University of Idaho
College of Agriculture
Cooperative Extension Service
Agricultural Experiment Station

Current Information Series No. 211
December 1973

Fumigating Medium-Textured Soils In Southeastern Idaho To Control Early Dying of Potatoes

C. E. Dallimore and Glenn E. Vogt

Verticillium wilt, commonly called "early dying", is one of the most widespread diseases of potatoes in Idaho. It can be found in most fields that have produced one or more crops of potatoes.

The organism generally considered to cause the disease is a fungus called **Verticillium albo-atrum**. However, the "early dying" disorder is probably due to a complex of disease organisms such as fungi and nematodes. Stress factors — for example, cultivation, hail injury, inadequate soil nutrition, lack of or excess water — bring on the symptoms known as early dying, although the plant was infected by the pathogen(s) sometime before.

Symptoms particularly become evident as the plant approaches maturity and stress conditions increase. The disease is more severe on sandy soils and older medium-textured soils having a high population of the pathogen than on land more recently placed under cultivation.

Typical symptoms include a one-sided yellowing followed by death of leaflet, leaf and eventually stem, beginning at the bottom of the plant and moving upwards.

Over the years, many methods of control have been tried. Several years ago, soil fumigation was found to be economically feasible on a sandy soil in Eastern Idaho where the disease was extremely severe[1]. However, the fumigants were not economically beneficial in increasing yields on medium-textured soils. Since then, chloropicrin (tear gas) has been added to fumigants to make them effective in controlling a wider range of organisms.

Methods

In 1971, one of these fumigants containing chloropicrin, Telone C, was compared with its predecessor, Telone, to determine if early dying can be controlled and yields increased sufficiently to make control economically feasible on medium-textured soils in Eastern Idaho.

Three field trials[2] were conducted in Bonneville County on Pancheri silt loam and one in Butte County on Packham gravelly loam where early dying was reducing potato yields. The previous crop in three of the fields was a small grain.

The fourth field was next to one of these fields, but had been in sugar beets. Two of the fields were furrow irrigated; the adjoining grain and sugar beet fields were sprinkler irrigated.

All the treatments used in the trials were applied the full length of the field in 16-foot strips (one round with the applicator). The fumigants were broadcast 8 to 10 inches deep with a gravity flow applicator with chisels 12 inches apart. All applications were made in the spring after soil temperatures had warmed to at least 40°. The soil surface was sealed by dragging a spike tooth harrow behind the applicator, followed by

[1] Dallimore, C. E., Jay G. Garner and R. E. Ohms. 1967. Control of Early Dying of Potatoes by Soil Fumigation. Univ. of Idaho CIS 52.

[2] Cooperation of the Dow Chemical Company is gratefully acknowledged for supplying the chemicals and assisting in the field trial work.

cultipacking as a separate operation. The soil was thoroughly aerated 10 to 14 days later to allow the remaining toxic gases to escape. The seed bed was then prepared by plowing or deep tilling.

At the Bonneville county locations, Telone and Telone C were used at 30 and 20 gallons per acre, respectively. At these rates, costs of the chemicals applied were approximately the same. At the Butte county location, Telone was applied at 40 and 30 gallons per acre and Telone C at 30 and 20 gallons. Each treatment was randomly repeated four times.

All cultural operations were performed by the grower-cooperator. At harvest, the center four rows of each plot were harvested with bulk harvesting equipment. The total yield was determined from the net truckload weights. Three samples of approximately 60 pounds each were taken from each truckload for grade determinations. Specific gravity was also determined for the Bonneville county potatoes.

Results

For reasons we cannot explain, soil fumigation was of no benefit in the Butte county trial. Neither rate of either chemical significantly affected total yield or other yield factors measured (Table 1). In previous years, early dying had consistently been severe in the area where the trial was located, but symptoms were not severe in 1971.

In the Bonneville county trials, symptoms again were not as severe as expected. Total yields of potatoes

Table 1. Average yield and grade of potatoes from spring applications of Telone and Telone C, Moore area of Butte County, 1971.

	Check		Telone (per acre) 30 gal /acre		Telone (per acre) 20 gal /acre		Telone C (per acre) 20 gal /acre		Telone C (per acre) 30 gal /acre	
	cwt /A	%	cwt /A	%	cwt /A	%	cwt /A	%	cwt /A	%
*Total yield	183.9	--	176.6	--	181.1	--	178.5	--	177.0	--
*U.S. No. 1's	95.4	51.9	92.2	52.2	95.6	52.8	90.1	50.5	95.2	51.8
*1's over 10 oz	0.8	0.4	2.0	1.1	1.3	0.7	1.5	0.8	2.3	1.2
*U.S. No. 2's	9.8	5.3	12.0	6.8	8.6	4.8	11.9	6.7	10.0	5.4
*Undersize	78.0	42.4	70.5	39.9	75.7	41.7	75.0	42.0	76.4	41.6

* These differences are not statistically significant.

Table 2. Potato yields from surface and sprinkler irrigated fields receiving spring applications of Telone and Telone C following a small grain crop, Bonneville County, 1971.

