Station, on the value of beet tops when used in a dairy cow ration: "In comparing the value of alfalfa and beet tops as a cured roughage, the following results are reported: (7) "During the first year's test, 1 pound of alfalfa was equal to 1.1 pounds of beet tops when compared on a dry matter basis. In other words in this test beet tops were 91% as valuable as alfalfa (D.M.B.) without considering the increase in milk yield. In the second year (1938-39) of the experiment, 1 pound of alfalfa was equal to 1.1 pounds of beet tops not considering the increase in milk yield. This gives beet tops a value 83% as great as alfalfa. Taking a mean of the two years together the tops were worth 87% as much as alfalfa on a dry matter basis."

"Estimating cured alfalfa in the stack at 90% dry matter and cured beet tops in piles or stacks at 70% dry matter, beet tops were worth $5.64 per ton the first year and $5.18 per ton the second year when alfalfa is worth $8.00 per ton. The mean of the two years gives beet tops a value of $5.41 per ton when alfalfa is worth $8.00 per ton. (7)

Summary

Dried beet tops are a source of nutrients approaching alfalfa in protein content and the small grains in nitrogen free extract when calculated on a dry basis. Too much emphasis cannot be placed on the value of proper curing and storing of the feed to prevent nutrient loss from unfavorable weather conditions or negligence.

Feeding operations by men who are investigators on the subject have demonstrated the value of beet tops in the replacement of a large portion of concentrates and alfalfa in rations for fattening cattle and in the production of milk from a dairy herd.

Literature Cited and Other Sources of Data

(1) Mr. D. J. Roach, from office files
(2) Mr. R. A. Brackenburg, "Through the Leaves," November 1939, page 192.
(3) Mr. E. J. Maynard, "Through the Leaves," November 1939, page 181.
(4) Mr. R. C. Rom, "Through the Leaves," November 1939, page 187.
(5) Mr. M. A. Alexander & Mr. Paul C. Swanson, Mimeographed Circulars, Scottsbluff Experiment Station, Sheep Feeding Operations for the three years 1936-37, 1937-38 and 1938-39.
(6) Mr. E. J. Maynard, "Through the Leaves," September 1939, pages 156-7.
(7) Mr. Paul C. Swanson, "Through the Leaves," March 1939, page 59.

DUSTING AND SPRAYING FOR THE CONTROL OF BLIGHT OF THE SUGAR BEET

H. C. Young[1]

It is difficult to estimate the annual loss incurred by Cercospora leaf blight of beets. The disease has been present in our fields almost since beet growing started. More than 30 years ago experiments on dusting and spraying

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[1]Chief, Department of Botany and Plant Pathology, Ohio Agr.Exp.Sta., Wooster, Ohio

were conducted and the results indicated that the disease could be controlled. However, it was stated in these earlier conclusions that the cost was probably too great to warrant such recommendations.

A general survey indicates that the disease has gradually increased until at present it is causing distinctive losses. Formerly it was estimated that actual losses occurred in 1 year out of 5 or 7 years but during the past 5 years leaf spot has caused losses each year.

In 1938 many growers of northwestern Ohio decided that if they were to remain in the beet growing business, blight would have to be controlled. Consequently a series of dusting and spraying tests were arranged. Bordeaux and several of the fixed coppers were used. The results are given in Table 1.

Table 1.—Spraying and dusting of sugar beets at Ralph Watson farm at Old Fort, Ohio, 1938. The spray plots were on resistant beets. Tons and sugar per acre and percentage of blight. Applications - 7/13, 7/22, 8/12.

Materials	Yield per acre	Increase over check	Sugar	Purity	Sugar per acre	Increase over check	Gain over check at 4¢ sugar	Blight
	Tons	Tons	%	%	Lbs.	Lbs.		%
Sprays								
Bordeaux 8-12-100	22.93	3.35	16.0	84.6	6310	1580	$63.20	5.0
Basic Copper Chloride	21.09	1.51	16.0	83.8	5652	922	36.88	5.0
Cupro-K	22.73	3.15	15.4	83.2	5819	1089	43.56	8.0
Basicop	24.81	5.23	15.0	81.4	6053	1323	52.92	10.0
Check. No treatment	19.58	—	14.8	81.7	4730	—	—	60.0
Dusts								
Basic Copper Chloride	20.23	2.72	15.2	82.9	5098	1178	47.12	20.0
Cupro-K	20.11	2.62	17.2	82.9	5715	1795	71.80	30.0
Basicop	21.92	4.42	15.4	82.4	5567	1647	65.88	25.0
Tribasic	21.48	3.98	14.6	83.8	5297	1377	55.08	25.0
20-80 Copper-lime	22.19	4.69	14.0	80.9	5028	1108	44.32	30.0
Check. No fungicide	17.50	—	14.0	80.1	3920	—	—	70.0
Average dust plots	21.20	3.70	15.3	82.6	5341	1421	$56.84	
Cost of 3 applications							4.65	
						Net gain	$52.19	

