Chemical Control of Cercospora Leaf Spot of Sugarbeets in Nebraska, 1965[1]

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Cercospora leaf spot of sugarbeets is a major problem in Europe and North America. This disease caused by *Cercospora beticola* Sacc. is important in central and eastern Nebraska. Fungicide tests have been made in Europe and North America as referred to recently (1,2,3)[3].

The Cercospora leaf spot control tests of 1965 were a continuation of research begun in 1961 in Nebraska. Results of the 1964 leaf spot control tests indicated the need for more information on the efficiency of the newer fungicides in relation to the recommended products, plus additional data on rates and number of applications necessary to provide satisfactory disease control. The plot locations in Burt County, Nebraska were chosen on the basis of a relatively high incidence of disease in 1964, plus the intensive cropping practices employed by the growers. Because aircraft has been considered as a possible method of overcoming some of the problems of late application, a treatment was included with one fungicide using only 10 gallons of water per acre to simulate aerial application rates.

Materials and Methods

The following fungicides were incorporated in the tests conducted at both locations during 1965.

Fungicide	Supplier
Tri-basic copper sulfate	Tennessee Corporation College Park, Georgia
Daconil 2787 W-75[a]	Diamond Alkali Company Painesville, Ohio

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[3] Numbers in parentheses refer to literature cited.

Dithane M-45[b]	Rohm and Haas Company Kansas City, Missouri
DU-TER 20% WP[c]	Thompson-Hayward Chemical Co. Kansas City, Missouri

[a]Active ingredient: Tetrachloroisophthalonitrile
[b]Active ingredient: Manganese ethylene bis-dithiocarbamate
[c]Active ingredient: Triphenyl tin hydroxide

The experimental design was a randomized complete block with three replications. The treatments were randomized within each replication at each location. Test plots were placed within beet fields away from extraneous influencing factors. Plots consisted of five 30-foot rows spaced 22 inches apart. Four of the five rows were treated, while the remaining row served as a buffer strip between plots. Replications were separated by a three foot alley.

Sprays were applied with a SOLO-PORT, a high air velocity engine driven mist blower. It was easily calibrated and gallonages were accurately controlled. Plyac, a spreader-sticker, was used with Daconil 2787, Dithane M-45, and tri-basic copper sulfate at the rate of one ounce per gallon of water. Spray application dates were as follows:

Cooperator	Number of applications	
	4	6
Englert	July 8	July 8
	July 22	July 22
	Aug. 5	Aug. 5
	Aug. 19	Aug. 19
		Sept. 2
		Sept. 15
Morrow	July 9	July 9
	July 22	July 22
	Aug. 5	Aug. 5
	Aug. 19	Aug. 19
		Sept. 2
		Sept. 15

Leaf spot data were gathered on whole plots August 19, September 2, and September 15, 1965. Disease incidence data consisted of a visual rating for leaf spot based on percentage of leaf surface infected, as listed below:

Rating	% of leaf Surface infected
1	0-10
2	11-25
3	26-50
4	51-75
5	76-100

Yield data and sugar analysis data were collected from the two center rows of each treated 4-row plot. Both tests were harvested October 8, 1965.

Results

Englert Plots: On July 8 at the time of first fungicidal application, disease incidence was 5 to 20 leaf spot lesions per plant. Two weeks later the amount had increased to a level greater than 100 leaf spots per plant. By August 19, heavy infection was observed in the untreated plots with somewhat less infection on foliage of plants in treated plots. Severely infected lower leaves had begun to dry and fall, giving rise to a slight "pineapple effect". Consequently, such leaves escaped detection and consideration in subsequent leaf spot ratings.

Results indicate several treatments effectively controlled disease development but had no significant effect on tons of beets per acre, percentage of sucrose, and pounds of sugar produced per acre on this farm. Only small differences could be attributed to four versus six applications of fungicides. Duncan's Multiple Range Test indicated better disease control was achieved with DU-TER than with Dithane M-45, Daconil 2787, or tribasic copper sulfate.

Morrow Plots: At the time the first application of fungicides were made (July 8), an insignificant amount of leaf spot was observed in this field (5-10 lesions per plant). Disease incidence increased rapidly during the next two weeks to well over 100 leaf spots per plant. The plants also were not developing as vigorously as those in the Englert plots. The stand was poorer, the leaves smaller, and the foliage less dense. By August 19, very heavy infection was noted throughout most of the plots, with severe infection on untreated beets between the experimental plots and a corn field north of the plots. While the present experimental plots were established in a field that was idle ground in 1964, the existing corn field had been in sugarbeets the previous year and sugarbeet residue could easily be collected from the corn field. Within the next two weeks severely infected lower leaves blackened and dropped, causing a moderate

to obvious "pineapple effect" of the crowns. Leaves killed in this manner escaped detection and were thus not reflected in subsequent leaf spot ratings.

