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The Influence of Seed-Piece Treatment On Disease Control and Yield Of Russet Burbank Potatoes

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Caution

Care should be exercised at all times when using pesticidal chemicals.

Follow instructions on the label to avoid injury—

——to personnel handling the chemicals,

——to crops to which they are applied,

——and to consumers.

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The Influence of Seed-Piece Treatment On Disease Control and Yield Of Russet Burbank Potatoes

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Research from past years (1,2,3,5,6,7,8,10) has shown that treating cut potato seed pieces with certain chemicals normally results in better germination, stronger plants and increased yields by protecting the seed pieces and young plants from degradation by soil-borne pathogens. In Idaho, however, the planting of untreated seed is becoming progressively more common. Reasons for this are numerous, but the ones most frequently encountered are: 1) failure of the grower to dilute the chemicals properly, resulting in poorer stands and lower yields than untreated sets, 2) unsatisfactory results with inadequately tested new chemicals, and 3) high cost of materials.

The most important of these is the improper dilution of chemicals. Many growers and warehouse operators attempt to maintain a constant volume in their treating tanks by adding more water or chemicals as needed instead of replacing the entire solution periodically with a fresh mixture. The addition of excessive amounts of chemicals, particularly those containing mercury, can cause severe burns on the seed pieces. The addition of too much water reduces the effectiveness of the treatment by diluting the chemical. In some instances, excess dilutions can actually create an inoculum bath of rot-producing organisms, particularly if ring rot bacteria are present.

The present study was made to compare some of the standard materials used for seed-piece treatment with new commercial fungicides and bactericides as seed-piece protectants. The chemicals used were further tested to determine their effctiveness when treated seed was held in storage for 10 days before planting and then planting a dry *versus* an irrigated seed bed.

Methods and Materials

During 1956 and 1957, the following five chemicals were tested: Agrimycin (streptomycin 15.0 per cent and oxytetracycline 1.5 per cent), Phygon XL (2,3 dichloro-1, 4-napthoquinone 50 per cent), Semesan Bel (hydroxymercurinitrophenol 12.5 per cent and hydroxymercurichlorphenol 3.8 per cent), Captan 75 (N-(trichloromethylthio)-4-cyclohexene-1, 2 dicarboximide 75 per cent) and Terraclor 75 (pentachloronitrobenzene 75 per cent). The last four chemicals

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were also combined with Agrimycin; these, with an untreated check, made a total of ten treatments. Each chemical was mixed as follows: Agrimycin, 26 grams per 10 gallons; Phygon XL, 453 grams per 10 gallons; Semesan Bel, 648 grams per 10 gallons; Captan 75, 181 grams per 10 gallons and Terraclor 75, 453 grams per 10 gallons. The effect of each chemical on seed pieces held in storage after treatment was determined by dipping one sample of cut seed in each chemical ten days before planting and a second sample one day before planting. The seed pieces that were cut and treated 10 days before planting were placed in burlap bags and stored in the potato cellar until planting time. In an attempt to duplicate the actual storage conditions that are usually found in a commercial cellar, the bags were stacked with no special allowances made for optimum suberization.

Experiments were conducted in the University of Idaho Branch Experiment Stations at Parma and Aberdeen. The design used was a 10 x 10 Latin square split for dates of treatment. There was one major difference in procedure between the two locations. The seed bed at Aberdeen was irrigated before planting, whereas at Parma the seed bed was planted without pre-irrigation. Planting dates were April 17 at Parma, and May 14 at Aberdeen. All potato seed for both locations came from the same source. Two-row plots were planted for each treatment. At both locations the seed was planted with an assisted feed planter in rows 36 inches apart. The seed pieces were planted at a depth of 6 inches and spaces 12 inches apart in the row. The plants in one row were dug early to obtain disease indexes on both seed piece decay and Rhizoctonia damage to the stem. A disease index rating of 0 to 100 used for seed piece decay indicated that 0 was for no rot and 100 was for a completely rotted seed piece. A similar disease index was used for rating Rhizoctonia damage to the stem; 0 indicates that no lesions were present while 100 indicated that the underground plant structure was completely covered with lesions from the seed piece to the ground level or the plant destroyed due to Rhizoctonia. The second row of plants was left undisturbed for yield data. After they were harvested, the potatoes from each plot were sorted into grades of U.S. No. 1, No. 2 and culls, according to USDA standards. The grade U.S. No. 1 are those tubers with a 2 inch minimum diameter, more than 4 ounces, and of standard shape; U.S. No. 2 are off-grade tubers due to second growth and other blemishes rather than small size; Culls are small size or grossly malformed tubers.

Results

When treated seed pieces were planted in irrigated soil, there were no statistically significant differences in yield among treatments, between any treatment and the check, or between dates of planting. This was true for total yield and also for yield of any of the three grades.