The results of the 1938 series were very favorable and indicated that the increases were well within the economic range.

Many growers did not wait for the outcome of our tests but went ahead on a regular dusting or spraying schedule. Their returns were also on the profit side of the ledger. The general conclusions gained from the 1938 program were (1) that yield was increased 1.5 to 2 tons per acre, (2) that the sugar content of the beet was increased about 1.5%, and (3) that the purity was raised significantly.

The results of these 1938 tests were so favorable that a very large percentage of the acreage was treated in 1939. In arranging our own series we began the study of timing, quantity of dust or spray to use, methods of

application, and types of materials. This study required a large acreage of beets, which was generously supplied by Ralph Watson at Old Fort and the Great Lakes Sugar Company at Findlay and Elmore. The chemical tests, which were very extensive, were handled by the Great Lakes Company in their Fremont factory.

The first applications in general were applied on early beets on July 5. Power machines were used for both sprays and dusts. All copper materials were used at a uniform metallic content and all concentrations were about the same as the 20-80 copper-lime dust. The results are shown in Tables 2 to 6.

The results of the 2 years spraying tests indicate that a 4-6-100 Bordeaux controls very well and that the use of substitute materials is scarcely warranted.

Leaf spot in the Old Fort area was very severe in 1939. There was an abundance of rain until July 1 and the remainder of the season was quite dry. It was a surprise to us that the disease continued in such severity. It may be a general indication that we can expect severe blight almost every season. The control with dusting was successful, even better than with spraying. You will note from the tables that leaf spot was better controlled by spraying, yet dusted beets gave slightly higher yields. Either sprays cause more injury or it is not necessary to have so complete control of the disease.

Table 2.—Spraying of sugar beets at the Ralph Watson farm, Old Fort, Ohio - 1939. Tons of beets, sugar per acre and percentage of blight, 3 applications - 7/5, 7/27, 8/16

Spray materials	Number beets in .01 acre sample	Average weight per beet	Yield per acre	Increase over comparable check	Sugar content	Purity	Sugar yield	Increase over comparable check	Increase in returns computed @ 4¢ sugar	Blight Sept.9 % dead leaf area
		Lbs.	Tons	Tons	%	%	Lbs.	Lbs.		
Bordeaux 6-8-100	158	2.31	18.25	6.02	15.4	83.9	4716	1949	$77.96	5.0
Bordeaux 3-6-100	144	2.37	17.05	4.82	14.0	82.9	4005	1238	49.52	10.0
Check	146	1.70	12.23	—	13.6	83.2	2767	—	—	85.0
Brown Cupric Oxide 2#	151	2.20	16.65	4.42	14.6	84.5	3908	1141	45.64	12.0
Brown Cupric Oxide 1#	155	2.02	15.65	3.42	15.3	84.6	4050	1283	51.32	16.0
Copper Oxychloride Sulfate 2#	154	2.02	15.60	3.37	14.7	85.0	3898	1131	45.24	5.0
Tribasic 2#	140	2.18	15.30	3.07	14.5	82.6	3665	898	35.92	10.0
Check	146	1.70	12.23	—	13.6	83.2	2767	—	—	85.0
Basicop (tribasic) 2#	134	2.43	16.30	4.07	13.2	80.5	3464	687	27.88	10.0
Basic Copper chloride 2½#	138	2.68	18.55	6.32	15.2	84.1	4742	1975	79.00	8.0

Average of 4 replicates. 2.2 tons necessary for significance.

