festation may be expected within one to two weeks.

*Moderator:* Thank you Mr. Thompson. Our time has been consumed and we have been requested to make an announcement. This information about Parathion which we have discussed will be published in the Proceedings. The moderator would like to express appreciation for all members of the panel for your patience in this rather lengthy proposition. I am confident that each and every one of you feel indebted to these 22 gentlemen at the table here who have come from their businesses and homes and work to come, not only to be with you on this panel this morning, but most of them have spent weeks in trying to answer questions that have been accumulated rather early after the panel was announced; and I would like to acknowledge, as moderator, their great assistance and their patience. That concludes the panel.

# VEGETABLE SECTION

## CONTROL OF LATE BLIGHT AND GRAY LEAF SPOT OF TOMATOES WITH NEW FUNGICIDES

ROBERT A. CONOVER
*Florida Agricultural Experiment Stations*
*Sub-Tropical Experiment Station*
Homestead

Since the demonstration by Ruehle (1) that nabam* plus zinc sulfate provided outstanding control of late blight (*Phytophthora infestans* DBy.), this fungicide has been widely adopted by tomato growers throughout Florida. Even though this material has given excellent results, fungicide testing has continued at the Sub-Tropical Experiment Station with the aim of finding new and more effective fungicides. This paper is a report of the results of experiments with tomato fungicides conducted at Homestead during the seasons of 1948-49 and 1949-50. All data were obtained from field plots, each containing 36 plants. All treatments were randomized and replicated four times. The plots were sprayed with a tractor-drawn power sprayer operated at a pressure of 400 pounds at the pump. Three to 11 nozzles per row were used as needed according to plant size. Cultural care of the plots approximated commercial practice common in the area. Insects were controlled by separate blanket applications of recommended insecticides.

The first experiment was set out on November 17, 1948, with Grothen Globe tomatoes. Fungicides were applied every seven days, a total of 11 applications being made during the experiment. Foliage diseases did not appear until the first picking when gray leaf spot (*Stemphylium solani* Weber) appeared. This disease spread rapidly and did considerable damage in the check and in plots sprayed with ineffective materials. Late blight and early blight (*Alternaria solani* (Ell. and Mart.) Jones and Grout) were found in the checks but only in trace amounts and did not influence the yields. The treatments used, disease

*See footnote, Table 1.

readings, and yields are presented in Table 1.

It is clear from these data that the nabam treatments, zineb A and magnesium ethylenebisdithiocarbamate plus zinc sulfate gave excellent gray leaf spot control. CR 305, Phygon XL, Copper Compound A, Copotox and zineb B failed to give commercial control of gray leaf spot in this test. It should be mentioned that observations made in this and other experiments with this particular lot of zineb B indicated it to be substandard. These data strongly confirm the data obtained by Walter (2) from experiments conducted at the Vegetable Crops Laboratory.

The second test of the 1948-1949 season was set out January 13, 1949. Fungicides were applied twelve times on a schedule varying from four to seven days with fluctuations of disease intensity. Late blight was present in the plots during most of the test; however, it was comparatively mild and caused little damage in plots other than the check. From the data presented in Table 2, it is clear that while all treatments were much superior to the check there were no significant differences among fungicides either with respect to yield or late blight control.

Only one experiment was conducted during the 1949-50 season but late blight was rampant during the test and thus offered an opportunity to evaluate the fungicides under unusually rigorous conditions. The Missouri S-34 tomato used in this test appeared to be more susceptible to late blight than standard commercial varieties. The plants were set out January 3, 1950. The plots were sprayed 20 times, the first application being made on January 11 and subsequent applications being applied at intervals of two to six days. Late blight was

TABLE 1.
INCIDENCE OF GRAY LEAF SPOT AND YIELDS OF MATURE-GREEN GROTHEN GLOBE TOMATOES FROM THE FIRST FUNGICIDE TEST, 1948-49 SEASON. FIGURES ARE AVERAGES OF FOUR REPLICATES.

