were sown with cv. Sinatra. Furrows approx. 3 cm deep were made across the beds and seed sown 5 cm apart. Twenty-two seeds were sown per row. There were four replications of each treatment.

Seed treatments (slurries) were applied the day before sowing. In-furrow row treatments (Table 1) were made after seed was sown and before closing rows. A pressurised spray with fan jet (73011 nozzle/260 kPa) applied a band approx. 5 cm wide centred over the furrow. The volume applied was 274 litres per 20,000 m of row (1 ha). Plots were irrigated immediately after sowing and then at approximately weekly intervals.

Two weeks after sowing, emergence counts were made (plants/plot) and the severity of Rhizoctonia lesions assessed by rating five plants from each plot using the scale. 0, no symptoms; 1, slight-small surface discolouration only; 2, one or two distinct depressed stem lesions; 3, one or more large lesions encircling up to 50% of the stem circumference; 4, up to 75% of stem encircled; 5, >75% encircled. A second rating was not made since there was no apparent change in severity.

The effect of fungicide seed dressings and soil applications on emergence of bean plants and the severity of *Rhizoctonia* stem lesions in beds infested with 3 levels of inoculum of *R. solani*

Treatment*	Population**				Disease severity (0-5)			
	0	Low	High	Means	0	Low	High	Means
a) Water injection								
1. Rizolex 62.5 g a.i./ha	15.75	14.25	14.25	14.750	0	1.15	2.25	1.133
2. Rizolex 125 g a.i./ha	16.50	13.50	15.25	15.083	0	0.45	1.35	0.600
3. Rizolex 250 g a.i./ha	15.75	15.50	16.00	15.750	0	0.15	0.05	0.067
4. Rizolex 500 g a.i./ha	15.75	16.25	12.75	14.917	0	0.05	0.00	0.017
5. CGA 173506 125 g a.i./ha	12.25	13.50	14.00	13.250	0	0.95	1.05	0.667
6. CGA 173506 250 g a.i./ha	10.75	13.00	14.75	12.833	0	0.15	0.60	0.250
7. Rovral 125 g a.i/ha	14.00	11.75	12.25	12.667	0	1.25	2.75	1.333
8. Rovral 250 g a.i/ha	13.25	13.75	13.75	13.583	0	1.10	2.15	1.083
9. Quintozene 5000 g a.i/ha	15.00	13.75	15.25	14.667	0	0.10	0.2	0.100
b) Seed treatment								
10. Rizolex 5 g a.i./kg	15.00	14.75	13.50	14.417	0	0.30	0.6	0.300
11. CGA 173506 5 g a.i./kg	13.50	12.75	13.50	13.250	0	0.20	0.45	0.217
12. Rovral 5 g a.i./kg	15.00	14.00	15.50	14.833	0	1.20	0.60	0.600
13. Check (+ Apron)	16.50	15.50	14.75	15.583	0	1.70	2.80	1.500
14. Check	1.75	5.25	6.25	4.417	0.7	2.19	3.42	1.896
Means***	13.625 a	13.393 a	13.696 a		0.005 x	0.782 y	1.3055 z	
LSD P = 0.05 P = 0.01				1.941 2.565				0.456 0.602

* Apron seed dressing 1.5 g/kg seed applied to treatments 1-13

** Emergence at 14 days from 22 seed per plot

RESULTS

There were no appreciable differences in emergence apart from the untreated (treatment 14) in which populations were very low (Table 1). There were no symptoms of Rhizoctonia in the uninfested bed and disease severity was significantly higher in the more heavily infested bed.

Seed dressings of tolclofos-methyl, CGA173506 and iprodione significantly reduced disease severity.

With the in-furrow applications, increasing dosages of both tolclofos-methyl and CGA 173506 gave improved disease control. Iprodione was significantly less effective. Metalaxyl treated seed (treatment 13) was affected by Rhizoctonia but a comparison with the untreated (treatment 14) showed it was effective against pre-emergence rots due to *Pythium* spp. (emergence of 15 vs approx. 5). The standard treatment of quintozene was effective although seedlings showed signs of root burn. Damage in the form of several "blind" seedlings was noticed in the seed treatment with CGA173506.

DISCUSSION

Disease levels in this experiment were sufficiently high and uniform in the infested beds to provide an adequate test of the treatments. The fungicides tolclofos-methyl and CGA173506 showed high levels of control of stem lesions due to *R. solani* when applied as either seed dressings (5 g a.i./kg) or as in-furrow sprays (250 g a.i./ha). In both cases similar quantities of product were applied on a per hectare basis since 50-70 kg seed is the usual sowing rate. It is possible that the greater surface coverage of a spray may be the more effective method of application for long term control. For CGA173506 it would overcome the slight toxicity problem with the seed dressing treatment.

