Effects of Herbicides Applied to Soil on Fusarium Root Rot of Processing Peas

H. W. JOHNSTON, Plant Pathologist, J. A. IVANY, Weed Scientist, and J. A. CUTCLIFFE, Horticulturist, Agriculture Canada, Research Station, Charlottetown, Prince Edward Island, Canada C1A 7M8

ABSTRACT

JOHNSTON, H. W., J. A. IVANY, and J. A. CUTCLIFFE. 1980. Effects of herbicides applied to soil on Fusarium root rot of processing peas. Plant Disease 64:942-943.

The herbicides trifluralin, ethalfluralin, dinitramine, and dinoseb were examined for their influence on pea root rot incited by a *Fusarium* complex. Although root rot severity was reduced in greenhouse trials, yield was not increased in greenhouse or field trials, and reductions in root rot were not evident in field trials. Under commercial conditions, these herbicides are unlikely to reduce pea root rot and improve yields where similar *Fusarium* spp. are present.

The influence of herbicides applied to soil on root or soilborne diseases of plants has received attention for some crops (1). Root rots of processing peas are among the diseases that are altered in severity by herbicides, but influences differ depending on the herbicide and pathogen (6,8). The frequently occurring pea root rot incited by *Aphanomyces euteiches* Drechs. has been reduced in severity by herbicides, especially trifluralin and dinitramine (3,4), applied to soil, but little information is available on effects on root rots caused by other pathogens such as the Fusaria.

In Canada, and Prince Edward Island in particular, pea root rot is caused by a complex of pathogens. *Fusarium solani* (Mart.) Appel & Wr. f. *pisi* (Linf.) emend. Snyd. & Hans. and *Fusarium oxysporum* Schlecht. f. *pisi* Snyd. are the major incitants, but species of *Ascochyta* and *Rhizoctonia* may be involved (2,5). Long rotations tend to be impractical, and other controls are largely ineffective. In recent years, local growers have begun to apply several herbicides to soil, not only for weed control but also because of an unconfirmed belief in a secondary controlling effect on root rot.

The purpose of our study was to determine if selected herbicides would reduce the severity of the pea root rot incited by *Fusarium* spp. and thereby provide an additional method of disease control.

Charlottetown Research Station, Contribution 436.

MATERIALS AND METHODS

Soil for the greenhouse experiments was collected from Prince Edward Island fields with a history of pea root rot. Field trials were done at sites where root rot had been detected previously. The cultivar Dark Skin Perfection was used for all tests. The herbicides were trifluralin, ethalfluralin, dinitramine, and dinoseb.

For greenhouse trials, herbicides were calculated for 2.24×10^6 kg of soil per hectare. Pots, 15 cm high, were filled to 6 cm from the top with untreated soil. Herbicides were applied before planting (ppi) by spraying a greenhouse flat, filled with soil to a depth of 7 cm, at a fixed distance below the nozzle. This treated soil was thoroughly mixed and then used to fill the pots. The pea seeds were planted 5 cm below the soil surface. Dinoseb was applied before emergence (pre) by filling the pots with untreated soil and then spraying the soil surface after seeding.

Field trial sites were prepared by using standard farm equipment. The herbicides, in 300 L of water per hectare, were applied with a CO_2 backpack sprayer delivering 425 kg/cm^2 pressure to 1×4 m plots arranged in randomized blocks. Incorporation was by double disking the treated plots. All herbicides were applied at the rates indicated in Tables 1 and 2.

