Spray and Dust Treatments of Potato Demonstration Plots, 1945

By
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This article written by Mr. Gordon A. Brandes and Dr. Ely M. Swisher is based on spray and dust treatments of demonstration plots of potatoes located on farms of grower cooperators. While this work did not include check plots nor enough replications to justify the formulation of definite conclusions, it does indicate how the treatments reacted under practical farm use. It is a pleasure to present these results in this issue of the Bimonthly Bulletin.—H. L. Walster, Director, North Dakota Agricultural Experiment Station.

Various spray and dust treatments were applied to potato demonstration plots located on the farms of grower cooperators at 15 well-distributed points throughout the potato growing area of northeastern North Dakota during the summer of 1945. Valuable cooperation was received from the North Dakota Agricultural Experiment Station in checking on insect development in relation to the treatments applied; the State Seed Department in locating fields for the tests; the cooperating growers (1) who furnished the plots and applied the treatments, and the chemical supply companies (2) who furnished the spray and dust materials.[2]

Each plot consisted of 20 to 32 rows, depending on the size of the equipment used. Most fields were one-half mile long and averaged from 3 to 6 acres for each material tested. All equipment used was the grower's standard commercial machines, and the wet sprayers were the new high pressure type.

Most plots received 4 applications at 10-day intervals during the season. Sprays were applied at about 400 lb. pressure, beginning at 75 gal. per acre and increasing to 100 gal. per acre for the 4th spraying. Dust applications began at 15 lbs. per acre, increased 5 lbs. per application, reaching 30 lbs. per acre for the 4th application.

A combination fungicide—insecticide was used in each plot. DDT was included in at least one combination on every farm as well as the more commonly used arsenical and contact insecticides. The Dust Series, with one exception, used only one copper fungicide per farm, while the Spray Series included both copper and the newer organic thio-carbamate fungicides. A complete list of materials is in the footnotes.

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[2]The reader is referred to another series of experiments in the article on "Evaluation of various sprays and dust materials in the control of insects and of the fungus causing early blight of potatoes," appearing in this issue of this Bimonthly Bulletin. H.L.W.

No untreated check plots were included in the tests, except on one farm referred to below. Because of the relatively large sized check plot required, serious losses might have resulted if severe insect or disease conditions had developed during the season.

Observations and Results

Insect Control: Periodic insect counts through sweepings were made by personnel of the Agricultural Entomology Department of the NDAC Experiment Station. These counts were made in accordance with standardized procedure and took into consideration the four insect pests of major importance; the six-spotted leafhopper, the potato leafhopper, the potato fleabeetle, and the Colorado potato beetle. The insects ranked in the foregoing order in resistance to the insecticidal treatments, with the six-spotted leafhopper being the most difficult to control and the Colorado potato beetle being the easiest. Insect populations were generally light to moderate in these fields in 1945.

A study of the results show the combinations containing DDT to have given the highest degree of insect control. Combinations containing the arsenical-sabadilla insecticides proved slightly less effective and in this respect held second place to DDT. The other combinations containing DDD, Dow F508-DN 1%, arsenical-Lethane and arsenical ranked lower in controlling the insects.

Disease Conditions: Early Blight, *Alternaria solani.*

The infection of early blight in potatoes was generally moderate to heavy in the Red River Valley in 1945. In spite of the common name in general usage in North Dakota "early blight" seems to develop more severely in the latter part of the season. The disease may show up early in the season but becomes more pronounced as the vigor of the foliage is lost and the plants reach maturity.

General observations made from this year's tests indicate that the organic fungicides, Fermate and Dithane, effected better control of early blight than the copper materials used. There was a lower incidence of early blight lesions in the organic sprayed plots than in the copper sprayed plots. The organic sprayed plots remained green longer than the copper plots which went down and matured one to two weeks earlier.

Plots treated with DDT which effected better potato flea beetle control, also showed a lower degree of infection of early blight. Not only is the flea beetle capable of transmitting the early blight organism but the small round puncture typical of flea beetle damage permits easier entrance of air and of the insect-carried early blight disease organism.

Late Blight, *Phythophthora infestans,* developed in epidemic proportions on only a few isolated fields in the Red River Valley in 1945. Tuber damage was found on only one of the field demonstration plots. This occurred in 134 rows left by one grower, who treated this plot only once with a straight arsenical dust. An estimated 10 to 15 per cent of the tubers in this plot were infected with late

blight, while no trace of blight could be found in the adjoining plots which received four applications of fungicide spray. The potatoes from the treated plots were packed in the field for Red Tag Certified grade. Those from the unsprayed plot required machine grading. With this one exception, late blight degree of infection was so slight in any of the demonstration plots that no further results can be reported from this series of tests.

