EVALUATION OF FENPICLONIL AS A POTATO SEED TUBER TREATMENT FOR THE CONTROL OF *RHIZOCTONIA SOLANI* AND *HELMINTHOSPORIUM SOLANI*

R.D. WELSH

Ciba-Geigy New Zealand Limited, P O Box 284, Rangiora

ABSTRACT

Fenpiclonil, a phenylpyrrole-based seed treatment fungicide, was evaluated for the control of *Rhizoctonia solani* (stem canker/black scurf) and *Helminthosporium solani* (silver scurf). Treatment of tuber (seed potatoes) with fenpiclonil (50 g/tonne) gave similar levels of control of *R. solani* as toclofos-methyl and benomyl at crop establishment and harvest. Treatments significantly reduced the level of infection compared to untreated control. As a tuber treatment for *H. solani*, fenpiclonil (50 g/tonne) gave significant disease control on tubers harvested a short time after haulm desiccation. There was no difference in disease control where fenpiclonil was used either as a dust or liquid formulation.

Keywords: *Rhizoctonia solani*, *Helminthosporium solani*, fenpiclonil, potatoes

INTRODUCTION

On a global basis, potatoes are a major item of human food consumption. The quality of potato tubers whether for seed, fresh market or processing requires a high marketing standard (R. Wood pers. comm.). The treatment of seeds to control seedborne disease has become standard practice in most arable crops (Jeffs 1978). This has led to an overall improvement in the health of seeds and plants with an increase in crop yield (Salter and West 1990) and enhancement of tuber appearance.

Several diseases affect potato production. *Rhizoctonia solani* (Khun) has been identified as an important pathogen of potatoes in New Zealand (Wilson 1974). This soil-borne fungus causes 'black scurf' on potato tubers and stem canker on stems underground. Severe stem canker can kill shoots and also delay crop emergence. On the surface of infected tubers the fungus forms dark brown to black encrustations; these vary in size and are most obvious on washed tubers. The encrustations (sclerotia) are resting structures that allow the fungus to survive for long periods. This is a significant problem in seed tubers as the sclerotia can act as a source of infection for the new plant.

Silver scurf caused by *Helminthosporium solani* has resulted in serious marketing problems for the fresh pack industry (Shetty *et al.* 1994). The infection spreads in the epiderm (skin) of the potato where it produces characteristic silvery patches that can vary in size from small dots to lesions that almost cover the entire tuber. This disease is widespread in New Zealand and is most important in the long term storage of tubers (R. Genet pers. comm.). Badly affected tubers of both diseases are unsightly with the resulting reduction in the market value of table and seed grade potatoes.

The tuber borne nature of *R. solani* and *H. solani* is an important component of the disease cycle. There is a need for the development of effective treatments to minimise the primary spread of the diseases from seed to progeny tubers (Shetty *et al.* 1994). Fenpiclonil (Beret) is a non-systemic, phenylpyrrole seed treatment fungicide and is effective against seedborne and some soil-borne ascomycetes, basidiomycetes and deuteromycetes (Nevill *et al.* 1988). This paper reports on field trials conducted in Canterbury and South Auckland for the control of *R. solani* and *H. solani* during 1990-1993.

Proc. 49th N.Z. Plant Protection Conf. 1996: 152-156

METHODS

Rhizoctonia solani

Two trials were in the Canterbury region on the cultivar Rua, which is particularly susceptible to *Rhizoctonia solani* probably because of inherently low stem numbers and slow emergence (Genet 1983). Fenpiclonil was compared with the most commonly used chemical treatments, tolclofos (Rizolex) 250 g/tonne and benomyl (Croppars Potato Seed Dust) 200 g/tonne and an untreated. Fenpiclonil treatments were applied at 50 g/tonne for dust and spray formulations and 200-300 g/100 litres for dipping.

All seed tubers carried a moderate to high level of sclerote infection. For dusting, tubers were placed inside a plastic bag, dust added, the bag closed and the shaken for 15 seconds by which time virtually all dust had adhered to the tubers. A fine spray containing fenpiclonil liquid was dispensed through a calibrated hand held atomiser onto tubers spread loosely in trays. The tubers were gently agitated to expose all surfaces to the spray. Upon completion the tubers were entirely dampened, then left to air dry. For dipping treatments, tubers were placed in a net bag lowered into a large container with the respective fenpiclonil mixture and suspended with occasional agitation for 20 seconds before removal and air drying.

Tubers were planted early November 1990 (Wakanui silt loam) and 1991 (Templeton silt loam) on land previously cropped with cereals. Trials were in completely randomised block designs with 6 or 10 replicates in double row plots of twenty plants. Assessment for disease damage, stem and plant number was made on two replicates dug 40 days after planting (1990) and four replicates dug 74 days after planting (1991).

