Herbicide Suppression of Bean Root and Hypocotyl Rot in Wisconsin

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ABSTRACT

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Root and hypocotyl rot of bean (*Phaseolus vulgaris*) was suppressed significantly by preplant incorporation of the herbicide dinoseb at the rate of 6.7 kg/ha as indicated by disease severity reductions and yield increases. Other treatments using dinoseb at 10.1 kg/ha and at the lower rate in combination with trifluralin were also effective, but treatments with trifluralin alone were not as beneficial.

An important factor in the production of processing beans (*Phaseolus vulgaris* L.) in Wisconsin's irrigated Central Sands is a root and hypocotyl rot incited by *Pythium* spp., *Fusarium solani* (Mart.) Appel & Wr. f. sp. *phaseoli* (Burk.) Snyd. & Hans., and *Rhizoctonia solani* Kühn. Recent studies have indicated that the primary pathogen is *Pythium ultimum* Trow (6) and that *Aphanomyces euteiches* f. sp. *phaseoli* is also important (5). Control is difficult because there are no suitable highly resistant cultivars, approved fungicides are not sufficiently effective, and bean growers have been hesitant to practice adequate crop rotation because the choice of other economically promising crops is limited.

The use of herbicides to suppress plant diseases has been researched with success, especially during the last 15 yr (1,3,10). Pea (*Pisum sativum* L.) researchers at the University of Wisconsin have demonstrated beneficial results using dinitroaniline herbicides to suppress the effects of *A. euteiches*, incitant of pea common root rot (11–13). These promising results, plus the continued economic losses due to bean root and hypocotyl rot, prompted us to undertake the studies reported here. A preliminary report has been published (4).

MATERIALS AND METHODS

The 1977–1979 research plots were located in a highly infested field on the University of Wisconsin Experimental Farm, Hancock, in the Central Sands irrigated agriculture area. The bean cultivar Early Gallatin, kindly supplied by the Gallatin Valley Seed Co., was used exclusively. Four replicates of the following six treatments were used: no herbicide; dinoseb (also called DNBP or dinitro) at 6.7 and 10.1 kg ai/ha; trifluralin at 0.6 and 0.8 kg ai/ha; and trifluralin at 0.6 + dinoseb at 6.7 kg ai/ha. A randomized complete block design was used.

The treatments were broadcast-sprayed on the soil surface and immediately incorporated preplant to a depth of 10 cm by using a double disk. Individual treatments were 3.9 m wide by 6.2 m long and contained four single bean rows. The beans were planted 3 cm deep at 95 kg/ha with a commercial-type bean planter that also applied 6-24-24 granular fertilizer at 135 kg/ha 5.5 cm below and 5.5 cm to the side of the seed. When the bean plants were in the early bloom stage, they were given an additional application of nitrogen at 84 kg/ha. The plot was overhead irrigated as needed.

The plot was carefully laid out and located within a prescribed area in 1977 so that each individual treatment area in 1978 and 1979 was identical to the original (1977). The plot was hand-weeded to negate any effect weeds might have on yield.

When the plants were at the full-bloom stage, 50 plants were dug at random from the two outside rows of each treatment. They were washed and the severity of the root and hypocotyl rot on each plant was recorded, after which a disease index was calculated for the treatment according to the system described by Sherwood and Hagedorn (8). Yield data were obtained by picking the pods from the two inner rows using a commercial-type, two-row, mechanical bean picker. This harvest took place when the pods were at prime green harvest stage—no more than 50% of the pods were size 5 or larger.

RESULTS

Table 1 summarizes the results obtained in all experiments and indicates the statistical significance of the data. A reduction in the disease severity index was obtained the first year (1977) by applying dinoseb. All three treatments with this chemical alone or in combination significantly reduced the effects of the disease compared with the control (no herbicide). The two trifluralin treatments had no effect on disease index. There was no statistically significant difference in yield among treatments in 1977, although a much better yield was obtained with the low rate of trifluralin.

The treatments using dinoseb were again effective in suppressing the disease in 1978. On the average, they lowered the disease index 28.7 points. The two trifluralin treatments also significantly reduced the disease index, but only by 13.3 points. Yields were significantly improved by all of the dinoseb treatments in 1978, with increases of 259, 308, and 309% recorded for the low, high, and combination treatments, respectively. On the other hand, only the high rate of trifluralin gave a significant, but less striking, yield increase of 142%.

Table 1. Suppression of bean root and hypocotyl rot by trifluralin and dinoseb

		1977		1978		1979	
Treatment	Rate (kg/ha)[a]	Disease index[b]	Yield (kg/ha)	Disease index	Yield (kg/ha)	Disease index	Yield (kg/ha)
Trifluralin	0.6	48.3	5,615	54.0	1,710	46	327
Trifluralin	0.8	53.0	4,883	52.8	2,360	44	269
Dinoseb	6.7	39.5	4,721	39.3	3,500	32	409
Dinoseb	10.1	33.3	4,151	38.5	3,982	39	650
Dinoseb +	6.7						
trifluralin	0.6	38.5	3,580	36.3	3,987	31	630
No herbicide	···	49.0	3,662	66.7	976	55	71
Means		43.6	4,435	47.9	2,753	41	393
LSD (0.05)		8.7	NS	7.7	839	18	299

[a] Preplant incorporated.
[b] 100 = All plants dead, 0 = all plants healthy.