Yield Data

Yields in bushels per acre showed the natural variation that would be expected from the diversity of soil and climatic conditions on the different farms. Yields were taken by counting the actual number of sacks per picker row (4 planted rows) several times within a plot. These were averaged and calculated to bushels per acre for each plot. See tables 1 and 4. Yield data were secured on 12 of the 15 farms.

In order to compare one plot with another a standard material on each farm was assigned a value of 100 percent. All other yields on that same farm were calculated to the standard in terms of percentage. The percentage figure can then be used to make comparisons of yields for a given material between farms. Dust 25D, DDT and Tribasic copper sulphate, was used as the standard material on farms 1 and 2. Dust 1D, DDT and Cuprocide, was the standard material on farms 3 and 4. Spray 4S, Dithane and DDT, was used as the standard for the spray plots because this material was used on each of the eight spray series. See tables 2, 3, and 5.

In the dust plots, DDT with copper out-yielded Arsenical and copper from 8.6 to 44.3 bushels per acre and Lethane-arsenical-copper by 5.0 to 9.3 bushels per acre. The combination of DDT-Pyrocide-copper yielded 5.2 and 6.9 bushels per acre more than DDT-Cuprocide. The Dow experimental dust, F-508, containing dinitro insecticide yielded the same on one farm and 10.7 bushels per acre more on another than Cuprocide-DDT. Yield data were not obtained on the Copper A dust series.

Several combinations of spray materials that were actually quite similar in chemical composition, although made up from different commercial products, were grouped together to simplify the compilation of results. The Dithane-DDT plots were the highest yielding plots in all but two cases. Dithane-DDT was outyielded by Fermate-DDT by 4.1 bushels per acre on one farm and by Dithane-Arsenical-Lethane by 2.1 bushels per acre on another. The Dithane-Arsenical plots yielded from 11.4 to 18.5 bushels per acre less and Dithane-Lethane-Arsenical yielded 8.8 bushels less in one case and 2.1 bushels per acre more in another than Dithane-DDT. No direct comparisons could be made on the same farm but the percentage yield of Copper A-DDT was not significantly higher (1%) than Dithane-Arsenical. Copper A-DDT yielded from 3.2 bushels to 14.0 bushels per acre less than Dithane-DDT. Copper A-DDT yielded 35.5 bushels per acre more on one farm and 1.3 bushels per acre less on another than Cuprocide-DDT, where direct comparisons could be made.

In the percentage average Copper A-DDT exceeded Cuprocide-DDT by 2.8%. Copper A-Arsenical-Lethane on farm No. 10 yielded 8.7 bushels per acre less than Dithane-DDT. The general group of copper-arsenicals yielded from 22.2 to 62.3 bushels per acre less than Dithane-DDT. The check plot on farm 7 which received only one application of arsenical dust yielded 73.8 bushels per acre less than the Dithane-DDT and showed the greatest difference in yield of any of the plots.

Table 1

Yield in Bushels Per Acre—Dust Plots

Farm No.	Mat. No. Material— 25D DDT Tri Basic	24D Arsenical Tri Basic	26D Arsenical, Lethane Tri Basic
1	254.3	234.2	243.5
2	240.0		235.0

Mat. No. Material	1D DDT Cuprocide	5D Quik Kill Cuprocide	23D DDT, Pyrocide Cuprocide	29D Dow F-508
3	303.3	259.0	308.5	303.4
4	237.3	228.6	244.2	248.0

Table 2

Percentage Yields — Dust Plots

Farm No.	Mat. No. Material— 25D DDT Tri Basic	24D Arsenical Tri Basic	26D Arsenical, Lethane Tri Basic
1	100.00%	92.0%	95.7%
2	100.00%	.....	97.9%
Average	100.00%	92.0%	96.8%

Mat. No. Material—	1D DDT Cuprocide	5D Arsenical Cuprocide	23D DDT, Pyrocide Cuprocide	29D Dow F-508
3	100.00%	85.3%	101.7%	100.00%
4	100.00%	96.3%	102.9%	104.5%
Average	100.00%	90.8%	102.3%	102.2%