Root rot severity was indexed on a 1–4 scale representing healthy and slightly,

Table 1. Influence of herbicides applied to soil (in greenhouse) on pea growth and root rot severity

Treatment[w]	Rate (kg a.i./ha)	Percent emergence	Dry weight (g/pot)			Root rot index[x]
			Tops	Roots	Seed	
			1977			
Trifluralin, ppi	1.0	76 a[y]	10.66 a	3.56 a	1.87 a	1.5 bc
Ethalfluralin, ppi	1.0	73 a	9.35 a	2.74 a	1.35 a	1.6 bc
Dinitramine, ppi	0.55	71 a	10.63 a	3.26 a	1.64 a	2.0 b
Dinoseb, pre	4.0	72 a	9.61 a	2.03 a	1.72 a	2.3 b
Check	0.0	76 a	9.08 a	2.63 a	1.56 a	3.3 a
Check	Sterile soil	68 a	...[z]	...	...	1.0 c
			1978			
Trifluralin, ppi	0.8	41 c	11.60 abc	5.95 a	2.47 bc	2.5 d
	1.0	56 b	10.70 abc	5.95 a	3.42 a	3.0 bcd
	1.5	43 c	12.25 ab	6.05 a	2.46 bc	2.5 d
Ethalfluralin, ppi	0.8	52 b	12.25 ab	6.90 a	2.96 ab	2.8 cd
	1.0	55 b	11.15 abc	6.30 a	3.10 ab	2.8 cd
	1.5	45 c	9.30 bcd	5.25 a	1.87 cd	2.5 d
Dinitramine, ppi	0.55	45 c	10.85 abc	5.50 a	2.36 bc	3.3 b
	0.8	61 b	8.35 cd	5.00 a	1.67 cd	4.0 a
	1.0	48 b	9.00 bcd	5.10 a	1.82 cd	3.5 ab
Dinoseb, pre	4.0	55 b	6.95 d	3.70 a	1.58 cd	2.8 cd
Check	0.0	51 b	10.00 bcd	5.90 a	2.91 ab	3.5 ab
Check	Sterile soil	88 a	13.60 a	6.10 a	1.19 d	1.0 e

[w] ppi = preplant incorporation, pre = preemergence application.

[x] Root rot index: 1 = healthy, 4 = severe rot.

[y] Values in each column (by year) followed by the same letter are not significantly different according to Duncan's multiple range test ($P = 0.05$).

[z] Not recorded because of poor growth.

Table 2. Influence of herbicides applied to soil in field on yield and root rot severity of processing peas

Treatment[x]	Rate (kg a.i./ha)	1977 Dry seed yield (g/plant)	1977 Root rot index[y]	1978 Dry seed yield (kg/plot)	1978 Root rot index[y]
Trifluralin, ppi	0.80	0.91 a[z]	3.2 a	1.11 a	4.0 a
	1.12	0.86 a	3.0 a	1.09 a	4.0 a
Ethalfluralin, ppi	0.80	1.14 a	3.2 a	1.17 a	4.0 a
	1.12	0.96 a	3.2 a	1.09 a	4.0 a
Dinitramine, ppi	0.55	0.88 a	3.3 a	1.03 a	4.0 a
	0.80	1.13 a	3.2 a	1.09 a	3.7 a
Dinoseb					
ppi	4.0	0.94 a	3.2 a	1.04 a	3.5 a
pre	4.0	1.09 a	3.0 a	1.09 a	3.0 a
Check	0.0	0.36 b	3.4 a	1.15 a	3.5 a

[x] ppi = preplant incorporation, pre = preemergence application.
[y] Root rot index: 1 = healthy, 4 = severe rot.
[z] Values (by column) followed by the same letter are not significantly different (Duncan's multiple range test, $P = 0.05$).

moderately, or severely infected plants. Healthy plants were those with no root discoloration; severely infected roots were uniformly blackened. A sterile (autoclaved) soil check was used to ensure production of healthy roots for greenhouse trials.