	Irrigation	Check		Telone 30 gal /acre		Telone C 20 gal /acre		Significance *
		cwt	%	cwt	%	cwt	%	
Total yield	surface	231.0	--	(266.4)	--	(279.7)	--	5%
	sprinkler	212.9	--	(250.2)	--	(272.1)	--	1%
U.S. No. 1's	surface	183.4	79.4	208.9	78.4	221.5	79.2	n.s.
	sprinkler	140.9	66.2	169.2	67.8	198.4	72.9	n.s.
1's over 10 oz	surface	75.8	32.8	97.2	36.5	106.6	38.1	n.s.
	sprinkler	15.5	(7.3)	16.3	6.5	19.9	(7.3)	5%
U.S. No. 2's	surface	18.0	7.8	24.5	9.2	31.6	11.3	n.s.
	sprinkler	8.7	4.1	12.0	4.8	10.3	3.8	n.s.
Undersize (culls)	surface	29.3	12.7	32.8	12.3	26.3	9.4	n.s.
	sprinkler	62.6	29.4	57.5	23.0	74.0	27.2	n.s.

* n.s. — date not significantly different; 5% — odds are 19:1 that these differences are statistically significant; 1% — the odds for differences are 99:1. There is no statistical difference between figures in parentheses.

in both cases were significantly increased by both soil fumigants with a slight but insignificant advantage for Telone C (Table 2). The percentage of U.S. No. 1's was not significantly changed. With Telone fumigation, yield of over 10 ounce U.S. No. 1's was significantly reduced under sprinkler irrigation (Table 2). The difference in yield of U.S. No. 1's between treated and untreated areas of the field was not great enough to pay for the cost of the fumigant.

The treatments had no effect on specific gravity.

Although the adjoining areas where sugar beets and small grain had been the preceding crop cannot be experimentally compared, the yields from the two fields are presented together in Table 3. In both cases, yield increases significant at the 1% level were obtained by soil fumigation. But even with fumigation, the yield of potatoes following sugar beets was no better than the yield following small grain without fumigation. No difference was observed in the percentage of potatoes in the various grades due to preceding crop. These data are believed to indicate the importance of cultural practices upon early dying of potatoes.

Discussion

The results of these 1971 soil fumigation trials confirm that early dying cannot be economically controlled on medium textured soils in southeastern Idaho. This is based on the assumption that to be "economical" a treatment should yield a financial return of at least twice the investment. Naturally, this will vary from year to year according to the price of potatoes which will probably fluctuate more than the cost of the fumigant.

Soil fumigants are valuable in controlling pests such as nematodes, soil animals and insects, weeds, fungi, and some virus diseases where one of these organisms acts as a vector. Where several pests can be controlled by soil fumigation, the chances of economic return are much greater. Under any circumstances, however, a grower should attempt soil fumigation for one or more pests only on a trial basis to prove its value under his particular situation.

Other Methods of Control

Preceding crop can influence yield and early dying. Observations indicate that changes in other cul-

THE AUTHORS

When this publication was written, C. E. Dallimore was assistant research professor of plant pathology at the University's Aberdeen Branch Experiment Station. He is now area potato specialist with the Cooperative Extension Service, headquartered at Idaho Falls. Glenn E. Vogt was formerly extension area potato specialist with the University and is now associated with a private firm in the potato industry.

Table 3. Effects of spring fumigation following small grain and sugar beets on yield of potatoes under sprinkler irrigation in Bonneville County, 1971.

	Previous Crop	Check		Telone 20 gal/acre		Telone 30 gal/acre		Significance *
		cwt	%	cwt	%	cwt	%	
Total yield	grain	(212.9)	--	(250.2)	--	(272.1)	--	1%
	beets	(181.3)	--	(198.9)	--	227.8	--	1%
U.S. No. 1's	grain	140.9	66.2	169.6	67.8	198.4	72.9	n.s.
	beets	114.2	63.0	136.8	68.8	145.1	63.7	n.s.
1's over 10 oz	grain	15.5	(7.3)	16.3	6.5	19.9	(7.3)	5%
	beets	13.8	7.6	17.9	9.0	17.3	7.6	n.s.
U.S. No. 2's	grain	8.7	4.1	12.0	4.8	10.3	3.8	n.s.
	beets	8.7	4.8	10.7	5.4	13.0	5.7	n.s.
Undersize (culls)	grain	62.6	29.4	57.5	23.0	74.0	27.2	n.s.
	beets	62.7	34.6	60.3	30.3	76.5	33.6	5%

* n.s. — data not significantly different; 5% — odds are 19:1 that these differences are statistically significant; 1% — odds of 99:1 for statistically significant differences. There is no statistical difference between figures in parentheses.

tural practices will increase yield and assist in reducing early dying. Improvement of soil fertility, good soil moisture management and proper timing of cultivation delay the appearance and severity of Verticillium wilt symptoms. Burning the old potato vines after harvest reduces the amount of Verticillium propulges returned to the soil and probably should be practiced so long as permissible.

Verticillium wilt is considered to be a soil-borne disease, but apparently it is not present in soils just coming under cultivation. These soils may become contaminated by the Verticillium carried on the surface of potatoes used for seed. The possibility of dissemination in this manner can be reduced by proper chemical treatment of potato seedpieces.

USE OF SOIL FUMIGANTS

Soil fumigants are lethal to man as well as soil organisms. They must be handled with extreme care. Specific conditions are required for effective soil fumigation. Special equipment is used for their application. Before attempting soil fumigation, even on a trial basis, obtain the advice of someone familiar with this technique.

Published and Distributed in Furtherance of the Acts of May 8, and June 30, 1914,
By the University of Idaho Cooperative Extension Service, James L. Graves,
Director; and the U.S. Department of Agriculture, cooperating.

4M 12-73