EFFECT OF THREE YEARS FUMIGATION AND BURNING OF VINES ON THE CONTROL OF VERTICILLIUM WILT IN RUSSET BURBANK POTATO[1/]

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Introduction

Serious losses in potato production are caused by Verticillium albo-atrum, miscrosclerotial form. The organism persists in soils for long periods as microsclerotia (7, 9, 10). Fumigation of infested soil has been reported to yield (1, 2, 3, 4, 6).

This study investigated the control and changes in populations of the Verticillium wilt organism in infested soil following soil fumigation and burning of vines before harvest.

METHODS AND MATERIALS

The field chosen for this experiment had been cropped to dry land wheat until 1962 when it was planted to alfalfa under irrigation. The soil was artificially infested with Verticillium albo-atrum in 1965 by planting potato seed pieces which had been dipped into a suspension of conidia, mycelial fragments, and microsclerotia of the fungus. Successive crops of Russet Burbank potato were grown in 1966, 1967 and 1968 without further artificial infestation.

Fumigation treatments of Telone + Picfume (20 + 5 gal/A) and DD + Picfume (20 + 5 gal/A) were applied each spring of 1966, 1967 and 1968 in their original randomization plots. Treatments were randomly replicated 6 times in plots 24 x 50 feet. The infested vines were allowed to die naturally and then were either beat with a vine beater or burned with a propane gas burner in falls of 1966 and 1967. Each year one row out of eight in each treatment was harvested for yield. The remaining crop was allowed to freeze in the field.

At various times during the 1968 growing season stem infection by the

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1/ This investigation was made possible through a grant supplied by the Washington State Potato Commission.

Verticillium wilt organism was determined by plating stems on streptomycin-ethanol agar (8). Verticillium populations in infested soil were determined during the 1968 growing season by a method previously described (5).

All data in tables 1-4 are means of 6 random replications. Analysis of variance was determined on data in tables 2 and 4 and Duncan's Multiple Range Test at the 5% level was used to determine differences between means.

RESULTS

Throughout the 1968 growing season fewer potato stems were infected by the Verticillium wilt organism in plots fumigated for 3 years than in non-fumigated plots (table 1).

Both fumigation treatments reduced stem infections and plant wilting (table 2) and burning of vines added to the effectiveness of the fumigation treatments.

Burning of infected vines before harvest on fumigated plots appeared to reduce the number of propagules of the Verticillium wilt organism in the soil in the spring of 1968 compared to beating the vines on fumigated plots (table 3). The fumigation treatments which reduced the disease (table 2) also reduced the numbers of propagules in the soil in the spring of 1968 (table 3), however, by harvest time (Oct. 18, 1968) the propagule numbers were as high or higher in the fumigated soils whether the vines had previously been burned or beaten as in the non-fumigated controls.

Both fumigation treatments significantly increased yield in 1967 and 1968 compared to the non-fumigated control treatments (table 4). Burning of infected vines without fumigation significantly increased yield in 1968 [83 cwt/A (605 cwt/A - 522 cwt/A = 83 cwt/A)] compared to beating of vines without fumigation.

DISCUSSION

Annual fumigation of soil infested with the Verticillium wilt organism delayed stem infection and wilt symptoms, reduced numbers of propagules in the soil, and increased yield of the Russet Burbank potato. Two years of burning dead vines with the microsclerotia increased yield without fumigation.

After fumigation of infested soils and burning of infected vines for a period of 3 years the number of Verticillium propagules were reduced during the growing season but by harvest time in 1968 they were as high or higher, than the controls. Possibly this increase was caused by the organism being moved in irrigation water from non-fumigated to fumigated plots (5) or by an increase in the non-resting conidial stage of the organism. Recontamination and/or repropagation in fumigated soil in this manner, at the end of each growing season probably explains previously reported results wherein a yield response

did not occur the second year after fumigation (2).

Washington State University at this time does not recommend any fumigation treatment for control of Verticillium wilt. The fumigant combinations used in this sutdy have not been cleared for use by U.S.D.A. Food and Drug Administration.

Table 1. The effect of repeated fumigation (3 years) on the incidence of stem infection of Russet Burbank potato by the Verticillium wilt organism during the third growing season.

Date of stem sampling	Planted April 26 % Stems with Verticillium organism[1/] Telone + Picfume 20 + 5 gal/A	Untreated
June 12	1	2
July 1	1	1
July 25	5	31
August 15	6	48
Sept. 10	23	53

1/ One hundred stems collected at random from 6 replicated plots and assayed on streptomycin-ethanol agar medium.

Table 2. The effect of repeated fumigation (3 years) and repeated burning of vines (2 years) on incidence of Verticillium wilt in Russet Burbank potato at the end of the third growing season (Sept. 10, 1968).

Fumigant and gal per acre	Vine sanitation treatment	Verticillium wilt: Mean plant wilt[1, 2]	Verticillium wilt: Mean % stems with Vert. organism[2]
Telone + Picfume (20 + 5)	beating	15 b	74 c
"	burning	4 a	19 a
DD + Picfume (20 + 5)	beating	9 b	62 bc
"	burning	2 a	23 a
Control	beating	34 c	33 a[3]
"	burning	32 c	53 b

1/ Number of plants showing Verticillium wilt symptoms out of approximately 34 plants.
2/ Means containing the same letter of the alphabet are not significantly different according to Duncan's Multiple Range Test at the 5% level.
3/ Many stems were dead at collection due to Verticillium wilt, therefore, isolation of Verticillium organism was low.

Table 3. Effect of repeated fumigation (3 years) and repeated burning of vines (2 years) on the Verticillium wilt organism.

Fumigant and gal per acre	Vine sanitation treatment	Average no. of Verticillium propagules per gram of oven-dry soil: March 14	April 10	Oct. 18
Telone + Picfume (20 + 5)	beating	172	138	1222
"	burning	86	9	4245
DD + Picfume (20 + 5)	beating	242	330	1632
"	burning	101	0	996
Control	beating	631	1066	959
"	burning	1801	1684	1355

Table 4. The effect of successive fumigation (3 years) and repeated burning of vines (2 years) on yield of Russet Bubank potatoes.

Fumigant and gal per acre	Vine sanitation treatment	Mean yield, cwt/acre 1/ 1966	1967	1968
Telone + Picfume (20 + 5)	beating	639 a	629 a	692 a
"	burning	575 bc	580 a	711 a
DD + Picfume (20 + 5)	beating	2/	557 ab	735 a
"	burning	2/	605 a	750 a
Control	beating	546 c	450 c	522 c
"	burning	546 c	488 bc	605 b

1/ Means followed by the same letter of the alphabet are not significantly different according to Duncan's Multiple Range Test at the 5% level.

2/ Fumigated with 30 gal per acre of Telone PBC in place of the indicated fumigation for 1966.

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