Table 3

Material Group Percentage Yield Averages—Dust Plots

DDT Copper	DDT Pyrocide Copper	Dow F-508	Arsenical Lethane Copper	Arsenical Copper
100.%	102.3%	102.2%	96.8%	89.3%

Table 4—Yield in Bushels Per Acre—Spray Plots

Farm No.	Mat. No. / Material	4S Dithane DDT	10S Fermate DDT	7S, 17S, 21S Dithane Arsenical	19S Copper A DDT	8S Cuprocide DDT	20S, 22S, 23S Coppers Arsenical	24S Copper A Arsenical Lethane	Check 1 application Arsenical Dust
5		198.4	196.0	187.0 (17S)	.....	.....	.....	.....	.....
6		424.3	428.4	.....	410.3	375.8	.....	.....	.....
7		408.7	.....	390.2 (21S)	.....	.....	346.4 (20S)	.....	334.9
8		347.5	344.8	332.7 (17S)	.....	.....	325.3 (22S)	.....	.....
9		327.6	.....	329.7 (7S)	.....	319.8	287.4 (23S)	.....	.....
10		219.0	.....	.....	215.8	.....	.....	210.3	.....
11		270.7	265.0	.....	264.0	265.3	.....	.....	.....
12		276.6	.....	267.8 (7S)	.....	.....	.....	.....	.....

Table 5—Percentage Yields—Spray Plots

Farm No.	Mat. No. / Material	4S Dithane DDT	10S Fermate DDT	7S, 17S, 21S Dithane Arsenical	19S Copper A DDT	8S Cuprocide DDT	20S, 22S, 23S Coppers Arsenical	24S Copper A Arsenical Lethane	Check 1 application Arsenical Dust
5		100.00%	98.7%	94.2% (17S)	.....	.....	.....	.....	.....
6		100.00%	100.9%	.....	96.7%	88.5%	.....	.....	.....
7		100.00%	.....	95.4% (21S)	.....	.....	84.7% (20S)	.....	81.9%
8		100.00%	99.2%	95.7% (17S)	.....	.....	93.6% (22S)	.....	.....
9		100.00%	.....	100.6% (7S)	.....	97.6%	87.7% (23S)	.....	.....
10		100.00%	.....	.....	98.5%	.....	.....	96.0%	.....
11		100.00%	97.8%	.....	97.5%	98.0%	.....	.....	.....
12		100.00%	.....	96.8% (7S)	.....	.....	.....	.....	.....
Average		100.00%	99.1%	96.5%	97.5%	94.7%	88.6%	96.0%	81.9%

Summary and Conclusions

15 potato dusting and spraying field demonstration plots were conducted in the Red River Valley potato section in 1945. Plots of 3 to 6 acres each were treated with the growers' regular equipment. Of the four insect pests of major importance the six-spotted leafhopper proved to be the most difficult to control, with the potato leafhopper, the potato fleabeetle, and the Colorado potato beetle more easily controlled in the order listed. Spray and dust treatments containing DDT gave a higher degree of control of these insects than did any of the other insecticidal combinations.

The organic thio-carbamate fungicides Dithane and Fermate gave more effective control of early blight, *Alternaria solani*, than the fixed copper fungicides. Generally good control of the potato flea beetle with DDT produced lower incidence of early blight.

Late Blight, *Phythophthora infestans*, was not general in these plots, except in one check which received only a single application of a straight arsenical dust. This plot not treated with a fungicide had 10 to 15% blighted tubers.

Yield data were secured by taking the actual count of the packed potatoes and calculated to bushels per acre. Yield differences in most of the dust plots were only slightly significant but the copper-DDT plots outyielded the copper-arsenical plots by 8.3 to 44.3 bushels per acre. DDT-Pyrocide-copper and Dow F-508 dust slightly outyielded DDT-copper.

Average percentage ratings for the dust groups were: DDT-copper 100.00%; DDT-Pyrocide-copper 102.3%; Dow F-508 102.2%; Arsenical-Lethane-copper 96.8%; Arsenical-Copper 89.3%.

Yield variations were small and of little significance in the Dithane-DDT, Fermate - DDT, Copper A-DDT, Dithane-Arsenicals, and Cuprocide-DDT spray plots. But Dithane-DDT outyielded the general group of copper-arsenicals by 22.2 to 62.3 bushels per acre and the check receiving one application of arsenical dust and no fungicide by 73.8 bushels per acre.

