CONTROL OF POTATO WART BY CHEMICAL TREATMENTS]

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Abstract

Investigation of chemical control of wart in potatoes has been conducted in Newfoundland during the years 1958-62 and 1964-65 inclusive. The soil fungicide Vancide 51 at 400 lb/acre gave best results and was non-phytotoxic. Uracide and CP30249 were effective but somewhat phytotoxic. The herbicide dinoseb gave wart control at rates of application in the range used for weed control. The fumigants Vorlex and Trapex, containing methyl isothiocyanate were effective but stronglyphytotoxic after a 4-week periodbetween application and planting.

Introduction

Soil fungicide treatments were successfullyused in Pennsylvania to eradicate the potato wart disease, according to Hartman (3). On an acre basis, 2,500-3,000 lb of copper sulfate were disced or dug into cultivated plots; bare areas near walks or foundations received a fall treatment of 10,000 lb in solution, and lawns, flower beds, shrubs and trees were treated with a 10% solution of 40% formaldehyde at the rate of 20 gal/100 ft^2. On some infested areas the soil was sterilized with 5 tons/acre of copper sulfate, followed by 5 tons of lime/acre one year later. Hartman also found that ammonium thiocyanate at 2,500-3,000 lb/acre eradicated the wart organism. Bell (2) had previously noted that ammonium sulfocyanate at 1,200-3,200 lb/acre gave wart control. In afew cases, where 2,000 lb/acre were applied to soil containing sods and trash, wart was not eradicated.

Roach et al. (6) found that the application of sulfur at 10 cwt/acre on sandy soil and 40 cwt/acre on clay give wart-free plots. Roach and Glynne (5) and Roach (4) concluded that the effect was due to acidified thiosulfate formed from sulfur.

Zakopal (7) reported that a 2% solution of the 25% sodium salt of dinitro ortho cresol at 10 liter/m^2 gave some control of wart without phytotoxicity. It has recently been claimed (1) that Nitraphen, a nitrous salt, has given complete control of wart when the soil is treated with a 1.5% solution.

Materials and methods

Studies on the chemical control of wart in naturally-infested field plots have been conducted in Newfoundland since 1958. During that period, 8 soil fungicides, 1 herbicide and 3 fumigants have been tested. Replicated field plots of one 30-ft, or two 15-ft rows side by side, separated by suitable guard rows, were used. The wart-susceptible cultivar, 'Arran Victory', was grown as the test plant in all cases. Soil fungicides were broadcast and dug in to a 3- or 4- inch depth and soil fumigants were injected 7 inches deep, 6 inches apart each way, with a hand applicator. A waiting period of 4 weeks elapsed between application of fumigants and planting to allow dissipation of toxic vapors. Planting was done immediately after the application of soil fungicides. The herbicide dinoseb was applied as apreemergence spray, and was also sprayed on the soil surface and dug in prior to planting.

Results were assessed in several ways. From 1958-1960 inclusive, wart disease indices and numbers of tubers set were used; from 1962-1965, the marketable and total yields and weights of warted cull potatoes were determined. Measuring wart development by a disease index instead of weight of warted cull gives higher readings for wart in the check plots where wart development on each infected tuber is nearly always greater than in treated plots. Weight of warted cull, on the other hand, is a more useful measure for practical purposes.

The soil fungicides used were: calomel (Calogreen 76.5%); bis ethyl xanthogen (Herbisan 58%); chloro (tolylsulfonyl) propionitrile (CP30249, 4 lb/gal); ethylene thiuram monosulfide (Amobam 50%); pentachloronitrobenzene (Terraclor, 75% WP); sodium dimethyldithiocarbamate (Vancide 51, 30%); tetrachlorotetrahydrothiophene dioxide (DAC-649, W50) and uracide (urea formaldehyde 85%). The fumigants were: mylone (Crag Mylone 50 D, Soil Kare 50); methyl isothiocyanate (Trapex 20%); and methyl isothiocyanate - chlorinated C_3 hydrocarbon mixture (Vorlex 100%). The herbicide was dinoseb (Sinox P.E. 3.6 lb/gal).

The wart disease index was obtained by grouping thepotato tubers into five classes as follows: 0 = no wart; 1 = one or two small pustules, total diameter less than 1.0 cm; 2 = up to $\frac{1}{4}$ of tuberwarted; 3 = $\frac{1}{4}$ to $\frac{1}{2}$ of tuber warted; 4 = $\frac{1}{2}$ to entire tuber involved.

$$\text{Disease Index} = \frac{1\ (\text{No. of (class 1) (tubers)}) + 2\ (\text{No. of (class 2) (tubers)}) + 3\ (\text{No. of (class 3) (tubers)}) + 4\ (\text{No. of (class 4) (tubers)})}{\text{Total no. of tubers} \times 4} \times 100$$

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'Table 1. Wart control obtained from soil fungicides.