| | Material and Amount Used per 100 Gallons | Gray Leaf Spot Count[1] | Marketable Yield in Bu./Acre |
|---|---|---|---|
| 1. | Zineb A[2] (2 lb.) | 2.6 | 329.8 |
| 2. | Nabam A[2] (2 qts.), $ZnSO_4$ (1 lb.), lime (0.5 lb.) | 1.5 | 327.4 |
| 3. | Nabam B[2] (2 qts.), $ZnSo_4$ (1 lb.), lime (0.5 lb.) | 2.0 | 326.5 |
| 4. | No. 2 alternated with No. 11 | 13.2 | 310.7 |
| 5. | CR 305 (2 lb.) | 29.2 | 309.5 |
| 6. | Nabam A[2] (2 qts.), $ZnSO_4$ (1 lb.) | 1.7 | 304.4 |
| 7. | Magnesium ethylenebisdithiocarbamate (2 qts), $ZnSO_4$ (1 lb.) | 2.2 | 302.0 |
| 8. | No. 9 first 8 applications, then 3 applications of No. 2 | 19.2 | 281.7 |
| 9. | Copper Compound A (4 lb.) | 39.0 | 274.2 |
| 10. | Copotox (4 lb.) | 53.9 | 269.6 |
| 11. | Phygon XL (0.75 lb.) | 28.9 | 266.2 |
| 12. | Zineb B[2] (2 lb.) | 20.8 | 265.0 |
| 13. | Check | 68.3 | 180.8 |
| Difference necessary for significance | | 12.5 | 70.7 |

[1] Average number of spots per leaflet.

[2] Nabam and zineb are generic names adopted by the American Phytopathological Society for fungicides containing, respectively, the sodium and zinc salts of ethylenebisdithiocarbamate. Nabam A = Dithane D14; nabam B = Parzate Liquid; zineb A = Dithane Z78; zineb B = Parzate.

TABLE 2.

INCIDENCE OF LATE BLIGHT AND YIELDS OF MATURE-GREEN GROTHEN GLOBE TOMATOES FROM THE SECOND FUNGICIDE TRIAL, 1948-1949 SEASON. FIGURES ARE AVERAGES OF FOUR REPLICATES.

| Material and Amount Used per 100 Gallons | Late Blight Data[1] | Marketable Yield in Bu./Acre |
|---|---|---|
| 1. SR 406 (4 lb.) | 1.2 | 275.4 |
| 2. No. 6 alternated with No. 4 | 0.2 | 249.8 |
| 3. Magnesium ethylenebisdithiocarbamate (2 qts.), $ZnSO_4$ (0.75 lb.) | 0.2 | 249.8 |
| 4. Phygon XL (0.75 lb.) | 0.5 | 248.4 |
| 5. Copper tetramethylthiuramdisulfide (2 lbs.) | 3.7 | 246.8 |
| 6. Nabam A[2] (2 qts.), $ZnSO_4$ (1 lb.), lime (0.5 lb.) | 0.3 | 246.4 |
| 7. Nabam A[2] (2 qts.), $ZnSO_4$ (0.75 lb.) | 0.3 | 236.0 |
| 8. Nabam B[2] (2 qts.) $ZnSo_4$ (0.75 lb.) | 0.3 | 235.8 |
| 9. CR 305 (2 lb.) | 2.7 | 226.4 |
| 10. Check | 35.7 | 116.4 |
| Difference necessary for significance | 13.8 | 52.8 |

[1] Average number of lesions per plant, March 4, 1949.
[2] See footnote, Table 1.

TABLE 3.

INCIDENCE OF LATE BLIGHT AND YIELDS OF MATURE-GREEN MISSOURI S-34 TOMATOES FROM THE FUNGICIDE TRIAL OF THE 1949-50 SEASON. FIGURES ARE THE AVERAGES OF FOUR REPLICATES.

