Evaluation of Various Spray and Dust Materials in the Control of Insects and of the Fungus Causing Early Blight of Potatoes[1]

By

J. A. Munro[2] and Wm. G. Hoyman[3]

OBJECTIVES AND MECHANICS OF THE EXPERIMENT

During the summer of 1945, the North Dakota Agricultural Experiment Station, in cooperation with the State Seed Department and commercial companies[4], tested several of the newer spray and dust materials on potatoes at Grand Forks and Park River, North Dakota; the object being to test the effectiveness of the various treatments in combating insects such as leafhoppers, the potato fleabeetle, and the Colorado potato beetle, and in preventing infection from the early-blight fungus, *Alternaria solani*. At Grand Forks, the spraying and dusting operations were conducted by Mr. Gordon Brandes of the Agricultural Supply Company and Dr. Ely M. Swisher of the Rohm and Haas Company; and at Park River by Mr. C. E. Nelson, Jr. of the E. I. du Pont de Nemours & Company and Mr. B. M. Legrid of the State Seed Department. At Grand Forks, a total of 4 applications were made at 10 to 14-day intervals, beginning July 16th and ending August 23rd. At Park River, a total of 5 applications were made at approximately similar intervals, beginning July 17th and ending August 28th. The spraying was done with a small 2-row power sprayer at a pressure of about 175 pounds, except for the second application to the Park River plots which, because of a temporary breakdown of the power sprayer, was done with a hand sprayer at a pressure ranging from 50 to 75 pounds. For the first application, sufficient coverage of the foliage was obtained at the rate of about 75 gallons per acre, but as the plants increased in size the amount was gradually increased to a maximum of 100 gallons for the final application. The dusts were applied with a small power duster at Park River and a crank duster at Grand Forks. The amounts applied increased as the

[1]An experiment conducted by the North Dakota Agricultural Experiment Station in cooperation with the State Seed Department and commercial companies. Approved by H. L. Walster, Experiment Station Director, and Mr. R. C. Hastings, State Seed Commissioner.

[2]Entomologist, North Dakota Agricultural Experiment Station

[3]Associate Plant Pathologist, North Dakota Agricultural Experiment Station and State Seed Department

[4]The commercial companies cooperating in the work included the Agricultural Supply Company, Grand Forks, N. Dak.; the E. I. du Pont de Nemours & Company, Wilmington, Del.; and the Rohm and Haas Company, Philadelphia, Pa. Special appreciation is expressed to Mr. James McConnon of the McConnon Company, Winona, Minn., for furnishing the power sprayer used at Grand Forks and the power duster used at Park River, and to Mr. Ole A. Flaat, Grand Forks, and Mr. Harry D. Long, Park River, in whose fields the experiments were conducted.

foliage became more abundant. Rates of application ranged from 15 to 20 pounds per acre for the first treatment to 30 to 35 pounds for the final application.

Size and arrangement of plots

The randomized plots at Grand Forks were established in 14 rows along the south side of a 40-acre field of Bliss Triumphs. Each plot was 6 rows wide and 75 feet long, the seventh and eighth rows were not treated and separated the 6-row-wide plots. The randomized plots at Park River were established in 20 rows along the east side of an 80-acre field of Bliss Triumphs. Plots receiving spray materials were 4 rows wide and 80 feet long, while those treated with dusts were the same length but 6 rows in width. The number of replications for each material is indicated in tables 1 and 2. Due to the proximity of the variously-treated plots, the applications were made during the absence of any wind of sufficient velocity to cause the materials to drift to neighboring plots. The composition of the dust mixtures and spray mixtures used in these experiments is shown in Table 3 (Materials and Concentrations)

Effects of treatment determined

The effectiveness of the treatments in controlling insects was determined largely from collections made with a net. A standard insect net of 12-inch diameter was used for this purpose. Each collection consisted of the insects captured in 50 sweeps of the net over a plot. Three such collections were made from the plots at Grand Forks, July 27th, August 8th and August 24th; and 4 similar collections from the plots at Park River, July 17th, July 26th, August 6th and August 21st. Further information on insect activity was secured from field observations made from time to time during the growing season and at harvest. The collecting, indentifying of specimens and tabulating of results were done by Dr. Kenneth Redman and Mr. Arden Aanestad of the North Dakota Agricultural Experiment Station.