Soil fungicide	Rate of application	Method of application	Year of test	Disease index	No. of healthy tubers	Marketable yield cwt/acre	Total yield cwt/acre	Warted culls cwt/acre	Total plus culls cwt/acre
Vancide 51	150 lb/acre	Broadcast	1958	* 4, 8	193	Yields not measured		Culls not measured	
" "	300 lb/acre			2. 6	207	" "		" "	"
" "	400 lb/acre			1. 1	238	" "		" "	"
Check				14. 8	148	" "		" "	"
Vancide 51	300 lb/acre		1959	5.9	162	" "	"	" "	"
" "	400 lb/acre			4. 6	178	" "	"	" "	"
Check				20.5	142	" "	"	" "	"
Vancide 51	200 lb/acre		1960	0.8	169	126.0	161.0	" "	"
" "	300 lb/acre			0. 6	170	140.0	177.2	" "	"
" "	400 lb/acre			0.5	157	135.0	165.4	" "	"
Uracide	150 gal/acre	"		2.0	204	182.4	221.7	" "	"
	300 gal/acre	"		1. 2	231	159.1	210.2	" "	"
CP30249	240 lb/acre			0. 4	144	115.1	138.0	" "	"
Check				3. 7	151	119.6	148.8	" "	"
Vancide 51	300 lb/acre		1962	(Disease index		140.6	248.4	10.2	258. 6
" "	400 lb/acre			and number of		156.6	258. 7	11.5	270. 2
CP30249	120 lb/acre			tubers not		135. 0	240. 2	17. 6	257. 8
	240 lb/acre			determined.)		67. 5	152.6	5.2	157. 8
Check						103.4	164.8	72. 9	237.7

* All figures are the mean of four replicates

Table 2. Wart control obtained from soil fumigants.

Soil fumigant	Rate of application	Method of application	Year of test	Disease index	No. of healthy tubers 30' row	Market-able yield cwt/acre	Total yield cwt/acre	Warted culls cwt/acre	Total plus culls cwt/acre
Trapex	30 gal/acre	Injected	1960	*0.2	72	24.2	37.9	Culls not measured	
	80 gal/acre			0.0	2	1.5	3.0	" "	"
Check				3.7	151	119.6	148.8	" "	"
Vorlex	40 gal/acre		1962	(Disease index not		76.6	161.8	1.3	163.1
	70 gal/acre			determined.)		5.6	20.5	0.4	20.9
Check						103 4	164.8	72.9	237.7

Table 3. Wart control obtained from the herbicide Dinoseb

Treatment	Rate of application	Method of application	Year of test	Market-able yield cwt/acre	Total yield cwt/acre	Warted culls cwt/acre	Total plus culls cwt/acre
Dinoseb	5 lb/acre	Pre-emergence spray	1964	*165.6	215.2	13.8	229.0
	10 lb/acre			170.8	218.0	8.2	226.2
	15 lb/acre			148.4	193.4	12.8	206.2
	30 lb/acre			92.2	120.4	5.8	126.2
Check				156.8	199.8	31.8	231.6
Dinoseb	5 lb/acre		1965	158.3	233.6	1.1	234.7
	10 lb/acre			179.3	259.1	1.0	260.1
	20 lb/acre	Pre-plant, dug in		64.2	98.4	0.0	98.4
	40 lb/acre	" " " "		27.0	51.4	0.0	51.4
Check				50.8	103.0	6.8	109.8

* All figures are the mean of four replicates.

Results and discussion

All of the following materials, at the rates of active ingredient shown, gave a statistically significant degree of control, but not enough for practical application: calomel at 147 lb/acre; Herbisan at 200 lb/acre; Amobam at 240 and 480 lb/acre; Terraclor at 188 and 262 lb/acre; DAC-649 at 100 and 150 lb/acre; and the fumigant mylone at 200, 300, and 400 lb/acre.

The results with Vancide 51, uracide, CP30249, Trapex, Vorlex and dinoseb, which gave a high degree of control, are listed in Tables 1 to 3.

From Table 1, it is evident that very good control of potato wart can be obtained with soil fungicides, but that relatively high rates of application are necessary.

From 1959-1960 inclusive, the wart disease index in the untreated controls varied from 20.5 to 3.7. This fluctuation was due to differences in soil moisture, to which wart development is quite sensitive. There was sufficient rainfall each year to produce a potato crop, but 1960 was too dry for good wart development. 1961 was so dry that wart did not grow enough to give results. In all trials, Vancide 51 gave the best results and had no toxic effects. Uracide is somewhat phytotoxic but the effect is counterbalanced by the nitrogen supplied by this compound. CP30249 was an effective fungicide but was phytotoxic at the 240 lb/acre rate.

The results obtained with Trapex and Vorlex are shown in Table 2. In spite of a four-week period between soil treatment and planting, emergence was prevented or the potatoes were badly stunted. In the surviving plants, wart control was very good. Since Trapex and Vorlex are active in cold soils, it is suggested that fall treatment would allow sufficient time for phytotoxic efiects to disappear from the soil and still give effective fumigation.

Dinoseb, in preemergence applications, gave effective control as shown in Table 3. The rates of application required were considerably lower than those of any material previously tested. Poor weed control and rather dry field conditions may explain the low yield from the 1965 check plots. The quantity of warted cull potatoes was also low, but considerably higher than in the treated plots.

literature cited

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