Results of the fungicidal tests indicate that all chemical treatments provided better leaf spot control than did water alone (check plots) under high disease intensity. However, even with satisfactory control being achieved, there were little or no significant differences in tons of beets per acre, percentage sucrose, or pounds of sugar per acre. Moreover, no significant difference in control was noted with the addition of two fungicidal applications. Duncan's Multiple Range Test indicated DU-TER treatments resulted in better control than did Daconil 2782, Dithane M-45, or tri-basic copper sulfate.

Composite date (Englert-Morrow plots): When the data for the two locations are combined (Table 1), significant differences occur between treatments and between locations for tons of beets per acre, percentage sucrose, and leaf spot ratings. There was a significant treatment by location interaction, indicating the degree of fungicidal control of leaf spot was influenced by the severity of the disease in 1965. The fact that the treatments and the locations of the plots had no effect on the pounds of sugar produced per acre is noteworthy.

Any treatment in which DU-TER was applied resulted in superior control of leaf spot as compared to the control achieved by Dithane M-45, Daconil 2787, or tri-basic copper sulfate.

To extract additional statistical information, treatment sums of squares for each of 3 dates-of-leaf-spot-incidence ratings at both locations were partitioned into 17 single degree of freedom orthoginal comparisons (Table 2). The following comparisons are of particular interest.

Number 9: The degree of control of Cercospora leaf spot achieved when Daconil 2787 was applied at the rate of 2 pounds of formulation in 100 gals/acre was no greater than when the same material was applied at the rate of 1 pound/100 gals/acre.

Number 13: DU-TER, when applied at the rate of 1.25 pounds of formulation in 10 gallons of water per acre, prevented disease development equal to or better than the same material applied at the same poundage in 100 gallons of water.

Number 14: No greater control of Cercospora leaf spot was achieved with DU-TER at the rate of 1.25 pounds of formulation per acre than that achieved by half that rate.

Number 15: DU-TER applied at the rate of 0.625 pounds in 10 gallons of water per acre was equal to or better than the same material in 100 gallons of water per acre, in terms of Cercospora leaf spot control.

Table 1.—Cercospora leaf spot on sugarbeets, fungicidal trials, composite date (Englert - Morrow farms), 1965

Treatment	No. of appli	Rates/acres Lbs chem	Rates/acres Gals H_2O	Tons of beets per acre	Percent sucrose	Lbs sugar per acre	Average leaf spot rating	Duncan's mult range
Tribasics copper sulfate	4	4.0	100	24.5	11.50	5593	2.93	de
Tribasic copper sulfate	6	4.0	100	24.4	11.38	5507	3.07	e
Daconil 2787	4	1.0	100	23.2	11.18	5138	2.65	de
Daconil 2787	6	1.0	100	22.2	11.38	5004	2.88	de
Daconil 2787	4	2.0	100	23.4	11.40	5305	2.57	d
Daconil 2787	6	2.0	100	22.7	12.48	5599	2.57	d
Dithane M-15	4	2.0	100	22.7	12.44	5422	2.95	de
Dithane M-45	6	2.0	100	24.2	11.61	5588	2.97	de
Triphenyl tin hydroxide (DU-TER)	4	1.25	100	25.2	12.08	5984	1.90	bc
Triphenyl tin hydroxide (DU-TER)	6	1.25	100	21.4	12.00	5057	1.55	ab
Triphenyl tin hydroxide (DU-TER)	4	1.25	10	23.6	11.75	5413	1.38	ab
Triphenyl tin hydroxide (DU-TER)	6	1.25	10	22.6	11.83	5246	1.17	a
Triphenyl tin hydroxide (DU-TER)	4	0.625	100	23.9	12.27	5692	2.02	c
Triphenyl tin hydroxide (DU-TER)	6	0.625	100	22.8	11.62	5213	1.85	bc
Triphenyl tin hydroxide (DU-TER)	4	0.625	10	23.4	11.92	5449	1.15	a
Triphenyl tin hydroxide (DU-TER)	6	0.625	10	21.8	12.50	5326	1.27	a
Check (Water only)	4	0.0	....	20.2	12.22	4747	4.00	f
Check (Water only)	6	0.0	....	20.9	12.12	4923	3.83	f
Average				22.95	11.87	5344.8	2.37	
Source of variation								
Treatments (T)				8.57*	4.37*	N.S.	40.39*	
Applications (A)				10.68*	N.S.	N.S.	N.S.	
T X A				4.29*	3.67*	N.S.	N.S.	
Location (L)				628.27*	1134.16*	N.S.	15.08*	
T X L				22.74*	5.68*	N.S.	3.49*	
Dates of rating (D)							N.S.	
A X D							N.S.	