Stem disease incidence was assessed using a specifically designed scoring system for eleven stages of development: 0 = no lesions, 1 = one small lesion, 2 = two small lesions, 3 = substantial lesion covering 30% of circumference, 4 = up to 50% of stem girdled, 5 = lesion affecting 95% of circumference, 6 = total circumference affected without detachment, 7 = separation of the haulm with opportunity to branch, 8 = death of first stem with unaffected regrowth, 9 = new branch with lesion, 10 = death of regrowth.

Four replicates were harvested 140 days after planting (1990) and six replicates 196 days after planting (1991). Washed tubers were assessed for sclerote infection (percentage surface area covered), and were graded into table, seed (50-100 g) or pig (<50g) categories.

Helminthosporium solani

The cultivar Nadine carrying moderate infection was established at two trial sites: trial 3 was at Pukekohe (Patamahoe clay loam), and trial 4 was situated at Lincoln (Templeton silt loam). Since there was no standard treatment, fenpiclonil dust and liquid (50 g/tonne) were compared to untreated. Tubers were treated as described above. Planting commenced in early December 1993. The trials were of a complete randomised block design with six replicates in single row plots of ten plants. The crop was desiccated chemically six weeks prior to harvest at Lincoln, whereas natural senescence occurred at Pukekohe. Assessments for determination of the degree of infection were conducted on washed tubers assessed whilst moist, immediately post harvest.

All data were statistically analysed by ANOVA and percentage data transformed ($\sqrt{X+1}$). Results are reported as untransformed means.

RESULTS

Rhizoctonia solani

In Trial 1, emergence was similar for all treatments and at 74 days after planting there was no significant difference in the number of plants and stems. Sclerote infection of the tubers at harvest (Table 1) from *R. solani* was significantly less ($P<0.05$) in the fenpiclonil and tolclofos treatments when compared with untreated. There was no significant difference ($P>0.05$) between treatments in the yield of potatoes (data not presented).

In Trial 2, plant and stem counts 41 days after planting showed that all treatments had 100% emergence but low stem numbers were recorded. The tolclofos treated potatoes had significantly lower numbers of stems per plant ($P<0.01$) than untreated, fenpiclonil or benomyl treatments. Fenpiclonil dip (300 g) had significantly higher numbers of stems per plant ($P<0.05$) when compared with untreated, fenpiclonil spray /dust or benomyl treated potatoes.

Stem infection by *R. solani* decreased in all fungicide treatments compared with untreated ($P<0.05$). There was no difference between the fenpiclonil treatments in the level of stem infection. Tolclofos treatments had noticeably lower numbers of stems infected than the fenpiclonil treatments while the benomyl treatment had considerably higher ($P<0.05$) numbers of stems infected than the fenpiclonil or tolclofos treatments. All treatments decreased the main stem disease score compared with untreated ($P<0.01$). The benomyl treatments had a higher disease score ($P<0.01$) than fenpiclonil or tolclofos treatments.

Table grade potato yields at harvest were not significantly different from untreated. The tolclofos treatment had lower seed grade yield ($P<0.05$) compared with untreated or fenpiclonil treatments. Classification for table and seed grade potatoes was on the basis of weight not disease infection. Total yields were significantly lower ($P<0.01$) in the benomyl and tolclofos treatments compared with untreated. There was no significant difference ($P<0.05$) between the fenpiclonil treatments and untreated.

Sclerote infection from *R. solani* decreased in the fenpiclonil and tolclofos treatments, while the benomyl treatment had noticeably higher sclerote infection compared with untreated. Fenpiclonil treated tubers gave similar *R. solani* control to the standard tolclofos at establishment and harvest but was superior to benomyl. There were no significant differences between the three methods of applying fenpiclonil to tubers.

TABLE 1: Incidence of *Rhizoctonia solani* on potato stems and final yield of potatoes at harvest resulting from different seed tuber treatments.

Treatment (g ai/tonne)	Form.	Establishment			Harvest			% No. tubers with sclerotes
		Mean number of stems/ plant	% number of stems infected/ plant	Stem disease score	Table grade (t/ha)	Seed grade (t/ha)	Total yield (t/ha)	
Trial 1 (1991)								
fenpiclonil (50)	dust	1.6						4.5
tolclofos (250)	dust	1.8						2.0
untreated	-	1.7						74.1
LSD _{0.05}		0.5						7.0
Trial 2 (1992)								
fenpiclonil (50)	spray	1.65	32.6	0.62	30.7	6.3	37.0	15.5
fenpiclonil (50)	dust	1.55	34.2	0.53	28.4	6.3	34.7	16.0
fenpiclonil (200) ¹	dip	1.75	34.2	0.55	29.2	7.7	36.9	24.0
fenpiclonil (300) ¹	dip	1.89	38.4	0.67	31.6	6.0	37.6	9.0
benomyl (200)	dust	1.61	48.8	1.33	28.1	4.6	32.7	62.0
tolclofos (250)	dust	1.16	23.7	0.42	28.0	3.3	31.3	2.0
untreated	-	1.59	63.9	2.50	31.3	5.8	37.1	27.5
LSD _{0.05}		0.22	12.1	0.22	4.3	1.8	3.3	28.9
LSD _{0.01}		0.30	18.3	0.34	5.9	2.5	4.5	39.8