Table 3.--Dusting and spraying of sugar beets, Elmore, Ohio, 1939. Tons of beets, sugar per acre and percentage of blight. Applications made 7/14, 8/7 and 8/24

Materials used	Weight per beet	Tons per acre	Increase over comparable check	Sugar content	Purity	Sugar per acre	Increase over check	Gain computed @ 4¢ sugar	% dead area from blight
	Lbs.		Tons	%	%	Lbs.	Lbs.		
Bordeaux 6-8-100	1.77	18.9	2.3	16.0	77.0	6048	139	$ 5.56	5.0
Bordeaux 3-6-100	1.70	19.3	2.7	16.0	80.0	6176	267	10.68	12.0
Tribasic Copper Sulfate 2 lbs. Flour 6 lbs. Tergitol 50 c.c. Water 100 gal.	1.92	19.7	3.1	15.8	79.0	6225	316	12.64	10.0
Basicop 2 lbs. Flour 6 lbs. Tergitol 50 c.c. Water 100 gal.	1.80	18.5	1.9	16.4	81.0	6068	159	6.36	15.0
20-80 copper-lime dust	1.84	18.8	2.2	16.2	80.7	6091	182	7.28	60.0
Basic copper chloride 2½ lbs. Flour 6 lbs. Tergitol 50 c.c. Water 100 gal.	1.80	17.45	.85	15.2	77.1	5305	-604	-24.16	10.0
Check - Average of duplicates	1.56	16.6	--	17.8	83.5	5909	--	--	85.0

Harvest September 24, 1939, which was too early and results are not significant.

Table 4.—Dusting of sugar beets at the Ralph Watson farm, Old Fort, 1939. Tons of beets, sugar per acre and percentage of blight. 4 applications - 7/5, 7/26, 8/16, 8/30

Dust materials	Number beets in .01 acre sample	Average weight per beet	Yield per acre	Increase over comparable check	Sugar content	Purity	Sugar yield	Increase over comparable check	Increase in returns computed @ 4¢ sugar	Blight Sept. 9 % dead leaf area
		Lbs.	Tons	Tons	%	%	Lbs.	Lbs.		
Copper-lime, 20-80	142	2.64	18.80	6.57	15.2	87.9	5023	2256	$90.24	20.0
Copper-lime-bentonite 20-60-20	162	2.33	18.90	6.67	15.8	89.5	5345	2578	103.12	18.0
Check	146	1.70	12.23	—	13.6	83.2	2767	—	—	85.0
Copper-lime-flour 20-60-20	164	2.11	17.35	5.12	16.0	88.5	4913	2146	85.84	15.0
Tribasic 8# Talc 42# Flour 15#	144	2.60	18.70	6.47	14.6	83.4	4553	1786	71.44	20.0
Brown Cupric Oxide 6# Talc 44# Flour 15#	172	1.97	17.0	4.77	16.0	94.7	5152	2385	95.40	20.0
Check	146	1.70	12.23	—	13.6	83.2	2767	—	—	85.0
Basic copper chloride 9# Talc 41# Flour 15#	158	2.10	16.67	4.44	15.4	89.3	4585	1818	72.72	10.0

Average of 4 replicates. 1.8 tons necessary for significance.

Table 5. Dusting of sugar beets on Ralph Watson farm, Old Fort, Ohio, 1939. Tons and sugar per acre. 3 applications applied at night

Material	Yield per acre	Increase over comparable check	Sugar content	Purity	Sugar per acre	Increase over check	Gain at 4 cent sugar
	Tons	Tons	%	%	Lbs.	Lbs.	
20-60-20 copper-lime-flour	11.37	2.31	14.6	81.8	2715	758	$30.32
Check. No treatment	9.06	---	13.4	80.6	1957	---	---
Spraycop	10.12	1.97	14.6	82.9	2449	713	28.52
Cuprocide GA	9.27	2.02	15.2	83.2	2343	728	29.12
Check	7.25	---	13.2	84.4	1615	---	---
Copper Oxalate	8.82	1.57	14.4	82.5	2099	484	19.36
Tribasic	10.76	3.51	14.2	80.9	2575	960	38.40

Late planted beets on sandy soil, 75% stand. 1.6 tons necessary for significance.