The high incidence of pre-emergence damping-off in the untreated control demonstrates the importance of *Pythium* spp. in the establishment of bean crops in the Lockyer Valley soils and the efficacy of metalaxyl seed dressing in its control.

CHRONOLOGICAL DATA

Beds infested	19 February 1993
Trial planted	25 February 1993
Disease rating	12 March 1993

ATTACHMENT 7

REPORT

SOIL INDEXING FIVE SOIL SAMPLES FOR THE SEVERITY OF BEETROOT SEEDING DISEASES

R.G. O'Brien
(23/3/93)

SUMMARY

As a measure of the probability of beetroot seedling diseases developing in field crops, five fields were sampled and sown with beetroot seed in a glasshouse experiment. The % survival varied from 4% to 96% with metalaxyl treated seed and from 5% to 75% with untreated seed. Survival was 100% in autoclaved soil. *Pythium* spp. predominated in four samples while *Aphanomyces euteiches* was prevalent in the severely affected soil sample.

INTRODUCTION

Many beetroot crops are affected by poor or uneven stands, particularly during the early part of the season. The main reason is seedling death due to pre- and post-emergence rots caused by fungi such as *Pythium* spp., *Rhizoctonia solani* and *Aphanomyces cochlioides*. Losses are most severe following wet weather. If a method of indexing soil for disease potential were available, it would allow management decisions to be made so that "at risk" soils were not sown when conditions most favour disease. The object of this experiment was to determine whether a glasshouse test was a useful indicator of probable field disease severity.

METHODS

Soil samples were collected from five fields prepared for beetroot growing in the 1993 season. Samples consisted of an amalgamation of several small samples from the 0-15 cm profile collected over areas of about 50 m diameter in each field.

After mixing each sample, sufficient soil to fill 10, 12.5 cm diameter pots was autoclaved to eliminate pathogens.

The experiment consisted of soil from five sites x ± autoclaving x ± metalaxyl treated seed x 5 replications. A plot was a 12.5 cm diameter pot sown with 10 beetroot seed cv. Detroit Short Top. These were sown on top of the soil and covered with a 1 cm layer of vermiculite. Metalaxyl treated seed was slurried with Apron^{R} 2 g/kg. Pots were lightly watered every day after germination.

Plants stands were examined every 2-3 days and records kept of plants as they emerged and dead plants. Several isolations were made from diseased plants as the experiment progressed.

RESULTS

Seedling death commenced soon after seedling emergence. The results of isolations showed these were due most often to *Pythium* spp. but also to *Rhizoctonia solani.* Two weeks after sowing, most deaths were due to *Aphanomyces cochlioides.*

Differences in emergence were small but there were differences in survival between soil samples (Table 1). A high incidence of *A. cochlioides* in the Litzow sample resulted in only 4% survival.

With metalaxyl treated seed, survival at 3 sites was high (87-96%).

DISCUSSION

There was much variability in disease levels between replications of treatments. This is easily explained since there was ample time for disease spread to occur from one seedling to another. Thus, once one or two seedlings became diseased in a pot, others followed giving that pot a high disease rating. This is a short coming of the method and may be overcome by using well mixed, finely ground, smaller soil aliquots with higher replications. Assessment of disease would be on a presence or absence basis in each small sample. Additional variability was provided by the polyembryonic nature of beetroot seed.

Despite these problems, it seems reasonable to predict that even under conditions favourable for disease, plant populations would be adequate at the Brimblecomb (old

J & L) site and the two D. Lerch sites. The Crowley Road site would be more affected while the Litzow site could sustain high losses.

It is proposed to monitor the beetroot crops at these sites when they are sown. Since taking the soil sample, Mr Litzow has fumigated his soil with Vapam since severe losses have occurred in recent crops.

CHRONOLOGICAL DATA

Soil samples collected:	10 February 1993
Experiment sown:	12 February 1993
First seedling losses:	18 February 1993
Experiment terminated:	8 March 1993

Table 1

The survival of beetroot seedlings in natural and sterilized soil taken from five Lockyer Valley beetroot fields

Site	Natural Soil				Sterilised Soil			
	+ Apron		- Apron		+ Apron		- Apron	
	Emerged*	% Surviving	Emerged	% Surviving	Emerged	% Surviving	Emerged	% Surviving
Brimblecomb (Old J & L)	16	96	15.6	73	17.4	100	15.8	100
Brimblecomb (Crowley Rd)	17	55	14.4	64	16.2	100	16.2	100
D. Lerch (Transformer)	15.4	87	14.0	69	19.0	100	16.6	100
D. Lerch (Water hydrant)	14.8	93	15.4	75	16.2	100	17.6	100
E. Litzow	19.2	4	15.4	5	19.0	100	18.4	100
LSD (P = 0.05)	N.S.	40	N.S.	24	N.S.	N.S.	N.S.	N.S.

