The Effect of Certain Fungicides on the Photosynthetic Activity of Sour Cherry Leaves[1]

By L. M. MURPHY, *Michigan State College, East Lansing, Mich.*

LONG experience with lime-sulfur as a spray for the control of cherry leaf spot has shown that, at least in the hands of the average producer, it fails to give satisfactory control in epidemic years. Applications of bordeaux mixture of usual strength have resulted in a decreased size of fruit and at times serious defoliation (1, 6). The success that has attended the use of certain, recently introduced, proprietary copper compounds has lead to their rather general adoption in several northern states.

That certain sprays have a deleterious effect on fruit foliage has been proved conclusively (2, 3, 4, 5). With the advent of these new copper compounds, questions arise as to their effect on some of the more important life processes and plant functions. Their ultimate place depends not only on their value in disease control but also on their physiological effect on the tree. Thus this study was made to determine their effects on the photosynthetic behavior of sprayed cherry leaves.

MATERIALS AND METHODS

Ten 5-year-old vigorous Montmorency cherry trees of uniform size were used in this study. The blossoms were removed from all trees on May 3 to insure uniform sampling. The plats each consisting of two trees were treated as follows: lime-sulfur (1–40), Cupro K (3–100), Coposil (3–100), bordeaux (6–8–100), and checks. The trees were sprayed according to the recommended schedule: namely, the petal-fall, 2-weeks, 4-weeks, and after-harvest applications.

The dry weight increment method for measuring the photosynthate produced was employed, since field results were desirable and this method offered the best means for obtaining such results unless considerable funds were expended for a carbon dioxide absorption tower set-up in the orchard. A leaf punch which removed an area of 0.3144 cm^2 was used to obtain the samples. All samples were taken from leaves on spurs of the previous season's growth located on the median portion of the shoots.

Two trees were studied under each treatment. A sample consisted of 30 punches, one punch being taken from each of 30 different leaves. Samples were taken three times daily: at 5:30 a.m., 2:00 p.m., and 7:00 p.m. The increase in dry weight during the day was obtained by subtracting the weight of the 5:30 a.m. sample from either the 2:00 p.m. or the 7:00 p.m. sample, depending upon leaf activity each day. Assuming that translocation and respiration proceed at the same rate during the day as during the night, the loss in dry weight during the night was added to the day gain to obtain the total photosynthate produced during the day. Six samples were taken from each leaf, and

[1]Journal Article No. 415 n.s. from the Michigan Agricultural Experiment Station.

TABLE I—TOTAL PHOTOSYNTHATE PRODUCED PER DAY BY LEAVES AFTER FIRST SPRAY APPLICATION (AVERAGE OF TWO TREES IN EACH PLAT; EXPRESSED AS GRAMS PER SQUARE METER LEAF AREA)

Date	Treatment					Temperature		Character of Day
	Cupro K	Coposil	Check	6–8–100	Lime-Sulfur	Maximum	Mean	
May 20	13.58	11.72	15.27	9.28	13.43	72	68	Cloudy
May 24	8.91	10.02	10.77	5.25	9.76	82	68	Partly cloudy
May 25	6.36	9.97	7.85	3.08	6.23	89	76	Partly cloudy
May 27	12.56	9.24	15.99	11.50	13.90	80	74	Cloudy
May 28	7.63	9.57	12.52	7.37	11.98	84	75	Partly cloudy
May 29	10.33	10.56	11.34	10.80	11.18	80	70	Clear
Total	59.37	61.08	73.74	47.28	66.48	—	—	———
Mean	9.90	10.18	12.29	7.88	11.08	—	—	———

this constituted a "run" which lasted for 2 days. Consequently, a new "run" was started every 2 days.

The leaves were washed with distilled water immediately preceding sampling. This was done by washing only the area taken as a sample. Immediately following collections, all samples were placed in glass vials. As soon as all samples were taken, they were brought to the laboratory, weighed, dried at 90 degrees C for 24 hours by which time they reached a constant weight. They were then removed, placed in a desiccator, cooled, and weighed again. The weights were recorded and the dry samples were then placed in crucibles and ash determinations were made. The weights for the ash were then subtracted from the constant dry weights to give the net dry weight. These net dry weights were used to compute the photosynthetic activities for the various treatments.

PRESENTATION OF DATA

Dry weight determinations were made from May 7 to 13 on all trees before any spray materials had been applied to learn if significant differences existed between the rates of the trees. The data showed there were no significant differences.