Average percentage yield for the spray material groups were Dithane-DDT 100.00%; Fermate-DDT 99.1%; Copper A-DDT 97.5%; Dithane-Arsenical 96.5%; Copper A - Arsenical - Lethane 96.0%; Cuprocide-DDT 94.7%; Copper-Arsenical 88.6%; check 81.9%.

Footnotes

(1) F. J. Butler, Grand Forks; Dickson Bros., Gilby; P. J. Flaten, Hoople; Art Greenberg, Grand Forks; Harris & Robbie, Cavalier; R. C. Hastings, Hillsboro; Bert Hvidsten, Neche; Dwight Holmes, Ralph Ingles, Walhalla; Ben Larson, Reynolds; Austin Pladson, Hatton; Gerald Ryan, John Scott, Gilby; Lawrence Tibert, Voss; Grant Trenbeth, Neche.

(2) Agricultural Supply Co., Grand Forks; Dow Chemical Co., Midland, Mich.; E. I. DuPont deNemours, Wilmington, Del.; McConnon & Co., Winona, Minn.; Rohm & Haas Co., Philadelphia, Pa.

Composition of Dust Mixtures used in the trials

1D Cuprocide 5% (metallic copper 4%); Gesarol, (DDT 5%)

5D Cuprocide 5% (metallic copper 4%) Quik Kill 33 1/3%

23D Cuprocide 5% (metallic copper 4%); Gesarol, (DDT 5%); Pyrocide (.1% Pyrethrins)

24D Tri-Basic Copper Sulphate 10% (metallic copper 5.2%); Quik Kill 33 1/3%

25D Tri-Basic Copper Sulphate 10% (metallic copper 5.2%); Gesarol, (DDT 5%)

26D Tri-Basic Copper Sulphate 10% (metallic copper 5.2%) Quik Kill 33 1/3%, Lethane B-71 14%

29D Dow Experimental Dust F-508 —DN (Dinitro) 1%; Metallic Copper 7%

Composition of Spray Mixtures used in the trials

Concentration per 100 gal. water

4S Dithane*-Zinc Sulphate-Lime; Gesarol (DDT½ lb.)

7S Dithane-Zinc Sulphate-Lime; Quik Kill 5 lb.; Lethane B-72 3 lb.

8S Cuper Spray** 5 lb., (Metallic Copper 1.2 lb.); Gesarol (DDT ½ lb.)

10S Fermate 2 lb.; Deenate (DDT ½ lb.)

17S Dithane-Zinc Sulphate-Lime; Quik Kill 5 lb.

19S Copper A 3 lb. (Metallic Copper 1.35 lb.); Deenate (DDT ½ lb.)

20S Kopper King 5 lb. (metallic copper 2.6 lb.); London Purple 5 lb.

21S Dithane-Zinc Sulphate-Lime; London Purple 5 lb.; Lethane B-72 3 lb.

22S Kopper King 5 lb. (Metallic Copper 2.6 lb.); Quik Kill 5 lb.

23S Cuper Spray 5 lb. (Metallic Copper 1.2 lb.) Quik Kill 5 lb.

24S Copper A 3 lb. (Metallic Copper 1.35 lb.); Quik Kill 5 lb.; Lethane B-72 3 lb.

*All Dithane mixtures ½ gal. Dithane D-14, 1 lb. Zinc Sulphate, ½ lb. Lime

**Cuper Spray—A prepared spray formulation containing 30% Cuprocide (metallic copper content 24%)

Inheritance in a Bread Mold

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have resulted where each one characterizes a loss in the bread mold in its ability to make a vitamin or an amino acid.

The elegance of these experiments lies in part in the highly accurate demonstration of the presence of genes responsible for the different characters. This comes about from the fact that the *Neurospora* plant, unlike the plants and animals most familiar to us, has but a single set of chromosomes for most of its life history. Thus there are but two kinds of offspring from a hybrid, the new mutants and the original type. Eight spores of one of the generations are formed in a small sac and if the spores result from a cross, four of them, arranged in regular order in the sac, produce the mutated mold, and four of them, the non-mutated mold. As this has happened very many times, no other conclusion seems possible than that there are separate chemical particles located in the chromosomes at different points, genes, each of which is responsible for a character in the organism or acts as a modifier of that character. Besides the additional light these studies have thrown upon inheritance, the various new forms of the mold furnish new and highly sensitive mediums for the testing of the presence of various vitamins. It is interesting that this obscure colorless plant has demands in the way of vitamins and basic foods similar to the human organism. (L.R.W.)