Statistically significant yield differences were recorded when the tubers were planted in dry soil that was not irrigated before planting (Table 1). When seed was planted one day after treatment, the total yield from seed treated with Semesan Bel (with or without Agrimycin), with Captan 75 (with or without Agrimycin), or with Phygon (with or without Agrimycin) was greater than that from untreated seed pieces. The same was true when yield was expressed in terms of U.S. No. 1 tubers. Only with the use of Captan 75 + Agrimycin and of Terraclor did treatment result in a greater yield of culls than was obtained from the controls. Agrimycin and Agrimycin plus Terraclor were detrimental since treatment with these materials resulted in a smaller yield than was obtained from untreated seed.

When seed pieces were stored 10 days between treatment and planting, only the use of Semesan Bel, with or without Agrimycin,

Table 1. — Yield from cut seed potatoes treated with various chemicals and planted 1 or 10 days later in a field not irrigated before planting.

Time in Days from Treatment to Planting	Treatment	Yield (lb/plot)[1] of Tubers of Indicated Grade			
		U.S. No. 1	U.S. No. 2	Culls	Total
10	Semesan Bel	28.5	9.8	4.4	42.7 *
	Semesan Bel + Agri-mycin	30.1**	8.5	4.5	43.1**
	Captan 75	25.4	9.1	4.2	38.7
	Captan 75 + Agri-mycin	24.5	10.3	4.1	38.9
	Terraclor	28.3	7.6	3.9	39.8
	Terraclor + Agri-mycin	25.6	7.5	3.7*	36.8
	Phygon XL	23.7	12.8**	3.5**	40.0
	Phygon XL + Agri-mycin	24.7	11.9**	4.6	41.2
	Agri-mycin	25.0	9.0	3.9	38.0
	None	26.2	8.8	4.3	39.3
	LSD (5 per cent)	2.7	1.7	0.6	2.7
	LSD (1 per cent)	3.7	2.2	0.8	3.6
1	Semesan Bel	27.5*	10.0	3.3	40.8*
	Semesan Bel + Agri-mycin	27.1*	9.5	4.0	40.7*
	Captan 75	27.5*	10.8	3.6	41.9**
	Captain 75 + Agri-mycin	28.8**	10.1	4.1*	43.0**
	Terraclor	25.9	8.8	4.1*	38.8
	Terraclor + Agri-mycin	22.6	7.3**	3.6	33.4**
	Phygon XL	27.0*	10.8	3.7	41.5**
	Phygon XL + Agri-mycin	26.9*	10.3	3.9	41.1*
	Agri-mycin	20.4**	9.5	3.4	33.3**
	None	24.1	10.3	3.5	37.9
	LSD (5 per cent)	2.7	1.7	0.6	2.7
	LSD (1 per cent)	3.7	2.2	0.8	3.6

[1] Plot size was 15 x 3 feet with 10 replications.
* A single asterisk indicates that the difference between the figure indicated and that for the check is statistically significant at the 5 per cent level.
**A double asterisk indicates significance at the 1 per cent level.

resulted in greater total yields than was given by the check. Only the use of Semesan Bel + Agrimycin resulted in significantly greater yields of U.S. No. 1 tubers than did the check.

RHIZOCTONIA CONTROL (IRRIGATED SOIL)

The seriousness of injury to the stems, roots, stolons, and immature tubers caused by *Rhizoctonia solani* Kuhn has probably been underestimated in relation to yield of marketable potatoes. In this experiment, potatoes grown from seed treated with Semesan Bel, Semesan Bel + Agrimycin, or Terraclor and held for 10 days before planting in irrigated soil had a lower Rhizoctonia index than did the control (Table 2). In irrigated soil, plants from seed pieces treated with Phygon XL + Agrimycin and held for 10 days had a higher Rhizoctonia index than did the control. The same was true for seed treated with Captan 75 and planted the day after treatment.

Table 2.—Rhizoctonia and seed piece decay indexes following treatment of cut potato seed with various chemicals, storage of treated seed for 1 or 10 days, and planted in irrigated or dry soil.

Days between Treatment and Planting	Treatment	Condition of Soil When Planted			
		Irrigated		Dry	
		Rhizoctonia Index[1]	Seed Piece Decay Index[2]	Rhizoctonia Index[1]	Seed Piece Decay Index[2]
10	Semesan Bel	21**	43**	15**	7**
	Semesan Bel + Agri-mycin	20**	40**	22**	6**
	Captan 75	38	44**	27	8**
	Captan 75 + Agri-mycin	34	46**	25*	14**
	Terraclor	29*	64	17**	21**
	Terraclor + Agri-mycin	39	69	20*	45
	Phygon XL	36	48**	31	11**
	Phygon XL + Agri-mycin	43*	54*	27	10**
	Agri-mycin	35	71	27	45
	None	35	71	30	37
	LSD (5 per cent)	6	17	5	12
	LSD (1 per cent)	8	22	7	16
1	Semesan Bel	27	61**	19**	10**
	Semesan Bel + Agri-mycin	25*	52**	15**	2**
	Captan 75	43**	57**	24	8**
	Captan 75 + Agri-mycin	36	62**	23	15*
	Terraclor	29	78	17**	35
	Terraclor + Agri-mycin	35	78	23	43
	Phygon XL	37	47**	27	11**
	Phygon XL + Agri-mycin	37	43**	22*	10**
	Agri-mycin	35	89	25	43
	None	32	87	27	29
	LSD (5 per cent)	6	17	5	12
	LSD (1 per cent)	8	22	7	16

[1] Rhizoctonia disease index rated from 0 to 100; 0 was for no lesions and 100 for underground plant parts completely covered with lesions.
[2] Seed piece disease index rated from 0 to 100; 0 was for no rot and 100 for completely rotted seed piece.
* A single asterisk indicates that the difference between the figure indicated and that for the check is statistically significant at the 5 per cent level.
**A double asterisk indicates significance at the 1 per cent level.