RESULTS AND DISCUSSION

Root rot symptoms differed in severity between greenhouse and field grown peas, but *Fusarium* spp. were isolated from infected roots from both tests. Greenhouse plants grown in unsterilized soil exhibited general discoloration or darkening of all roots; roots from the field trials were blackened and stunting was widespread. Herbicidal influences on root rot were evident in the 1977 greenhouse trial, where trifluralin and ethalfluralin reduced root symptoms to a level similar to that exhibited by the sterile soil check (Table 1). Dinitramine and dinoseb reduced root rot levels less than either trifluralin or ethalfluralin. However, these herbicides did not influence either emergence or the yield of the plants as reflected by both dry weight of vegetative material and of seeds.

A greenhouse trial with additional treatment rates in 1978 gave evidence for the use of herbicides to reduce root rot, except that dinitramine failed to decrease disease severity. Trifluralin and ethalfluralin reduced the root rot index most in this second test. Emergence was decreased by all herbicides (except dinoseb) at one or more rates in unsterilized soil. Vegetative top and root dry weights were not improved by the use of herbicides nor was seed yield increased above the unsterilized check. The use of a sterile soil check allowed a higher rate of emergence, cleaner roots, and improved top weights, but neither root dry weight nor seed yield was improved, compared with other treatments.

Field trials in 1977 and 1978 did not show reductions in root rot when the plants were examined at harvest (Table 2). Yields were not influenced in 1978 by herbicides but were reduced in 1977 in the check plots. This reduction was attributed to excessive weed growth in check plots. Weed competition was not present in the 1978 trial when a different site with a very low weed population was used.

Soil interactions, pH, temperature, and host species are some factors that may alter the influence of herbicides on *Fusarium* root rots (7,8). Such may be the case here, where root rot control was suggested by greenhouse studies but not in the field under normal crop production conditions. Fungal pathogens may also differ in their response to herbicides. Grau and Reiling (3) reported that trifluralin and dinitramine reduced pea root rot. Harvey et al (4) also found that trifluralin reduced pea root rot in field tests, but they were dealing with a complex in which *A. euteiches* was the primary pathogen. This differs from the Prince Edward Island situation, where *Fusarium* spp. are the primary pathogens (2,5). From our tests, we conclude that these herbicides are unlikely to reduce pea root rot and increase yields in Prince Edward Island or other areas where a similar *Fusarium* complex may be responsible for root rot.

ACKNOWLEDGMENTS

We gratefully acknowledge the technical assistance of C. Mullin, G. Lewis, L. Arsenault, J. Baldwin, and R. Peters.

LITERATURE CITED

1. ALTMAN, J., and C. L. CAMPBELL. 1977. Effect of herbicides on plant diseases. Annu. Rev. Phytopathol. 15:361-385.
2. BASU, P. K., N. J. BROWN, R. CRETE, C. O. GOURLEY, H. W. JOHNSTON, H. S. PEPPIN, and W. L. SEAMAN. 1976. Yield loss conversion factors for Fusarium root rot of pea. Can. Plant Dis. Surv. 56:25-32.
3. GRAU, C. R., and T. P. REILING. 1977. Effect of trifluralin and dinitramine on Aphanomyces root rot of pea. Phytopathology 67:273-276.
4. HARVEY, R. G., D. J. HAGEDORN, and R. L. DeLOUGHERY. 1975. Influence of herbicides on root rot in processing peas. Crop Sci. 15:67-71.
5. JOHNSTON, H. W., and J. A. CUTCLIFFE. 1969. Root rot of peas in Prince Edward Island in 1969. Can. Plant Dis. Surv. 49:140.
6. PERCICH, J. A., and J. L. LOCKWOOD. 1975. Influence of atrazine on the severity of Fusarium root rot in pea and corn. Phytopathology 65:154-159.
7. RICHARDSON, L. T. 1959. Effect of insecticides and herbicides applied to soil on the development of plant diseases. II. Early blight and Fusarium wilt of tomato. Can. J. Plant Sci. 39:30-38.
8. WYSE, D. L., W. F. MEGGITT, and D. PENNER. 1976. Effect of herbicides on the development of root rot on navy bean. Weed Sci. 24:11-15.