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There was unusually high disease pressure in 1979, especially at the beginning of the growing season. As a result, the original adequate plant stand was reduced, and plants of normal vigor were rare even in the best treatments. This resulted in great overall reductions of yield but not in the disease index data, which were taken on the surviving plants just before blossom. For the third season, treatments with dinoseb showed the greatest suppression of disease severity compared with the control and trifluralin treatments. Significantly superior yields averaging an increase of 793% were also obtained by those treatments containing dinoseb, whereas trifluralin treatments did not increase yield significantly.

DISCUSSION

These are the first data that show positive results from research on the chemical control or suppression of the important bean root and hypocotyl rot as it is known in Wisconsin's Central Sands area. Teasdale et al (11–13) indicated the value of trifluralin and other dinitroanilines on the suppression of Aphanomyces root rot disease of pea in heavier Wisconsin soils. However, in our study dinoseb was clearly superior to trifluralin for the suppression of bean root and hypocotyl rot.

The severe disease development in 1979 was not properly shown in the disease index data for that year because by the time plants were dug and graded for disease severity, almost all of the severely diseased plants had succumbed to the disease. The plants remaining just before bloom stage, when the severity data were taken, were generally moderately diseased, and thus the true picture of the severe disease situation that had existed was not given. The poor yields obtained portrayed the real story more accurately.

Our results did not agree with those of Sumner (9), who found that trifluralin + dinoseb reduced plant growth and increased damping-off of snap beans in soils infested with *Pythium myriotylum.* This fungus was a pathogen present in our Hancock plots. This discrepancy could have occurred because of differences in herbicide combinations used and because Sumner's experiments were performed in the greenhouse. Also in contrast to our studies, Wyse et al (14) found that the herbicide *S*-ethyl dipropylthiocarbamate (EPTC) increased navy bean root rot, especially at temperatures unfavorable for plant growth and at high pathogen inoculum levels. Romig and Sasser (7), using in vitro tests, found that snap beans grown in soil treated with trifluralin or dinoseb had more and larger *R. solani* hypocotyl lesions than did beans grown without herbicide. Sumner et al (10) reported that these same herbicides in combination "occasionally reduced but never increased" snap bean root rot severity, the most common fungi isolated from diseased plants being *Pythium* spp., *R. solani*, and *F. solani.* Garren (2) found that peanuts (*Arachis hypogaea*) showed a significant decrease in infection by *Sclerotium rolfsii* Sacc. 2 yr out of 3 in dinoseb-treated plots.

These conflicting results point up the importance of performing such experimentation in the field for several years to experience the effect of a range of weather conditions. Differences in soil type, culture practices (including fertilization), and cultivar susceptibility can also influence root disease severity and yield. Some discrepancies in results can also be explained by differences in the kind and amounts of the pathogens involved.

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LITERATURE CITED

1. Altman, J., and Campbell, C. L. 1977. Effects of herbicides on plant diseases. Annu. Rev. Phytopathol. 15:361-385.
2. Garren, K. H. 1959. An evaluation of role of dinoseb in "non-dirting" control of peanut stem rot. Plant Dis. Rep. 43:665-667.
3. Grinstein, A., Katan, J., and Eshel, Y. 1976. Effect of dinitroaniline herbicides on plant resistance to soilborne pathogens. Phytopathology 66:517-522.
4. Hagedorn, D. J., Binning, L. K., and Rand, R. E. 1979. Effect of herbicides on Wisconsin's bean root rot complex. Phytopathology 69:1029-1030.
5. Pfender, W. F., and Hagedorn, D. J. 1982. *Aphanomyces euteiches* f. sp. *phaseoli*, a causal agent of bean root and hypocotyl rot. Phytopathology 72:306-310.
6. Reeleder, R. D., and Hagedorn, D. J. 1980. Effect of *Pythium* populations on severity of bean root rot in Wisconsin. (Abstr.) Phytopathology 71:251.
7. Romig, W. R., and Sasser, M. 1972. Herbicide predisposition of snapbeans to *Rhizoctonia solani.* Phytopathology 62:785-786.
8. Sherwood, R. T., and Hagedorn, D. J. 1958. Determining the common root rot potential of pea fields. Wis. Agric. Exp. Stn. Bull. 531. 12 pp.
9. Sumner, D. R. 1974. Interactions of herbicides and nematicides with root disease of snapbean and southern pea. Phytopathology 64:1353-1358.
10. Sumner, D. R., Johnson, A. W., Glaze, N. C., and Dowler, C. C. 1978. Root diseases of snapbean and southern pea in intensive cropping systems. Phytopathology 68:955-961.
11. Teasdale, J. R., Harvey, R. G., and Hagedorn, D. J. 1978. Suppression of pea root rot by dinitroaniline herbicides. Weed Sci. 26:609-613.
12. Teasdale, J. R., Harvey, R. G., and Hagedorn, D. J. 1979. Mechanism for the suppression of pea (*Pisum sativum*) root rot by dinitroaniline herbicides. Weed Sci. 27:195-201.
13. Teasdale, J. R., Harvey, R. G., and Hagedorn, D. J. 1979. Factors affecting suppression of pea (*Pisum sativum*) root rot (*Aphanomyces euteiches*) by dinitroaniline herbicides. Weed Sci. 27:467-472.
14. Wyse, D. L., Meggitt, W. F., and Penner, D. 1976. Effect of herbicides on the development of root rot on navy beans. Weed Sci. 24:11-15.