TABLE II—TOTAL PHOTOSYNTHATE PRODUCED PER DAY BY LEAVES AFTER SECOND SPRAY APPLICATION (AVERAGES OF TWO TREES ON EACH PLAT; EXPRESSED AS GRAMS PER SQUARE METER LEAF AREA)

Date	Treatment					Temperature		Character of Day
	Cupro K	Coposil	Check	6–8–100	Lime-Sulfur	Maximum	Mean	
May 30	12.02	12.67	11.51	10.60	6.90	84	72	Partly cloudy
May 31	11.86	9.74	9.33	7.42	7.22	80	72	Cloudy
June 1	12.19	11.02	10.81	7.27	6.90	78	66	Cloudy
June 2	6.05	8.70	8.71	7.91	8.16	73	64	Partly cloudy
June 3	5.83	6.57	4.41	4.40	5.79	77	64	Partly cloudy
June 7	12.74	11.78	11.46	8.38	8.59	67	61	Partly cloudy
June 8	12.37	11.72	9.12	9.75	7.48	67	58	Partly cloudy
June 9	8.70	7.54	15.21	15.17	12.14	76	62	Clear
June 10	9.76	7.75	8.48	9.50	8.33	78	70	Cloudy
June 13	11.98	10.39	10.61	13.67	8.59	73	60	Clear
Total	103.50	97.88	99.65	94.07	80.10	—	—	———
Mean	10.35	9.79	9.97	9.41	8.01	—	—	———

TABLE III—TOTAL PHOTOSYNTHATE PRODUCED PER DAY BY LEAVES AFTER THIRD SPRAY APPLICATION (AVERAGE OF TWO TREES IN EACH PLAT; EXPRESSED AS GRAMS PER SQUARE METER LEAF AREA)

Date	Treatment					Temperature		Character of Day
	Cupro K	Coposil	Check	6–8–100	Lime-Sulfur	Maximum	Mean	
June 14	14.05	10.55	11.88	9.86	5.04	76	64	Cloudy
June 15	11.99	7.52	11.56	10.39	7.89	84	72	Partly cloudy
June 16	7.85	2.75	6.20	6.52	4.98	69	65	Cloudy
June 20	13.52	5.52	13.36	11.92	6.75	83	70	Clear
June 21	13.47	6.95	10.71	14.68	5.36	84	72	Cloudy
June 22	8.48	9.38	8.80	6.62	6.23	85	72	Partly cloudy
June 23	7.37	6.91	6.63	5.72	3.84	86	74	Clear
June 28	9.97	8.43	6.79	7.94	7.21	72	60	Clear
June 29	10.81	8.06	7.05	4.18	4.61	75	62	Partly cloudy
Total	97.51	66.07	82.98	77.83	51.91	—	—	———
Mean	10.83	7.34	9.22	8.65	5.77	—	—	———

The petal-fall aplication was given May 13; however, no determinations were made until May 20 because weather conditions would not permit sampling. In Table I, data are presented showing the average amounts of photosynthate produced by the leaves of the two trees in each plat after the first spray application.

The mean of the leaves of the bordeaux-sprayed trees which was 7.98 grams was significantly less than the means of the leaves of the lime-sulfur-sprayed and check trees, which were 11.08 grams and 12.29 grams, respectively. Significance was determined on the basis of the 1 per cent level of probability.

The 2-weeks application was put on May 30; the data are presented in Table II.

There were no significant differences among the rates of the trees, though the lime-sulfur mean was a border line case.

The 4-weeks application was made June 14. In Table III are presented the data from the third application.

The lime-sulfur mean of 5.77 grams was significantly less than the Cupro K, bordeaux, and check means which were 10.83 grams, 8.65 grams, and 9.22 grams, respectively. The Coposil mean of 7.34 grams was also significantly less than the Cupro K mean.

The determinations of the effect of the third application were continued until June 29. It was originally planned to obtain the photosynthetic rates throughout the season, but by June 29, all the suitable leaves on spurs on the median portion of the shoots had been sampled. Since no check had been made on a new series of trees previous to any application of spray, the study was completed, observations having been made for 25 complete days.

The summaries for the total photosynthate produced by the leaves of the trees after three applications are presented in Table IV and the mathematical analysis is given in Table V. It can be stated that the means of the Cupro K-sprayed and check leaves, which were 10.38 grams and 10.25 grams, respectively, were significantly higher than those of the Coposil, bordeaux, and lime-sulfur-sprayed leaves which were 9.00 grams, 8.77 grams, and 7.94 grams, respectively. Further-

TABLE IV—SUMMARY OF TOTAL PHOTOSYNTHATE PRODUCED BY LEAVES OF TREES AFTER THREE SPRAY APPLICATIONS (FROM MAY 20 TO JUNE 29)