Principal insects collected

While a record was kept of all insects taken in the collections, only the 4 species of major importance are listed in the accompanying tables. They are (a) the six-spotted leafhopper, *Macrosteles divisus,* (b) the potato leafhopper, *Empoasca fabae,* (c) the potato fleabeetle, *Epitrix cucumeris* and (d) the Colorado potato beetle, *Leptinotarsa decemlineata.* In no instance did these insects become more than moderately abundant at either the Grand Forks or the Park River locations.

Explanation of "insect readings"

The relative frequency of occurrence of the important insects is shown in Tables 1 and 2 by a scale ranging from a low of 0.25 to a high of 6, with successive differences 0.25 along the scale. The lowest number indicates the lowest frequency of occurrence of a particular insect under the "treatment conditions" provided, and the highest number the greatest frequency of occurrence of a particular insect under the "treatment conditions" provided. This scale made possible 24 different frequency level ratings or classes. These ratings are called "insect readings" in this article.

There were marked differences in the resistance of the 4 species to the treatments. The six-spotted leafhopper was the most difficult to control and in this respect held first place; the potato leafhopper second; the potato fleabeetle third and the Colorado potato beetle, being the easiest to control, ranked fourth. This was indicated in averaging the insect readings from the treated plots. For the 2 locations (Grand Forks and Park River) the readings were for the six-spotted leafhopper, 2.17 and 2.70; for the potato leafhopper, 1.35 and 1.28; for the potato fleabeetle, 1.38 and .94; and for the Colorado potato beetle, .50 and .43 respectively.

Spraying and dusting compared

Dusting gave significantly better control of the 4 species on the Park River plots than spraying; whereas on the Grand Forks plots the difference in effectiveness, while slightly in favor of spraying, was negligible. At Park River the 7 dusting treatments containing DDT in combination with the fungicides Fermate, Zerlate and Copper A (9D, 10D, 11D, 12D, 13D, 14D and 15D) showed an average insect reading of 2.93, while for the corresponding spray treatments (10S, 11S, 12S, 13S, 14S, 15S and 16S) it was 5.18. This marked difference in favor of the dusting at the Park River location may be due to various causes, including the possible inadequate coverage of the foliage on the second application as the result of using the low pressure hand sprayer instead of the high pressure power sprayer as otherwise employed. For Grand Forks the 3 dust treatments containing DDT with Dithane, Fermate and Zerlate (8D, 10D and 13D), and the corresponding spray treatments (4S, 10S and 13S) showed no significant difference in relative insect abundance in that they averaged 4.25 and 4.16 respectively.

Variability in effectiveness of treatments

At Grand Forks the dust treatment, Copper A Sulfur-DDT (17D) proved most satisfactory in controlling insects, having the low insect incidence of 3.25; the spray treatment Zerlate-DDT (13S) ranked second with a rating of 3.50. At Park River the Zerlate-DDT (12D) and Copper A-DDT (15D) combinations proved most effective with ratings of 2.25 each, although at the Grand Forks location the last named treatment rated considerably lower in effectiveness. Why DDT usually gave better results as an insecticide when mixed with Zerlate, Copper A, or Copper A and Sulfur is not clearly apparent. Possibly the higher concentration of metallic copper (7 per cent) may partly account for the higher degree of insect control from treatments containing Copper A. It will be noted that the metallic copper basis of other copper dusting combinations was 4 per cent.

DDT lends effectiveness to treatments

Information contained in tables 1 and 2 shows the treatments containing DDT to have averaged the highest degree of insect control, with DDD combinations second and arsenical combinations ranking third. For the 11 treatments containing DDT at Grand Forks and the 17 at Park River, the "insect reading" number of the 4 species averaged 4.56 and 4.16; for the 4 treatments containing DDD at Grand Forks and the 5 at Park River 5.19 and 6.75 and for the 3 treatments containing the arsenical Quik Kill at Grand Forks and the 2 at Park River 7.55 and 9.37 respectively. The untreated plots (checks) at Grand Forks and Park River averaged 24.00 and 22.25 respectively.

