Control of Cercospora Leaf Spot of Sugarbeet Through Aerial Application of Systemic and Surface-Protecting Fungicides[1, 2]

C. L. SCHNEIDER, H. S. POTTER, AND F. B. RUSSELL[3]

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Leaf spot incited by *Cercospora beticola* Sacc. is often destructive in the North Central sugarbeet growing area of the United States where high summer temperatures and humidity favor development of the disease. Sugarbeet varieties with improved Cercospora resistance are by no means immune to the disease. The probability of reducing or avoiding leaf spot damage is increased, therefore, if control measures include an appropriate fungicide spray program and the use of Cercospora resistant varieties (2,6)[4].

Application of fungicides by aircraft offers advantages over ground application for control of foliage diseases. Aerial spraying is inherently much faster than ground spraying. Furthermore, when fields are wet, preventing use of ground equipment, aerial spraying avoids delay and eliminates plant damage and soil compaction which often adversely affect yield.

A disadvantage of aerial application, in comparison with high-volume ground application, is the increased difficulty in confining the chemical to the target area. Consequently, aerial spraying must be restricted to circumstances where environmental damage can be avoided.

In evaluating leaf spot severity in several sugarbeet fields in Austria, Zwatz showed the biological effect of aerial spraying equal to the effect achieved with ground equipment (8). Several investigators in the United States have reported effective control of the disease by aircraft (1,4,5,7). Calpouzos et al. obtained better control with ground equipment than with helicopter, yet the helicopter application was economically justified when compared to the unsprayed check (1).

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[2] Mention of a trade mark or proprietary product does not constitute a guarantee or warranty of the product by the United States Department of Agriculture, and does not imply its approval to the exclusion of other products that may also be suitable.

[3] Plant Pathologist, Plant Science Research Division, Agricultural Research Service, U. S. Department of Agriculture, East Lansing, Michigan; Plant Pathologist, Department of Botany and Plant Pathology, Michigan State University, East Lansing, Michigan; and Research Agronomist, Buckeye Sugars, Inc., Ottawa, Ohio.

[4] Numbers in parentheses refer to literature cited.

Our paper describes an aerial spray test on sugarbeets conducted in Ohio in 1970 with systemic and surface-protective fungicides that had recently been released for use on sugarbeet. At that time, information was lacking concerning the efficacy of these fungicides applied in low volume aerially under conditions favoring severe disease.

Methods and Materials

The test was conducted on an 80 acre field of sugarbeet variety U.S. H 20 in Putnam County, Ohio. The fungicides used were triphenyl tin hydroxide (47.5% WP); cupric hydroxide (56% metallic copper equivalent); cupric hydroxide in oil and emulsifiers (13.7% metallic copper equivalent); and thiabendazole (60% WP). Thiabendazole is a systemic fungicide, whereas the other compounds are surface protectants.

Each treatment was applied to plots 2385 ft long and 105 ft wide (approx. 5¾ acres), five times on a 14-day schedule beginning July 24. Two replications were used.

The fixed wing aircraft that applied the treatments was equipped with a 40 ft boom and diaphram-type hollow cone nozzles. Spraying was done with a pump pressure of 30 psi and at an average air speed of 90 mph. All treatments were applied at 5 gal per acre, except cupric hydroxide in oil and emulsifiers which was applied at 1 gal per acre without water. The 5 gal rate required 44 nozzles with D-8 orifices and the 1 gal rate 22 nozzles with D-4 orifices. All nozzles were furnished with #45 cores.

The aircraft was operated with the boom from 4 to 6 ft above the crop. To increase the likelihood of confining the chemicals to the target area, sprays were applied when meteorological conditions permitted good deposition with minimal drift. Three passes with the aircraft gave uniform coverage within a plot. The closely spaced droplet pattern on lower leaves indicated that spray penetration to all foliage levels was adequate.