RHIZOCTONIA CONTROL (DRY SOIL)

Similar, although more pronounced, results were obtained when the seed pieces were planted in dry soil. In this case, use of Semesan Bel, Semesan Bel + Agrimycin, or Terraclor resulted in a low-

er Rhizoctonia index regardless of whether the seed was stored 1 day or 10 days before planting; the difference was statistically significant between treatments and check at the 1 per cent level. Seed treated with Captan 75 + Agrimycin or with Terraclor + Agrimycin resulted in a low Rhizoctonia index if held for 10 days. A low disease index also resulted from the use of Phygon XL + Agrimycin one day prior to planting.

Every treatment used in this experiment, regardless of holding period or use of irrigation, except Agrimycin, Terraclor and Terraclor + Agrimycin resulted in a smaller amount of seed piece decay than resulted when untreated seed was used and Terraclor gave good control when seed was held 10 days and planted in dry soil. The difference was significant at the 1 per cent level. Semesan Bel + Agrimycin gave the most protection to the seed piece, particularly when the seed piece was planted in dry soil (Table 2). The predominant rotting organisms in Idaho are *Fusaria* species (4).

Discussion and Summary

The results obtained from this experiment show that chemical treatment of cut potato seed will not only give good control of certan diseases but will also increase yields. This is particularly true under certain conditions. For example, failure of a seed piece treatment to increase yield when the treated seed pieces are planted in an irrigated seed bed as compared with a seed bed that had not been irrigated indicates that soil moisture is of great importance in the parasitic activity of certain pathogens. This was apparent in the case of *Rhizoctonia solani*. Pelter (5), Hofferbert (2) and Sanford (8) found that *R. solani* exhibited greatest parasitism when soil moisture content was either too low or too high for the best development of the host. In the experiments reported here, the least amount of Rhizoctonia injury was found when seed pieces had been treated with Semesan Bel, Semsan Bel + Agrimycin, or Terraclor and planted in dry soil. Treatments consisting of Captan 75 or Phygon XL with or without Agrimycin resulted in more infection in soils of high moisture content.

The amount of seed piece decay was partially controlled by all treatments except Agrimycin. The least decay was found where seed was treated with Semesan Bel, Captan 75, and Semesan Bel + Agrimycin. This is contrary to results obtained by other workers, (3,10), who state that seed treated with Semesan Bel must be planted immediately to prevent serious decay because of interference with suberization. Seed treated with Semesan Bel, if held for ten days, may develop a slimy coating over the cut surface. This is primarily due to various saprophytes that grow on the dead tissue caused by the action of the chemical. It has been the author's experience that seed treated with Semesan Bel and held even as long as a month was equal to or better than seed treated with any of the other standard commercial seed piece treatments held for the same time.

Materials containing Terraclor or Agrimycin alone or in combination with each other were quite outstanding in their inability to prevent seed piece decay. In the case of Terraclor, this was unexpected, since the active ingredient, pentachloronitrobenzene, is primarily a fungicide; it apparently is not effective against the common seed-rotting organisms. Agrimycin, on the other hand, is composed of streptomycin and oxytetracycline, both of which are generally considered to be specific bacteriostatic agents. According to Waggoner (9), streptomycin increased the susceptibility of potato slices to Fusarium decay. Nielson (4) found that *Fusarium* species were the predominant rotting organisms of the seed pieces in Idaho soil. This may account for the lack of protection afforded by Agrimycin.

No large differences in yield of U.S. No. 1 potatoes were found when cut seed was treated with either Semesan Bel, Captan 75, or Phygon, with or without the addition of Agrimycin, if planted the day following treatment. Of all the treatments used, only the use of Semesan Bel plus Agrimycin resulted in an appreciably greater yield than was obtained from untreated seed if the seed pieces were held for ten days. Since Semesan Bel and Agrimycin have been reported to be effective in the control of scab, black leg, (1,10), seed piece decay (10), Rhizoctonia (10), and Verticillium wilt (6, 7, 10) and since their use may result in better yields than is obtained following the use of untreated seed, it is recommended that the combination of these two chemicals be used for treating potato sets in Idaho.

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WHEN USING ANY AGRICULTURAL CHEMICAL BE SURE AND FOLLOW CAREFULLY THE INSTRUCTIONS ON THE LABEL.