* Ten seeds were sown per pot but the polyembryonic seed resulted in more seedlings emerging than seed sown.

Appendix to Beetroot Soil Index Experiment

R.G. O'Brien 7 May 1993

At each of the sites where soil samples were taken, an estimate of plant population was made by counting the number of plants in 1 metre of row at five randomly selected locations. Mean figures were

1.	Brimblecomb (old J & L)	23.4
2.	Brimblecomb (Crowley Rd)	41.0
3.	D Lerch (Transformer)	19.2
4.	D Lerch (Water hydrant)	14.5
5.	E Litzow	19.6

The stand was patchy at site 4 and there were a few dead plants still occurring at site 5. Overall stands were satisfactory. Field conditions have been dry and thus not conducive to high seedling losses. Under these conditions there was no correlation between the potential disease indices and field results.

ATTACHMENT 8

EXPERIMENT REPORT

A comparison of metalaxyl seed and soil application with thiram soil application on emergence of beans in Pythium infested soil.

R.G. O'Brien **5/7/94**

Summary

Equivalent rates of Apron applied as seed dressing or water injection gave equal benefits (15%) in survival of bean seed planted in Pythium infested soil. Thiram water injection improved survival by 11%.

Introduction

Previous experiments have shown Apron (metalaxyl 350 g/kg) seed treatment is effective in controlling *Pythium* damping off in beans and Rhizolex (Tolclofos methyl) effective against *Rhizoctonia solani*. The preferred commercial method of application is water injection of fungicides into the seed row. This experiment was designed to compare application of Apron by seed and water injection at the standard seed dressing rate.

Experimental

The experimental site was infested with a culture of *R. solani* grown on sterilised white millet at the rate of 5g/M^2 on 30/4/94. It was scarified into the soil and irrigated.

The trial was sown 5/5/94 using bean cv. Covey. Plots were 2 rows x 5m with 150 seed sown per plot. The Apron seed dressing was applied as a slurry at the rate of 1.5g/kg seed. Water injection treatments of Apron and thiram were applied by a compressed air sprayer with the spray outlet behind the seed shute. The rate of metalaxyl was equivalent to that applied as a seed dressing and delivered at the rate of 660L water per 20,000 m of row. Thiram water injection was used as a standard for comparison.

Emergence counts were made 14 days after sowing and survival counts 28 days after sowing.

Results

All fungicide treatments gave increased plant populations. There was no difference between Apron applied as a seed dressing or as a water injection (Table 1).

Table 1 **The effect of fungicide treatment of seed or soil on emergence of bean seedlings in soil infested with *Pythium spp.***

Treatment	Emergence	
	at shield leaf stage	at 1st trifoliate stage
Apron treated seed (1.5g/kg)	89.1	84.4
Apron water injection g/ha	89.4	86.9
Thiram water injection g/ha	80.0	80.7
Untreated	70.5	69.9
LSD P = 0.05	6.9	6.3

Chronological Data

Trial site infested with Pythium	30/4/94
Trial site sown	5/5/94
1st rating	19/5/94
2nd rating	1/6/94

ATTACHMENT 9

REPORT

WATER INJECTION OF CGA173506, TOLCLOFOS METHYL, IPRODIONE AND QUINTOZENE FOR CONTROL OF *RHIZOCTONIA SOLANI* IN BEANS

R G O'Brien – 15 July 1993

SUMMARY

A field plot at Gatton Research Station was infested with *Rhizoctonia solani* (5 g/m^2 millet seed inoculum) and used to test fungicides for efficacy in controlling pre and post-emergence infection. All treatments significantly improved emergence while tolclofos methyl 500 g a.i./ha showed least disease severity three weeks after sowing. At the second rating (5 weeks), all treatments of tolclofos methyl (62.5, 125, 250 & 500 g a.i./ha), CGA 173506 (250 g a.i./ha) and quintozene (5000 g a.i./ha) had significantly less disease than the control. Iprodione (250 g a.i./ha) was not significantly different from the control.

INTRODUCTION

In a previous experiment (RGO'B, 15/3/93) the fungicides tolclofos methyl (Rizolex) and CGA173506 gave promising results in the control of Rhizoctonia stem rot of beans when applied as water injections to the soil or as seed treatments. Because seed and soil application rates were similar and seed treatments are incompatible with some planting methods, we decided to examine soil treatments in a larger experiment using conventional equipment.

METHODS

A trial site was selected at Gatton Research Station and infested with 5 g/m^2 millet seed inoculum, irrigated and left for five days before sowing.