First symptoms of leaf spot were not obvious until mid-August when the weather became warm, wet, and humid. These conditions, favorable to disease development, persisted into early October. By the third week in September all plants in unsprayed control plots showed symptoms.

Disease severity ratings based on an index ranging from 0 (no symptoms) to 9 (complete defoliation) were made on September 21 and 30. The ratings were based on observations of 100 consecutive plants in each of 10 transections spaced approximately 200 ft apart, and confined to the center 15 rows of each plot.

Yield data are based on the weight of roots harvested in the three center rows of each plot representing approximately 7% of the plot area. A 25-lb sample of beets for sugar analysis was obtained from the center of the load from each plot after it had passed the grab-roll screen. Determinations of percent sucrose, clear juice purity and white sugar per ton of beets were performed by the Michigan Sugar Company, Carrolton, Michigan in accordance with the method described by Dexter et al. (3).

Results

The disease ratings presented in Table 1 were made on September 30 when disease intensity was near its peak. The average disease ratings of the control plots almost doubled between the dates of the two reading but those of the treated plots remained essentially the same on both dates. Each fungicide treatment markedly reduced disease symptoms with some treatments giving significantly better protection than others.

Table 1. - Results of aerial spray treatments with fungicides for control of Cercospora leaf spot of sugarbeet.

Treatment and dosage (a.i. per acre)	Leaf[1,2] spot ratings	Yield[1]			
		Roots	Sucrose	White sugar	Purity[1]
		tons/acre	%	cwt/acre	%
Triphenyl tin hydroxide 2.38 oz	0.8 b	23.8a	14.00a	52.71a	92.7a
Cupric hydroxide 1.72 lb	1.5 c	23.5a	13.85a	50.77ab	91.9a
Cupric hydroxide in oil and emulsifiers 1.72 lb	1.3 c	19.1 b	12.75a	37.90 c	92.2a
Thiabendazole[3] 3 oz	0.7ab	23.6a	14.50a	57.33a	93.1a
Thiabendazole[3] 6 oz	0.4a	24.3a	14.35a	56.10a	93.5a
Control	4.8 d	19.8 b	12.15a	39.9 bc	91.5a

[1] Means of two plots; means followed by the same letter are not significantly different at the 5% level according to Duncan's multiple range test.

[2] Ratings of 0 to 9 with 0 = no symptoms and 9 = complete defoliation.

[3] A commercial spreader-sticker was added in compliance with recommendation of the manufacturer of the fungicide.

Cupric hydroxide in oil and emulsifiers, though effective in controlling Cercospora leaf spot, was phytotoxic and resulted in brown, irregular, necrotic spots on the foliage. Droplet size of sprays applied in this test (diam 250-300 μ) may have been associated with this phytotoxic response. According to the manufacturer, this formulation has been applied by air on sugarbeets in Texas using rotary atomizers (diam 125-150 μ) with no ill effects. Further, in our subsequent ground application experiments no phytotoxicity occurred when this formulation was applied in fine droplets (diam 25-75 μ) with a mist blower, but foliage damage resulted when the material was applied in larger droplets with a conventional knapsack sprayer.

All spray treatments, except cupric hydroxide in oil and emulsifiers, significantly increased root weight approximately 20% above the control. The phytotoxic effect of cupric hydroxide in oil and emulsifiers may have offset the beneficial effects of the fungicide in reducing Cercospora leaf spot symptoms.

There were no significant differences in percentage sucrose or clear juice purity between any treatments. The beneficial effect of spraying on root weight is reflected in the significantly higher net sugar yields of the thiabendazole and triphenyl tin hydroxide treatments over the check.

Summary

Aerial application of systemic and surface protectant fungicides significantly reduced severity of Cercospora leaf spot under relatively severe disease intensity. There was a significant increase in yield of roots with four of the five treatments, and an increase of net sugar with three of the treatments. There were no differences between treatments and non-treated control in percentage sucrose and in clear juice purity.

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