¹ g ai/100 litres

Helminthosporium solani

As a seed treatment, fenpiclonil significantly reduced the incidence and severity of *H. solani* infection on the table grade potatoes at harvest (Table 2). Both formulations of fenpiclonil gave a similarly high level of control in the resultant potato crop following treatment of tubers that had a moderate-heavy infection. Untreated tubers were slow to emerge, though eventually all treatments showed equivalent growth. The total number or weight of table and seed grade potatoes (data not presented) showed no significant difference between treatments. There was no evidence of *R. solani* on the seed or the tubers at harvest.

TABLE 2: Mean percentage number of tubers in each area infection category¹ and mean number of table grade tubers infected with *H. solani*.

Treatment	Form	Area infection category						Mean number of table grade infected (%)
		0	<5	<10	<20	<40	<60	
Trial 3								
fenpiclonil (50) ²	dust	98.4	0.3	0.6	0.7	-	-	
fenpiclonil (50)	spray	98.0	0.7	0.4	0.9	-	-	
untreated	-	90.1	5.3	1.9	2.2	0.5		
Trial 4								
fenpiclonil (50)	dust	98.5	1.5	-	-	-	-	1.32 b ³
fenpiclonil (50)	spray	95.1	4.9	-	-	-	-	3.57 b
untreated	-	61.5	22.6	7.8	3.2	4.2	0.7	25.12 a

¹ Percentage surface area covered with sclerotes

² g ai/tonne

³ means followed by same letters are not significantly different (P=0.05)

DISCUSSION

Rhizoctonia solani was present in the trials as observed by >63% of the stems showing signs of infection in untreated plots. Fenpiclonil was generally equivalent to tolclofos for the control of *R. solani*. Except for benomyl, fungicide treatments had lower tuber infection by *R. solani* at harvest than untreated. Plant establishment assessments showed that the fenpiclonil (50 g/tonne) reduced the level of *R. solani* infection compared with untreated. There was no difference between the methods of applying fenpiclonil. The high incidence of infection in untreated indicates the importance of the disease in the establishment of potato crops.

Emergence was excellent for a Rua crop (R. Genet pers. comm.). Dipping tubers does involve a risk of encouraging rotting organisms and reducing plant numbers (Wright and Anderson 1992). Tubers were air dried before planting, therefore minimising the risk of tuber rot.

Silver scurf is generally considered a tuber-borne disease, there being no evidence that it can persist in the soil or that there is an alternative host (Secor and Gudmestad 1994). Observations indicate that new and increased silver scurf infections may occur during long periods of storage whether in the ground after haulm desiccation or within in-shed storage systems. Trials indicated that significant control of silver scurf is achievable using fenpiclonil (50 g/tonne) as a seed treatment dust or spray before planting.

Although fenpiclonil treatments tended to have higher yields of seed potatoes, assessments at harvest showed no significant increase in yield with any fungicide treatment.

ACKNOWLEDGEMENTS

Russel Genet and Fred Braam for their assistance and to the growers who facilitated the trial work on their properties.

REFERENCES

- Genet, R.A., 1983. Report on a survey of Rua seed potatoes. *Report No. 83*. Crop Research Division. DSIR.
- Jeffs, K.A., 1978. A brief history of seed treatment. *CIPAC Monograph 2*. Seed Treatment 1978, 1-3.
- Nevill, D., Nyfeler, R. and Sozzi, D., 1988. CGA142705: A novel fungicide for seed treatment. *Proc. British Crop Prot. Conf.*: 65-72.
- Salter, W.J. and West, S.J.E., 1990. Control of seedborne diseases using fenpiclonil based seed treatments in the UK: *Proc. Crop Prot. in Northern Britain*: 19-24.
- Secor, G.A. and Gudmestad N.C., 1994. Post-harvest diseases - dry rot, silver scurf; Report by Plant Pathology Dept., North Dakota State University. *Valley Potato Grower*: 16-18
- Shetty, K.K., Frazier, M.J., Kleinkopf, G.E. and Nolte, P., 1994. Recent research information on silver scurf control under Idaho potato production and storage conditions. Pres. 26th Annual Idaho Potato School. Masters Thesis, University of Idaho.
- Wilson, G.J., 1974. *Rhizoctonia solani* control and effect on potato yields. *N.Z. J. Exp. Agr.* 2: 265-7.
- Wright, P.J. and Anderson, J.A.D., 1992. Potatoes: Reducing bacterial soft rot diseases in the field and in storage. *CropSeed Bulletin No. 1*. N.Z. Inst. Crop & Food Research.