Aphids have seldom been a problem with North Dakota growers; however, during the summer of 1945 they occurred in a number of fields throughout the potato-growing areas. They were found to some extent on most of the plots at Grand Forks and Park River, particularly during the latter part of the growing period. At harvest in September, they had become moderately abundant on plots treated with combinations containing the arsenical Quik Kill, but were scarce on plots which were otherwise treated. Plant bugs, *Lygus spp.*, were present to a limited extent on most of the plots, and it appeared that the insecticides employed had but slight effect upon them. To what extent the various treatments affected the beneficial insects, such as the ladybird beetles, lace-wing flies and others which prey upon injurious species, was not clearly demonstrated. Their numbers appeared to be correlated with the presence of aphids, upon which they fed, more than anything else.

Degree of control of early blight

In order to determine how effective the various materials were in preventing infection from *Alternaria solani*, the fungus causing early blight, 6 arbitrary classes, indicated in foot notes in the tables, were established to include infections ranging from a trace to very severe. The early-blight readings recorded in table 1 were made September 11th. The results indicated spraying was the most effective method of preventing early blight. The average amount of infection for the 18 sprayed plots was 2.78 as compared to 3.37 for 24 dusted plots. **See footnote c in Tables for scale used in rating** early blight infection. Of the sprayed plots, material 13S, containing Zerlate, was the most effective in preventing early blight followed by material 8S (Cuper Spray). Materials 4S and 7S, both containing Dithane, and 9S (Cuper Spray) were also very effective. Among the dusts, material 13D, containing Zerlate, had the lowest (2.50) incidence of infection followed by a Fermate - containing fungicide (10D).

Table 2 gives the early-blight readings taken at Park River September 10th. Eight of the dust and 2 of the spray materials tested at Grand Forks were also applied at Park River. In all 10 instances, the incidence of infection was lower at Park River. Although early blight may have been more prevalent at Grand Forks, as indicated by the readings on the nontreated plots, it is possible the one additional or fifth application at Park River reduced infection. Further evidence that spraying was more effective than dusting was obtained from the trials at Park River. The average incidence of infection for the 22 sprayed plots was 1.89 as compared to 2.30 for the 28 receiving dusts. Materials 1S, 2S, and 3S, all having 3 times the concentration of Dithane as Dithane-sprayed plots at Grand Forks, had the lowest incidence of early blight with readings of 1.00, 1.50 and 1.00 respectively. Materials 13S and 16S, with readings of 1.75, were very effective in preventing early blight at Park River. The former also was outstanding at Grand Forks. Among the materials listed in table 2 and applied as dusts, 16D, containing Copper A and Zerlate, had the lowest (1.75) incidence of infection followed by 5 other materials (10D, 12D, 13D, 14D and 15D) each with a reading of 2.00.

Effectiveness of the materials in controlling both insects and *Alternaria solani* are indicated by the figures in the extreme right column of tables 1 and 2. At Grand Forks, the spray material 13S, containing Zerlate and DDT, was the most effective of the 19 combinations tested. The most effective dust (13D) also contained Zerlate and DDT. At Park River, all but 5 of the dust materials gave better results than the best spray materials (14S and 16S). Materials 12D (Zerlate 10% and DDT), 13D (Zerlate 20% and DDT), 15D (Copper A and DDT) and 16D (Copper A, Zerlate and DDT) were the most effective of the 14 dust combinations. At both locations, the most effective materials contained DDT.

Summary

1. The effectiveness of some of the newer insecticides and fungicides in controlling certain potato insects and the fungus causing early blight was tested on potatoes at Grand Forks and Park River, North Dakota, during the summer of 1945. Seventeen dust and 16 spray combinations were included in the trials.

2. The insects varied in degree of resistance to the treatments. The six-spotted leafhopper showed the highest degree of resistance, while the potato leafhopper, the potato fleabeetle, and the Colorado potato beetle showed lower resistance in the order listed.

3. The treatments which contained DDT averaged the highest degree of insect control; combinations containing DDD and arsenicals ranked lower as insecticides in the order listed.

4. Aphids became moderately abundant only on the arsenical treated plots, which indicates that the other insecticides used had a controlling effect upon them.

5. The prevalence of ladybird beetles and lace wing flies appeared to be correlated more with the presence of the aphids upon which they fed than anything else.

6. The dust treatments containing DDT as the insecticide gave significantly better control of insects at Park River than corresponding spray treatments, while at Grand Forks the difference in insect control between the 2 methods of application was

negligible. Failure of the spraying to at least equal the results from dusting at the Park River location may possibly be due to inadequate coverage of the foliage at the second application because of the low pressure sprayer used. It is possible that the Sulfur, Zerlate or additional amount of copper included in such treatments as 12D, 15D and 17D, added to the effectiveness of the DDT in insect control.