Seed (cv. Sinatra) was slurry treated with Apron 350 SD (metalaxyl 350 g/kg) at 1.5 g per kg of seed and weighed into lots of 85 seed. Each plot consisted of 2 rows x 5 m,

each row containing 85 seed. Test fungicides were applied by a pressurized spray with fan jet (73011 nozzle, 260 kPa) centred over the open furrow. Rate of application was 275 L per 20 000 m of row (1 ha). The experiment was a randomized blocks design of 11 treatments replicated 4 times.

Three weeks after sowing, total emergence counts were made and the severity of Rhizoctonia lesions assessed by rating 20 plants per plot using the scale: 0, no symptoms; 1, slight surface discoloration; 2, one or two distinct small depressed stem lesions; 3, one or more large lesions encircling up to 50% of the stem circumference; 4, up to 75% of stem encircled; 5, >75% encircled. A second rating (10 plants/plot) was made 5 weeks after sowing.

RESULTS

All treatments showed significantly higher emergence than the untreated control (Table 1). Only two fungicide treatments (tolclofos methyl 62.5 & 250) significantly increased emergence over Apron treated seed (8).

In the first disease severity assessment, several treatments showed low disease levels which were not significantly different from the uninfested control plots. These included tolclofos methyl 125, 250 and 500 g a.i./ha and CGA173506 250 g a.i./ha.

At the second disease assessment, disease symptoms were generally higher. All fungicide treatments, except iprodione 250 g a.i./ha, showed significantly lower disease severity than the controls in infested soil (treatments 8 & 9). The four tolclofos methyl treatments showed a gradation in disease severity from 1.47 to 0.55 with increasing application rates but the differences were not significant. Disease severity in the controls in infested soil was high (2.87 and 3.45 for treatments 8 & 9). The percentage of plants severely affected (scores of 4 or 5) at the second rating are also shown and the disease severity ratings.

DISCUSSION

The severity of stem lesions due to *R. solani* was high and provided the basis for an adequate comparison of the fungicide soil treatments. A low disease incidence was

recorded in the two treatments of uninfested soil (treatments 10 & 11) due either to a natural presence of the disease or contamination from neighbouring plots.

Rhizoctonia did not cause severe pre-emergence problems since all treatments, with the exception of untreated seed-infested soil, showed >80% emergence. The best treatment was Apron treated seed – uninfested soil (92.4%) but all tolclofos methyl treatments and the CGA 173506 treatment were >87%. There is evidence from a comparison of treatments ± Apron (8 & 9; 11 & 10) that Pythium was present causing pre-emergence losses of about 10% in seed without the Apron treatment.

All fungicide soil treatments, except iprodione, were effective in reducing the severity of stem lesions. At the highest rate of tolclofos methyl only 2% of plants were severely affected by lesions compared with 47% in plots sown with Apron treated seed. The standard treatment, quintozene, was effective but rates of application were 20 times higher than for most alternative treatments.

The promising results obtained in this experiment with tolclofos-methyl and CGA173506 support the results in other experiments that these products would be useful in commercial application. Disease levels have been high but treatments of both fungicides at 250 g a.i./ha have consistently reduced losses. This rate of use is suggested as a suitable treatment for commercial application.

R.G. O'Brien

CHRONOLOGICAL DATA

Field plot infested	6 May 1993
Experiment sown	11 May 1993
1st disease assessment	1 June 1993
2nd disease assessment	15 June 1993

Table 1. Emergence of bean seedlings and disease severity ratings due to *R. solani* in plots receiving a range of fungicide treatments

Treatment	% Emergence	Disease severity 0-5		% plants scored
		1/6/93	15/6/93	>4 15/6/93
1. 62.5 g a.i./ha tolclofos methyl	88.9	1.150 b	1.475 b	22
2. 125 g a.i./ha tolclofos methyl	87.0	0.850 bc	1.425 b	22
3. 250 g a.i./ha tolclofos methyl	88.7	0.650 bc	0.800 b	10
4. 500 g a.i./ha tolclofos methyl	87.5	0.312 c	0.550 b	2
5. 250 g a.i./ha iprodione	82.4	1.250 ab	2.675 a	42
6. 250 g a.i./ha CGA 173506	87.8	1.000 bc	1.075 b	12
7. 5000 g a.i./ha quintozene	84.9	1.288 ab	1.500 b	17
8. 1.5 Apron 350 SD/kg seed	81.9	1.975 a	2.875 a	47
9. Untreated seed – infested soil	69.9	1.975 a	3.450 a	55
10. Untreated seed – non-infested soil	82.9	0.412 c	0.925 b	12
11. 1.5 g Apron 350 SD/kg seed – non-infested soil	92.4	0.275 c	0.850 b	12
LSD P = 0.05	6.45	0.731	1.117	27

* This column shows the mean % of plants per treatment which were scored as 4 or 5, i.e. severely diseased, on the 0-5 rating scale