* Denotes significance at the 5% level.

Table 2.—Sums of squares of 17 orthogonal comparisons between treatments. Rated for Cercospora leafspot of sugarbetts, 1965.

Orthogonal comparisons	August 19		September 2		September 15	
	Morrow	Englert	Morrow	Englert	Morrow	Englert
1. Tribasic copper sulfate, 4 vs. 6 appl.	1.500	1.500*	1.500*	.667	.000	.167
2. Daconil 1#/100 gal, 4 vs. 6 appl.	.667	.167	.167	.000	.000	.000
3. Daconil 2#/100 gal, 4 vs. 6 appl.	.167	.167	.167	.167	.000	.000
4. Dithane, 4 vs. 6 appl.	1.500	.167	1.500*	.667	.167	.167
5. DU-TER 1.25#/100 gal, 4 vs. 6 appl.	.667	.167	.167	.167	.667	.167
6. DU-TER 1.25#/10 gal, 4 vs. 6 appl.	.167	.000	.667	.167	.667	.000
7. DU-TER 0.625 #/100 gal, 4 vs. 6 appl.	.167	.667	.167	.167	1.500*	.167
8. DU-TER 0.625#/10 gal, 4 vs. 6 appl.	.167	.000	.167	.000	.000	.000
9. Daconil 1#/100 gal vs. 2#/100 gal	.083	.333	.000	.750	.333	.333
10. Tribasic copper sulfate vs. Dithane	.333	1.333*	.333	.333	.083	.333
11. Daconil vs. DU-TER	10.125**	19.013**	7.347**	13.347**	11.680**	3.556**
12. TCS & Dithane vs. Daconil & DU-TER	9.000**	12.840**	5.840**	14.694**	21.778**	3.361**
13. DUTER, 125 #/100 gal vs. 1.25#/10 gal	.083	2.083**	.083	.333	1.33*	2.083*
14. DU-TER, 125 # vs. 0.625 #	.042	.042	.042	.375	.042	.167
15. DU-TER 0.625 #/100 gal vs. 0.625 #/10 gal	.333	3.000**	1.333*	.750	4.083**	.750
16. Check, 4 vs. 6 applications	.667	.167	.667	.167	.000	.167
17. Check vs. all chemical treatments	23.148**	13.021**	13.724**	28.009**	13.370**	8.898**
Error mean square	.66	.23	.30	.27	.35	.24

* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

Discussion

The results of the 1965 fungicidal trials were, in part, substantiated by research conducted in prior years in this project at other state experiment stations and locations. Carlson (1), Finkner, et al. (2), and Forsyth and Broadwell (3) found results similar to those reported herewith. Polyram was not used because it proved least effective in previous tests. DU-TER was used instead of Brestan (triphenyl tin acetate) because of its earlier possible registration, although Brestan was very effective in 1964.

High disease incidence apparently had a greater effect on tonnage than on percentage of sucrose in these experiments. However, the pounds of sugar per acre produced in the Morrow plots did not differ significantly from that produced in the Englert plots.

Summary

1. Significant control of Cercospora leaf spot was achieved in all fungicide treated plots over the water check plots.
2. There was generally no significant increase in disease control when chemicals were applied 6 times as compared to 4 times.
3. DU-TER gave significantly better disease control than did Daconil 2787, Dithant M-45, or tri-basic copper culfate.
4. Daconil 2787 at 1 pound was just as effective in controlling the disease as the higher 2 pound rate.
5. There was no significant increase in disease control when DU-TER was applied at the 1.25 pound rate as compared to half that rate.
6. DU-TER at 1.25 pounds per 10 gallons of water was equal to or better than the same amount of material in 100 gallons of water in terms of disease control.
7. DU-TER at 0.625 pounds per 10 gallons of water per acre was equal to or better than the same amount of material in 100 gallons of water in terms of disease control.

Literature Cited

(1) CARLSON, L. W. 1966. Fungicidal control of sugarbeet leaf spot. J. Am. Soc. Sugar Beet Technol. 14 (3): 254-259.
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