7. The average relative degree of infection with early blight on sprayed and dusted plots indicated that fungicides applied as sprays were more effective in preventing infection than those applied as dusts.

8. With the exception of the 3 materials (1S, 2S and 3S) containing an excessive amount of Dithane, the lowest degree of infection with early blight at Grand Forks and Park River occurred on plots sprayed with material 13S (Zerlate). Materials 16S (Copper A) and 16D (Copper A and Zerlate) were equally as effective at Park River as 13S.

9. The most effective combination tested at Grand Forks for the control of insects and early blight, (*Alternaria solani*) was the spray material 13S (Zerlate and DDT). Zerlate and DDT were also included in the most effective dust (13D). At Park River, the most effective combinations for controlling insects and *A. solani* were dust materials 12D and 13D, both containing Zerlate and DDT, 15D (Copper A and DDT) and 16D (Copper A, Zerlate and DDT).

Table 1—Insect Readings and Early-Blight Scale of Infection at Grand Forks
(See Explanation of "insect readings" on page 24)

Material Number	Replications	Materials	Six-Spotted Leafhopper	Potato Leafhopper	Potato Flea-beetle	Colorado Potato Beetle	Total Insects	Early Blight	Total Insects and Early Blight
1D[a]	3	Cuprocide—DDT[b]	2.50	1.00	.50	.25	4.25	3.50[c]	7.75
2D	3	Cuprocide—DDD	1.75	.75	1.75	.50	4.75	3.33	8.08
3D	2	Cuprocide—DDD—Lethane	3.25	.75	1.25	.25	5.50	3.50	9.00
4D	2	Cuprocide—HE761—Lethane	1.50	1.50	4.25	1.75	9.00	3.75	12.75
5D	2	Cuprocide—QK[d]	3.75	1.75	1.75	.50	7.75	3.25	11.00
7D	2	Dithane—QK	3.25	2.75	1.75	.25	8.00	3.50	11.50
8D	2	Dithane—DDT	1.25	1.75	1.25	.25	4.50	3.75	8.25
10D	2	Fermate 20%—DDT	1.75	1.25	1.00	.50	4.50	2.75	7.25
13D	2	Zerlate 20%—DDT	1.50	1.00	.75	.50	3.75	2.50	6.25
15D	2	Copper A—DDT	3.00	2.25	1.00	.50	6.75	3.75	10.50
17D	2	Copper A—Sulfur—DDT	1.50	1.00	.50	.25	3.25	3.50	6.75
4S[a]	2	Dithane (½ gal)—ZS[e]—DDT	2.00	1.00	1.25	.25	4.50	2.75	7.25
5S	3	Dithane (½ gal)—ZS—DDD	1.75	1.00	2.50	1.50	6.75	3.00	9.75
6S	3	Dithane (½ gal)—SS[f]—DDT	1.75	1.50	1.25	.50	5.00	3.50	8.50
7S	2	Dithane (½ gal)—ZS—QK—Lethane	3.00	2.50	1.00	.50	7.00	2.75	9.75
8S	2	Cuper Spray—DDT	2.75	1.00	1.50	.50	5.75	2.50	8.25
9S	2	Cuper Spray—DDD	1.75	1.00	.75	.25	3.75	2.75	6.50
10S	2	Fermate (2 lbs)—DDT	1.75	1.25	1.25	.25	4.50	3.00	7.50
13S	2	Zerlate (2 lb)—DDT	1.50	.75	1.00	.25	3.50	2.00	5.50
Check	14	No treatment	6.00	6.00	6.00	6.00	24.00	5.86	29.86

[a]D and S indicate whether the material was applied as a dust or spray
[b]Both DDT and DDD were used at the 5% rate in dusts except for treatment 3D which contained 3% DDD
[c]The amount of infection was indicated by 1—trace, 2—very slight, 3—slight, 4—moderate, 5—severe and 6—very severe
[d]Quik Kill
[e]Zinc Sulphate
[f]Sodium Sulphate

Table 2—Insect Readings and Early-Blight Scale of Infection at Park River
(See Explanation of "insect readings" on page 24)