Perhaps the largest amount of our work centered around the use of monohydrated copper sulfate-hydrated lime dusts and substitutes. The results indicate that the copper-lime combinations may be a trace more effective than the fixed coppers but they must be applied at night or when the foliage is wet. The fixed coppers may be applied any time when dusting conditions are favorable. Dusting at night is not an agreeable practice and many times cannot be done satisfactorily. A comparison of these two general types of copper when applied during the night and during the day is given in Tables 6 and 7.

The results obtained in this comparison are interesting. Slightly higher yields were obtained from night dusting with most of the materials but this apparent difference becomes insignificant when statistics are applied. The only reason it can be pointed out at all is that the results from chemical tests indicate that slightly more copper adhered to the leaves through rains when the applications were made on wet foliage.

In this work about 35 pounds of dust were used per acre. This amount seemed adequate when the distribution was uniform. A power machine, covering 12 rows, had to be kept in A-1 working order.

Perhaps much more work needs to be done in determining the timing of the applications. The results given in Table 8 are for early and late beets.

The tonnage results given in the table are not too significant. However, after a detailed study of the plots during the growing season, results warrant the following conclusions. The first application should be made about 40 days after blocking and thinning. This means that four applications at not over 10-day intervals are required for early beets andperhaps three applications would be sufficient for late planted beets.

Table 6.—Dusting of sugar beets at the Ralph Watson farm, Old Fort, 1939. Comparison of day and night dusting. Tons of beets and sugar per acre and percentage of blight.

Dusting materials and time of dusting	Number beets in .01 acre sample	Average weight per beet	Yield per acre	Increase over comparable check	Sugar content	Purity	Sugar yield	Increase over comparable check	Increase in returns computed @ 4¢ sugar	Blight Sept. 9 % dead leaf area
		Lbs.	Tons	Tons	%	%	Lbs.	Lbs.		
Check	146	1.70	12.23	—	13.6	83.2	2767	—	—	85.0
Tribasic 8#) Talc 42#) Day Flour 15#)	153	2.04	15.62	3.39	15.4	87.7	4140	1373	$54.92	20.0
Tribasic 8#) Talc 42#) Night Flour 15#)	144	2.60	18.70	6.47	14.6	83.4	4553	1786	71.44	20.0
Brown Cupric Oxide 6#) Talc 44#) Day Flour 15#)	156	2.03	15.85	3.62	15.6	88.5	4376	1609	64.36	40.0
Brown Cupric Oxide 6#) Talc 44#) Night Flour 15#)	172	1.97	17.00	4.77	16.0	94.7	5152	2385	95.40	20.0
Basic Copper Chloride 9#) Talc 41#) Day Flour 15#	144	2.55	18.40	6.17	15.2	90.9	5084	2317	92.68	25.0
Basic Copper Chloride 9#) Talc 41#) Night Flour 15#)	158	2.10	16.67	4.44	15.4	89.3	4585	1818	72.72	10.0
Check	146	1.70	12.23	—	13.6	83.2	2767	—	—	85.0

Average of 3 replicates. 2.1 tons necessary for significance.

Table 7.—Dusting of sugar beets, Findlay, Ohio. Tons of beets, sugar per acre and percentage of blight. 4 applications - 7/13, 8/4, 8/17, 8/28

Material used	Yield per acre	Increase over comparable check	Sugar content	Purity	Sugar per acre	Increase over check	% dead leaf area from blight Sept. 9
	Tons	Tons	%	%	Lbs.	Lbs.	
20-80 copper-lime dust	16.1	6.0	16.0	84.2	4338	1803	40.0
20-60-20 copper-lime-flour	15.6	5.5	15.6	83.1	4044	1509	35.0
20-60-20 talc	14.9	4.8	16.7	85.2	4140	1605	32.0
Check	10.1	—	15.4	81.5	2535	—	80.0
Basicop (day)	14.5	4.4	16.4	85.2	4052	1517	25.0
Basicop (night)	14.5	4.4	15.6	85.8	3886	1351	20.0
Cupro-K (day)	11.7	.4	16.3	85.0	3242	180	25.0
Cupro-K (night)	14.1	2.8	15.7	83.2	3683	621	20.0
Check	11.3	—	15.9	85.2	3062	—	60.0
Brown Cupric (day)	14.5	3.2	15.5	84.1	3780	718	25.0
Brown Cupric (night)	15.0	3.7	15.5	83.6	3886	824	20.0
Copper Oxychloride Sulfate	13.5	—	15.6	82.3	3466	404	20.0

2 acre plots.