| Treatment and Amount Used per 100 Gallons | Late Blight Counts | | Marketable Yield in Bu./Acre |
|---|---|---|---|
| | Stem Cankers[1] | Fruit[2] | |
| 1. Zineb A[3] (2 lb.) | 1.8 | 0 | 342.0 |
| 2. Zineb C[3] (2 lb.) | 4.0 | 0.27 | 308.8 |
| 3. Zineb B[3] (2 lb.) | 3.3 | 0.10 | 297.8 |
| 4. Zineb D[3] (2 lb.) | 5.3 | 0.42 | 293.4 |
| 5. Phygon XL (0.75 lb.) | 5.0 | 0.08 | 288.6 |
| 6. No. 8 alternated with No. 5 | 2.3 | 0.07 | 288.2 |
| 7. Nabam B[3] (2 qt.), $ZnSO_4$ (0.75 lb.) | 3.5 | 0.09 | 263.6 |
| 8. Nabam A[3] (2 qt.) $ZnSO_4$ (1 lb.), lime (0.5 lb.) | 4.3 | 0.22 | 259.4 |
| 9 Nabam A[3] (2 qt.) $ZnSO_4$ (1 lb.) | 6.8 | 0.10 | 254.8 |
| 10. HL 446A (SR 406) (5 lb.) | 19.5 | 0.84 | 227.0 |
| 11. Tribasic Copper Sulfate (4 lb.) | 54.3 | 2.17 | 105.2 |
| 12. Copper tetramethylthiuramdisulfide (2 lb.) | 41.8 | 5.07 | 93.6 |
| 13. P 111-5 (1 pt.) | 34.3 | 16.88 | 28.4 |
| 14. Check | 86.5 | 28.24 | 10.4 |
| Difference necessary for significance | 10.5 | 2.67 | 54.4 |

[1] Total number of stem infections found on ten plants, March 9, 1950.
[2] Percent of total yield showing late blight infection.
[3] See footnote, Table 1. Zineb A = Dithane Z78; zineb B = Parzate; zineb C = Dithane Z78 M6A; zineb D = Dithane Z78 M4A; nabam A = Dithane D14; nabam B = Parzate Liquid.

present on a few plants before spraying was begun and was active throughout the test.

The data obtained from this experiment (Table 3) show that Phygon XL and the nabam and zineb treatments were outstandingly effective in controlling late blight. While these materials as a group outyielded all others, the zineb sprays and Phygon XL were superior to the nabam treatments. HL 446A gave good control of late blight, but not equal to that obtained from the above-mentioned materials. Tribasic Copper Sulfate, copper tetramethylthiuramdisulfide and P 111-5 all failed to control late blight and yields from plots sprayed with these fungicides were very low.

For the first time in several years of testing in the Homestead area, the nabam sprayed plots exhibited injury in the form of leaf roll, marginal chlorosis and stunting. It seemed likely that the reduced yields of these plots compared with zineb sprayed plots were due to this injury. The use of lime in one of the treatments failed to alleviate the injury; however, it was barely noticeable in the treatment alternating Phygon XL with nabam. This damage, which was also observed in some late commercial fields of the Grothen Globe variety, may have resulted in part from the heavy residue built up from frequent spraying in the absence of appreciable rain.

An injury to the cuticle and epidermis of the fruit was observed in certain treatments of the late test of the 1948-49 season and in the test of the 1949-50 season. This injury was seen initially on small fruit about one-half inch in diameter when it appeared as minute, roughened spots that were easier felt than seen. These were often found to be directly under dried droplets of spray. As the fruit enlarged the spots became larger and more prominent, perhaps being aggravated by additional sprays. On mature-green fruit the spots were up to one-fourth inch in diameter. At this stage the affected areas were corked over much as seen in scarred fruit but differed in that the areas were round and often were obviously distributed over the fruit in typical spray-droplet pattern. There was great variability in the number of spots, their size and distribution, although most were usually found on one side of the fruit. These spots usually did not interfere with ripening and did not result in the rotting of the fruit unless secondarily infected.

In both of the tests referred to, this damage was observed in all plots sprayed with the nabam treatments and with HL 446A (SR 406). In the alternating Phygon XL and nabam schedule the damage was appreciably less; no injury resulted from the use of Phygon XL alone. The injury was not observed in other treatments. In the 1948-49 test, approximately 35% of the third picking of Grothen Globe tomatoes exhibited this injury, much of it severe enough to make the fruit unmarketable. In the 1949-50 test the damage was less severe with about 5% of the total yield of the Missouri S-34 tomato being affected. It is interesting to note that the zineb sprays, which provide the same fungicide as nabam plus zinc sulfate, did not show this injury.

This damage has also been observed by Walter in the Manatee-Ruskin area (3). Observations made at Homestead and on the West Coast by Walter indicate there is considerable variation in the amount of injury displayed by different varieties. It is hoped that work this season at the Vegetable Crops Laboratory and at the Sub-Tropical Experiment Station will result in information that will provide an understanding of just what causes this injury and how it may be avoided.