Application	Treatment				
	Cupro K	Coposil	Check	6–8–100	Lime-Sulfur
Petal-Fall (6 days).....	59.37	61.08	73.74	47.28	66.48
Two-Weeks (10 days)....	102.50	97.88	99.65	94.07	80.10
Four-weeks (9 days).....	97.51	66.07	82.98	77.83	51.91
Total.....	259.38	225.03	256.37	219.18	198.49
Mean.....	10.38	9.00	10.25	8.77	7.94

TABLE V—ANALYSIS OF VARIANCE OF SUMMARY OF TOTAL PHOTOSYNTHATE PRODUCED AFTER THREE APPLICATIONS

Source	Degrees of Freedom	Sum of Squares	Variance	F	Standard Error
Total.....	124	1041.11	——	——	——
Applications.....	2	69.07	34.54	13.65	——
Treatments.....	4	107.16	26.79	10.59	——
Days.....	22	422.94	19.22	7.60	——
Application Xtreatment..	8	119.64	14.96	5.91	——
Error.....	88	322.29	2.53	——	1.59

more, no significant differences existed among the means of the Coposil, bordeaux and lime-sulfur-sprayed leaves, and thus, any variation could not be definitely attributed to any effect of the sprays themselves. However, since the lime-sulfur mean decreased markedly after the second and third spray applications and as a result was a bordeaux-lime case, it would appear that if more samples were taken, there might have been a significant difference between the means of the lime-sulfur-sprayed and the copper-sprayed leaves.

From this study, it appears that from the standpoint of photosynthetic efficiency, Cupro K is superior to Coposil, 6–8–100 bordeaux, and lime-sulfur as a spray for sour cherries.

LITERATURE CITED

1. CATION, D. New copper sprays for control of leaf spot. *Mich. Agr. Exp. Sta. Quart. Bul.* 19 (3) : 123–132. 1937.
2. CHRISTOPHER, E. P. The effect of flotation sulfur spray on the carbon dioxide assimilation of apple leaves. *Proc. Amer. Soc. Hort. Sci.* 33: 149–151. 1936.
3. CLORE, W. J. The effect of bordeaux, copper, and calcium sprays upon carbon dioxide intake of Delicious apple leaves. *Proc. Amer. Soc. Hort. Sci.* 33:177–179. 1936.
4. HEINICKE, A. J. How lime-sulfur spray effects the photosynthesis of an entire ten-year-old apple tree. *Proc. Amer. Soc. Hort. Sci.* 35: 256–259. 1938.
5. HOFFMAN, M. B. Carbon dioxide assimilation by apple leaves as affected by lime-sulfur sprays. II. Field experiments. *Proc. Amer. Soc. Hort. Sci.* 30:169–175. 1934.
6. RASMUSSEN, E. J. Effect of some copper and sulfur fungicides on the tree and fruit of Montmorency cherry. *Mich. Agr. Exp. Sta. Quart. Bul.* 19 (3) : 132–142. 1937.

A
(Process Slip)

D.A/c No.:

ORDER FORM 230
(please read Instruction on the back before filling up)

TO
THE DIRECTOR
INDIAN NATIONAL SCIENTIFIC DOCUMENTATION CENTRE
14, SATSANG VIHAR MARG, OFF S.J.S. SANSANWAL MARG
SPECIAL INSTITUTIONAL AREA, NEW DELHI 110067

INSDOC ORDER NO 6391/635
LL880

Customer's reference: 2|P|91|LIB

DATE 6.2.1991

22.2.91
22 FEB 1991

Name and address

DOCUMENTATION OFFICER
RUBBER RESEARCH INST OF INDIA
RUBBER BOARD PO
KOTTAYAM 686 009
KERALA

Advance received Rs

Service required:

- Micro-film ☐
- Bib ☐
- Paper Photo-copy ☑
- Positive Slide ☐
- Translation ☐

1. Author(s): Murphy, L M

2. Title of article: The effect of certain fungicides on the photosynthetic activity of sweet cherry leaves.

3. Title of pubn. In full: Proc Amer Soc Hort Sci

(If you are sending your own copy, check here) ☐

4 Year/ Date	Vol. No	Issue No.	Pages / Plates
1939	37		Pages 375 to 378 & Fig Plates to

NOT TO BE FILLED BY CUSTOMER

LOCAL	ORDERED ON 6/3/91	P	PAGES/STRIP 04
INLAND	REMINDED ON	T	DESPATCHED ON 26/3
			CHARGES
FOREIGN		Recd.	BILL NO

Please supply the above noted service. I certify that this document is required for private study only and that it will not be sold or reproduced without the permission of the copyright holder. I assume responsibility to the copyright holder for your acts in copying or translating this document.

Mercy Jose
SIGNATURE