Ma- erial Jum- ber	Repli- cations	Materials	6-Spotted Leaf-hopper	Potato Leaf-hopper	Potato Flea-beetle	Colorado Potato Beetle	Total Insects	Early Blight	Total Insects and Early Blight
1D[a]	2	Cuprocide—DDT[b]	1.25	1.00	.50	.25	3.00	2.75[c]	5.75
2D	2	Cuprocide—DDD	5.25	1.25	.75	.50	7.75	3.00	10.75
3D	2	Cuprocide—DDD—Lethane	4.00	1.25	.75	.75	6.75	2.50	9.25
4D	2	Cuprocide—HE761—Lethane	6.00	2.25	2.00	.25	10.50	2.50	13.00
5D	2	Cuprocide—QK[d]	2.50	2.00	1.25	.25	6.00	2.50	8.50
6D	2	Dithane—DDD	1.75	.25	.75	1.25	4.00	2.75	6.75
9D	2	Fermate 10%—DDT	1.50	.50	1.00	.25	3.25	2.25	5.50
0D	2	Fermate 20%—DDT	2.25	.25	.50	.25	3.25	2.00	5.25
1D	2	Fermate 10%—ZS[e]—DDT	2.25	.25	.75	.25	3.50	2.25	5.75
2D	2	Zerlate 10%—DDT	1.00	.75	.25	.25	2.25	2.00	4.25
3D	2	Zerlate 20%—DDT	1.00	.50	.75	.25	2.50	2.00	4.50
4D	2	Copper A—ZS—DDT	1.50	1.00	.75	.25	3.50	2.00	5.50
5D	2	Copper A—DDT	1.00	.75	.25	.25	2.25	2.00	4.25
6D	2	Copper A—Zerlate—DDT	1.25	.25	.75	.25	2.50	1.75	4.25
1S[a]	2	Dithane (1½ gal)—ZS—QK	5.75	6.00	.50	.50	12.75	1.00	13.75
2S	2	Dithane (1½ gal)—ZS—DDT	4.00	3.50	.75	.25	8.50	1.50	8.00
3S	2	Dithane (1½ gal)—DDD	3.50	1.75	1.25	.75	7.25	1.00	8.25
9S	2	Cuper Spray—DDD	3.75	1.25	1.00	2.00	8.00	2.50	10.50
0S	2	Fermate (2 lb)—DDT	1.75	1.25	1.25	.25	4.50	2.75	7.25
1S	2	Fermate (1½ lb)—DDT	2.25	1.00	1.50	.25	5.00	2.25	7.25
2S	2	Fermate (1½ lb)—ZS—DDT	2.75	1.00	1.75	.25	5.75	2.00	7.75
3S	2	Zerlate (2 lb)—DDT	3.25	1.50	1.75	.50	7.00	1.75	8.75
4S	2	Zerlate (1½ lb)—DDT	2.00	.75	1.00	.25	4.00	2.00	6.00
5S	2	Copper A (4 lb)—DDT	3.50	1.00	1.00	.25	5.75	2.25	8.00
6S	2	Copper A (4 lb)—ZS—DDT	2.50	.75	.75	.25	4.25	1.75	6.00
'heck	8	No treatment	5.50	4.75	6.00	6.00	22.25	5.00	27.25

D and S indicate whether the material was applied as a dust or spray
Both DDT and DDD were used at the 5% rate in dusts except for treatment 3D which contained 3% DDD
The amount of infection was indicated by 1—trace, 2—very slight, 3—slight, 4—moderate, 5—severe and 6—very severe
Quik Kill
Zinc Sulphate

Table 3—Materials and Concentrations used in the Experiments

Composition of Dust Mixtures:
(Concentration on percentage basis)

The numbers in the first column also appear in the first column in Tables 1 and 2

1D Cuprocide (4% Metallic Copper); Gesarol (5% DDT); Pyrax

2D Cuprocide (4% Metallic Copper); RHothane 25 (5% DDD); Pyrax

3D Cuprocide (4% Metallic Copper); RHothane 25 (3% DDD); Lethane B-71, 14%; Pyrax

