Control of Cercospora Leaf Spot by Aerial and Ground Applications of Fungicide[1]

L. CALPOUZOS, G. F. STALLKNECHT, AND H. G. JOHNSON[2]

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Low volume fungicidal sprays from aircraft and high volume sprays from ground equipment, for controlling Cercospora leaf spot on sugar beets, have not been thoroughly compared. The visible fungicide deposit on sugar beet leaves sprayed at 5 gallons per acre, does not appear to be as well distributed as the deposit from 40 gallons per acre (Figures 1 and 2). However, the effectiveness of a fungicide spray method should not be judged by its visible deposit, but by its effect on disease incidence and on crop yield. Therefore, we carried out an experiment comparing the disease control and yield of sugar beets sprayed by helicopter (low volume) and by tractor drawn equipment (high volume).

Materials and Methods

The ground equipment, a modified Kromer sprayer, had a 33-foot boom with nozzles spaced 20 inches apart. Nozzle pressure was 300 psi. The aerial equipment, a Bell Helicopter model 470-2, carried a 32-foot boom with nozzles spaced 1-foot apart. Nozzle size was No. 6, and nozzle pressure was 25 psi.

The fungicide, Dithane M-45 (a derivative of maneb), was applied at 2 lbs per acre in all treatments. A wetting agent, Triton B-1956, was included in the spray at 5-6 oz per acre. The helicopter travelled 45 mph as it applied the fungicide at 5 gallons per acre. The ground equipment travelled at 2.5 mph and applied 40 gallons per acre.

The fungicide was applied four times, at about 2-week intervals, on the same plots. The first spray was made when the first few Cercospora leaf spots were observed on about half of the plants in the test area. Applications by helicopter were made on July 20, August 3, August 16, and September 6; and applications by ground equipment were done within 3 days of the above dates. The beets were harvested on October 7, 31 days after the final spray.

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[2] Plant Pathologist and Agricultural Research Technician, Sugarbeet Investigations, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; and Extension Plant Pathologist, University of Minnesota, St. Paul.

Trade names are cited only for identification of equipment and materials used and do not signify that they are approved by the U. S. Department of Agriculture.

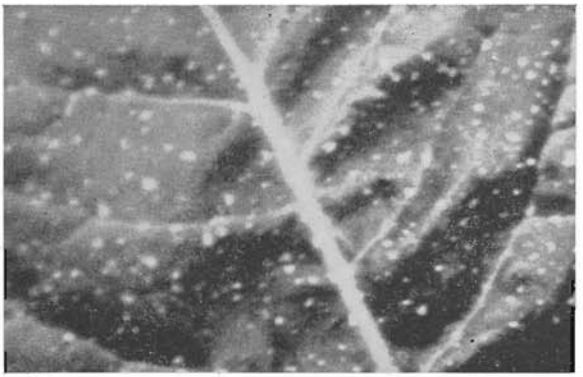

Figure 1.—Typical distribution pattern of a maneb spray deposit, on sugar beet leaves, resulting from a 5-gallon per acre aerial application.

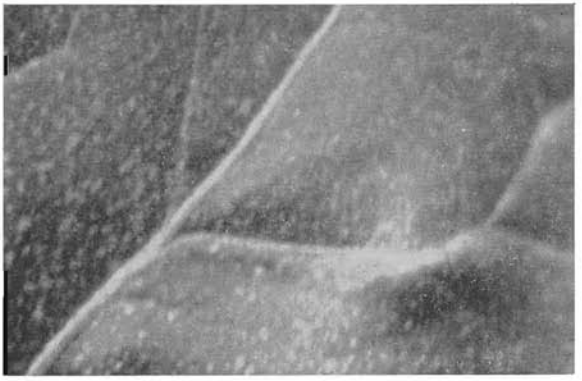

Figure 2.—Typical distribution pattern of a maneb spray deposit, on a sugar beet leaf, resulting from a 40-gallon per acre application by high pressure hydraulic ground-equipment.