Table 8.—Spraying of sugar beets to determine timing of applications, 1939, on the Ralph Watson farm, Old Fort, Ohio. Tons of beets, sugar per acre and percentage of blight.

Bordeaux 6-8-100 applied on	Number beets in .01 acre sample	Average weight per beet	Yield per acre	Increase over comparable check	Sugar content	Purity	Sugar yield	Increase over Comparable check	Increase in returns computed @ 4¢ sugar	Blight Sept. 9 % dead leaf area
		Lbs.	Tons	Tons	%	%	Lbs.	Lbs.		
					Early Beets					
July 5	156	1.91	14.90	2.67	13.4	80.6	3218	451	$18.04	20.0
July 5; 27	164	1.85	15.20	2.97	15.8	84.2	4044	1277	51.08	5.0
July 5; August 16	156	2.00	15.65	3.42	14.6	83.6	3820	1053	42.12	35.0
Check	146	1.70	12.23	—	13.6	83.2	2767		—	85.0
July 27	168	1.88	15.80	3.57	16.2	87.1	4459	1692	67.68	12.0
July 27; August 16	168	1.89	15.90	3.67	15.6	85.5	4242	1475	59.00	12.0
August 16	160	1.63	13.05	0.82	14.0	82.1	3000	233	9.32	75.0
July 5,27;Aug. 16	Discarded because of use for roadway.									
					Late Beets					
Check	146	1.70	12.23	—	13.6	83.2	2767	—	—	85.0
July 5,27; Aug. 16	158	2.31	18.25	6.02	15.4	83.9	4716	1949	77.96	5.0
Check	158	1.40	10.88	—	12.3	83.1	2224	—	—	85.0
July 5	162	1.58	12.80	1.92	12.6	82.9	2674	450	18.00	20.0
July 5;27	148	1.70	12.55	2.95	15.0	87.3	3287	1490	59.60	5.0
July 5; August 16	148	1.73	12.85	3.25	14.6	86.4	2842	1045	41.80	35.0
Check	158	1.21	9.60	—	11.4	82.1	1797	—	—	85.0
July 27	154	1.72	13.25	3.65	12.8	82.6	2802	1105	44.20	12.0
July 27; August 16	174	1.63	14.20	4.60	14.8	86.0	3615	1818	72.72	12.0
August 16	174	1.30	11.30	1.70	14.4	82.4	2681	884	35.36	75.0

Soil variation influenced the results of this series. 1.8 tons necessary for significance.

Cost of Dusting

This will vary, depending upon the cost of labor and materials. Considerable commercial dusting has been done in the beet area at the following figures.

Total for 3 applications
Copper-Lime Dust

3 applications at 75 cents per acre	$2.25
Monohydrated copper sulfate, 20 lbs. @ 9 cents	1.80
Hydrated lime, 80 lbs. at 1/2 cent +	.45
Total cost	$4.50
Flour, 15 lbs. at 2 cents adds	.30
	$4.80

Fixed Copper-Lime Dust

Fixed copper (based on 50% metallic), 12 lbs. at 15 cents	$1.80
Talc, 73 lbs. at 3/4 cents	.55
Flour, 15 lbs. at 2 cents	.30
3 applications at 75 cents per acre	2.25
Total	$4.90

These costs are on the basis of 33-1/3 pounds of dust per acre per application. The figures are based on 1939 costs and there is no guarantee that the cost of application or the materials will be the same in the future.

Spraying costs are slightly higher, due to the time factor. Materials for spraying are cheaper.

General Summary

The results for the 1938 and 1939 seasons indicate clearly that it pays to spray or dust beets. The tonnage increases range from 20 to 50 percent and there is an increase in sugar content of about 1½ percent.

Leaf spot was serious in both seasons and the untreated plots showed about 90 percent of their leaf area dead on September 1.

In general, dusting gave slightly higher yields than did spraying, although the latter gave somewhat better leaf spot control.

The copper-lime-flour combination, 20-60-20, was slightly superior in sticking and leaf spot control to any of the fixed copper compounds. However, this increase was scarcely significant.

The fixed coppers, particularly the chloride and sulfate types, can be used effectively in daytime dusting.