4D Cuprocide (4% Metallic Copper); HE761, 3%; Lethane B-71, 14%; Pyrax

5D Cuprocide (4% Metallic Copper); Quik Kill, 33 1/3%; Cherckee Clay

6D Dithane A-10 (5% Dithane); RHothane 25 (5% DDD); Pyrax and Gypsum

7D Dithane A-10 (5% Dithane); Quik Kill, 33 1/3%; Pyrax and Gypsum

8D Dithane A-10 (5% Dithane); Gesarol (5% DDT); Pyrax and Gypsum

9D Fermate 10%; Deenate 50P (5% DDT); Pyrax

10D Fermate 20%; Deenate 50P (5% DDT); Pyrax

11D Fermate 10%; Powdered Zinc Sulphate 2%; Lime 4%; Deenate 50P (5% DDT); Pyrax

12D Zerlate 10%; Deenate 50P (5% DDT); Pyrax

13D Zerlate 20%; Deenate 50P (5% DDT); Pyrax

14D Copper A (7% Metallic Copper); Powdered Zinc Sulphate 2%; Lime 4%; Deenate 50P (5% DDT); Pyrax

15D Copper A (7% Metallic Copper); Deenate 50P (5% DDT); Pyrax

16D Copper A (7% Metallic Copper; Zerlate 4%; Deenate 50P (5% DDT); Pyrax

17D Copper A (7% Metallic Copper); Dusting Sulphur 25%; Gesarol (5% DDT); Pyrax

18 Check

Composition of Spray Mixtures: (Concentration per 100 gallons of water)

The numbers in the first column also appear in the first column in Tables 1 and 2.

1S Dithane D-14, 1½ gal; Zinc Sulphate, 1 lb.; Lime, ½ lb.; Quik Kill, 5 lb.

2S Dithane D-14, 1½ gal; Zinc Sulphate, 1 lb.; Lime, ½ lb.; Deenate 25W (½ lb. DDT)

3S Dithane D-14, 1½ gal; RHothane 25 (½ lb. DDD)

4S Dithane D-14, ½ gal; Zinc Sulphate, 1 lb.; Lime, ½ lb.; Gesarol AK-40 (½ lb. DDT)

5S Dithane D-14, ½ gal; Zinc Sulphate, 1 lb.; Lime, ½ lb.; RHothane 25 (½ lb. DDD)

6S Dithane D-14, ½ gal.; Sodium Sulphate, 1 lb.; Gesarol AK-40 (½ lb. DDT)

7S Dithane D-14, ½ gal.; Zinc Sulphate, 1 lb.; Lime ½ lb.; Quik Kill, 5 lb.; Lethane B-72, 3 lb.

8S Cuper Spray, 5 lb. (1.2 lb. Metallic Copper); Gesarol AK-40 (½ lb. DDT)

9S Cuper Spray, 5 lb. (1.2 lb. Metallic Copper); RHothane 25 (½ lb. DDD)

10S Fermate, 2 lb.; Deenate 25W (½ lb. DDT)

11S Fermate, 1½ lb.; Deenate 25W (½ lb. DDT)

12S Fermate, 1½ lb.; Zinc Sulphate, 1 lb.; Lime, ½ lb.; Deenate 25W (½ lb. DDT)

13S Zerlate, 2 lb.; Deenate 25W (½ lb. DDT)

14S Zerlate, 1½ lb.; Deenate 25W (½ lb. DDT)

15S Copper A (1.8 lb. Metallic Copper); Deenate 25W (½ lb. DDT)

16S Copper A (1.8 lb. Metallic Copper); Zinc Sulphate, 1 lb.; Lime, ½ lb., Deenate 25W (½ lb. DDT)

18 Check

OATS RUST IN 1945

There was much less leaf (crown) rust injury on oats in 1945 than in the previous four years. Only in the northern sections of the State was the infection heavy. Stem rust, on the other hand, was heavier than usual, but developing late, it seemingly was not a large factor in determining yield differences, except in late fields or with late susceptible varieties like Victory. Rainbow yielded the highest at Fargo in 1945 and was among the highest yielding varieties also at Langdon and Edgeley. Gopher, though carrying considerable rust, compared favorably in yield this year with the more rust resistant varieties Vicland and Tama.

As in the case of wheat, some of the resistant varieties like Vicland and Tama were more rusted (mainly stem, but also some leaf rust) this year, in relation to other varieties, than in previous years. Rust readings for Vicland at Langdon were higher than for Rainbow, and farmer reports from northern counties tell of late fields of Vicland which carried considerable rust. This is in line with observations reported from the central states, where Vicland, Tama and similar varieties were grown very extensively, and which tell of an increase in the amount of rust on these oats in that area. The increase in the rust on these varieties is regarded as the

(Continued on page 32)