The experimental design consisted of three replicate plots for the helicopter application and three for the ground equipment. Each plot was 64 feet wide and 790 feet long. The six plots were adjacent to each other with the treatments alternating, a helicopter-spray plot next to a ground-spray plot and so on. One variety of sugar beet, American No. 3S, was planted. The test area was chosen for its uniform crop stand, soil type, and topography. There was one unsprayed plot located next to the block of treated plots. No noticeable spray drift occurred from one plot to another.

Exactly 0.40 acre was harvested in the center of each plot. For sugar analysis, two lots of eight beets were gathered at random from each harvested plot. The sucrose and purity analyses were made through the cooperation of the American

Crystal Sugar Company, Research Department, to whom we express our appreciation.

Results

Disease first appeared in mid-July, increasing slowly at first and finally reaching high incidence in the check plot by early September. We used the disease rating scale of 0 (no disease) to 5 (almost all leaves dead), established in the Kleinwanzlebener Cercospora Table. At harvest, disease incidence was rated: check plot = 4; average of the three plots sprayed by helicopter = 2.3; average of the three plots sprayed by ground equipment = 1.3.

Data on tons of sugar beets harvested, percent sucrose, and percent of press juice purity are presented in Table 1. The average yields of sugar beet roots for the helicopter and the ground equipment treatments were 13.09 and 13.07 tons, respectively. The sprayed plots yielded an average of 2.4 tons of beets more than the single unsprayed plot.

The average percent sucrose was 13.3 for the plots sprayed by helicopter and 14.1 for the plots sprayed by ground equipment. The percent sucrose from the unsprayed plot was 11.8, much lower than either of the two spray treatments.

Table 1. Yields from plots of sugar beets sprayed either by helicopter at 5 gallons per acre or by ground equipment at 40 gallons per acre.

Treatment	Rep. plot No.	Tons beets per acre[1]	Percent sucrose[2]	Lbs sugar per acre[3]	Percent purity[2],[4]	Disease rating[5]
	1	13.56	14.2	3,824	87.6	1.0
			14.0		89.2	
Ground spray	2	12.86	14.9	3,717	87.6	1.5
			14.0		88.8	
	3	12.80	13.7	3,520	88.1	1.5
			13.8		85.9	
	Average	13.07	14.1	3,687	87.8	1.3
	1	13.61	13.0	3,634	86.0	2.5
			13.7		85.8	
Helicopter spray	2	13.32	13.5	3,437	85.9	2.0
			12.3		86.9	
	3	12.36	13.5	3,399	87.1	2.5
			14.0		86.2	
	Average	13.09	13.3	3,490	86.3	2.3
Unsprayed	1	10.66	11.9	2,516	85.0	4.0
			11.7		85.2	
	Average		11.8		84.6	

[1] Tons of beets excluding the tare.
[2] Two samples of 8 beets each per plot.
[3] Average of the two sucrose samples multiplied by the pounds of beets per acre.
[4] Percent purity is based on press juice.
[5] 0 = no disease, 5 = almost all leaves dead. Observations made at harvest.

The average juice purity was highest (87.8%) from beets grown in the plots sprayed with the ground equipment. The plots sprayed by helicopter had a lower juice purity of 86.3%. From the unsprayed plot, the juice purity (84.6%) was lower than either of the two spray treatments.

Average pounds of gross sugar per acre was slightly higher for the plots sprayed by ground equipment than for the plots sprayed by helicopter, 3,687 lbs versus 3,490 lbs. Both spray methods resulted in approximately 1,000 lbs of sugar per acre more than that obtained from the unsprayed sugar beets.

Discussion

Disease incidence was sufficient to test the effectiveness of the two spray methods. Under these conditions, spraying with ground equipment was better than spraying with helicopter, not in terms of beet root tonnage but in percent sucrose and percent purity. Both methods of application were economically justified when compared to the unsprayed check. For example, 4 spray applications (either aerial or ground) may cost $12-$15 per acre. The 2.4-ton yield increase which resulted meant about a 100% financial return above spray costs.