

1964 FUMIGATION RESULTS

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Prior to 1948, soil fumigants were used almost exclusively for control of soil infesting nematodes; however, in that year, L. W. Nielson of Idaho showed that fumigation with chloropicrin increased potato yield, the set of tubers per hill, and delayed Verticillium wilt symptoms. The cost of chloropicrin prevented its use as a practical application. Later, R. A. Young (1956) of Oregon, J. W. Guthrie (1960) of Idaho, R. L. Powelson (1960, 1962, 1963) of Oregon, and J. D. Menzies (1950) and R. Kunkel (1960, 1963) of Washington reported increased yield by fumigation of wilt infested soils. Powelson showed that Telone, a relatively inexpensive fumigant, increased yields. Kunkel found yield to be increased even more when chloropicrin was added to Telone. Both of these workers also reported significantly higher yields in fumigated soils than non-fumigated soils 1, 2 and even 3 years after treatment.

In 1963 an extensive program was initiated by the Washington State Potato Commission and Washington State University on the control of soil infesting potato organisms such as Verticillium wilt and Rhizoctonia. In this same year it was found that the addition of chloropicrin to DD, M-2467 (propargyl bromide and Vidden D) and Vorlex, as well as Telone produced higher yields than did the latter fumigants alone (Table 1). None of the fumigants reduced Rhizoctonia stem canker or black scurf. These fumigants also showed a yield response the second year after treatment (Table 1).

In a similar test in 1964 propargyl bromide, a relatively new fumigant, when used as a mixture with other fumigants increased yield 75-90 cwt. per acre over untreated plots (Table 2). As in 1963, none of the fumigants reduced the Rhizoctonia. Stem cankering caused by this fungus was actually more severe where Vorlex was used.

Two experiments were initiated to determine (1) the effect on disease control and production of fumigation and soil fertility, and (2) fumigation and Terraclor (PCNB) treatment (Table 3 and 4). Terraclor is a soil fungicide which has been reported to control Rhizoctonia. In both experiments, fumigation with Telone (45 gal./A) and Telone-chloropicrin (20 & 3 gal./A) increased yield over the non-fumigated control. Likewise, in both experiments Telone-chloropicrin increased the total number of tubers produced per plot, while Telone alone did not. This indicates that the increased yield with Telone fumigation resulted from the increased weight of individual tubers, while Telone-chloropicrin increased both individual tuber weight and the total number of tubers per plot. Possibly this Telone-chloropicrin mixture stimulates stolon formation and tuberization or reduces stolon

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burn-off by the *Rhizoctonia* organism. Yield and the number of tubers produced was also increased by nitrogen fertilizer, at 100, 200 and 300 lbs. of N per acre, but not by any of the 3 rates of Terraclor applied (7.5, 15 and 30 lbs. active ingredient per acre). Premature plant death (due to deficiency in nitrogen) and *Verticillium* wilt symptoms were delayed by fumigation with Telone-chloropicrin, but not with Telone. The application of nitrogen also delayed premature plant death and the *Verticillium* wilt disease symptoms. Neither the two fumigants nor application of either Terraclor or nitrogen reduced the *Rhizoctonia* stem canker disease (evidence not given in Tables 3 and 4). The *Rhizoctonia* black scurf on tubers was not reduced by fumigation (Telone-chloropicrin fumigation actually increased black scurf, Table 4), but it was reduced by all three rates of Terraclor and by fertilization with nitrogen. Why the application of nitrogen fertilizer reduced black scurf is not understood.

Summary

The work in progress indicates the possible value of fumigation in areas of Washington where *Verticillium* wilt (the early dying disease) is severe. *Verticillium* wilt symptoms are delayed and the yield may be increased by 75 to 100 cwt. per acre, but the wilt organism is not eradicated. *Rhizoctonia* stem canker and tuber black scurf are not controlled. Yield will be increased only in soils heavily infested with the wilt organism. The increase in yield will probably not justify the cost of fumigation in areas of Washington (such as the Pasco area) where the crop is harvested before *Verticillium* wilt symptoms appear (evidence from additional experiments). Effective fumigation (chloropicrin at 2.5 to 5 gal. /A added to approximately 20 gal. /A of DD, Telone or Vidden D) will cost about \$50 to \$100 per acre. The effectiveness of treatment would last for 2 years. Research will continue in 1965 to determine if fumigants are effective, economical, and safe for use in potato production. Fumigation as a means of controlling the *Verticillium* wilt organism is not recommended at this time by Washington State University.

Table 1. The residual effect of fumigants applied in the spring of 1963 on yield at Prosser, Washington.

Fumigant	Gal. per acre	Mean total yield (cwt)	
		1963	1964
Control	--	268	234
DD	30	318	268
DD & chloropicrin	30 & 2.5	375	261
M-2467 (Propargyl bromide & Vidden D)	30	360	303
M-2467 & chloropicrin	30 & 2.5	379	296
Telone	45	337	241
Telone & chloropicrin	30 & 2.5	410	310
Vorlex	30	318	289
EP-201 (Vorlex, chloro- picrin, & DD)	45	398	323
Chloropicrin	7.5	283	227

Table 2. The effect of fumigants applied in Spring of 1964 on Verticillium wilt and yield at Othello, Washington.

Fumigants	Gal. per acre	% Vert. wilt (plants)	Total yield (cwt)
Control	--	63	530
Chloropicrin	5	72	553
DD	30	56	569
DD & chloropicrin	20 & 5	50	600
M-2467 (Propargyl bromide & Vidden D)	30	50	607
M-2633 (Propargyl bromide, Telone, & chloropicrin)	30	49	623
Vorlex	30	53	584

Table 3. The effect of fumigation and fertilization on disease control and production at Othello, Washington in 1964.

	Yield (cwt)	Total number of tubers	Plant death and wilt	Rhiz. tuber black scurf
No fumigation	0	0	0	0
Telone, 45 gal./A	+	0	0	0
Telone - chloropicrin 20 & 3 gal./A	+	+	-	0
No N	0	0	0	0
100 lbs. nitrogen/A	+	+	-	-
200 lbs. nitrogen/A	+	+	-	-
300 lbs. nitrogen/A	+	+	-	-

+ = increase

0 = no change

- = decrease

Table 4. The effect of fumigation and Terraclor (PCNB) on disease control and production at Prosser, Washington in 1964.

	Yield (cwt)	Total number of tubers	U. S. No. 1	Rhiz. tuber black scurf
No fumigation	0	0	0	0
Telone, 45 gal./A	+	0	0	0
Telone & chloropicrin 20 & 3 gal./A	+	+	-	+
No PCNB	0	0	0	0
7.5 lb. PCNB/A	0	0	0	-
15 lb. PCNB/A	0	0	0	-
30 lb. PCNB/A	0	-	-	-

+ = increase

0 = no change

- = decrease