THE EFFECT OF VARIOUS DEFOLIANTS ON POTATO VINES AND TUBERS IN WASHINGTON[1]

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(Accepted for publication, January 15, 1950).

Potato-vine killing has become a common practice in eastern United States, eastern Canada, and England (a) to prevent late season spread of virus diseases, (b) to prevent over-sized seed potatoes, (c) to prevent spread of late blight, and (d) to facilitate harvesting the crop (2, 3, 4, 8, 9). However, this practice has not been widely adopted in the potato-growing regions of the West, probably because of frequent appearance of xylem discoloration in the tubers following the use of an herbicide* (3, 6). The type of discoloration referred to here (Fig. 1) is distinctly different from net necrosis which is confined to the phloem, from the

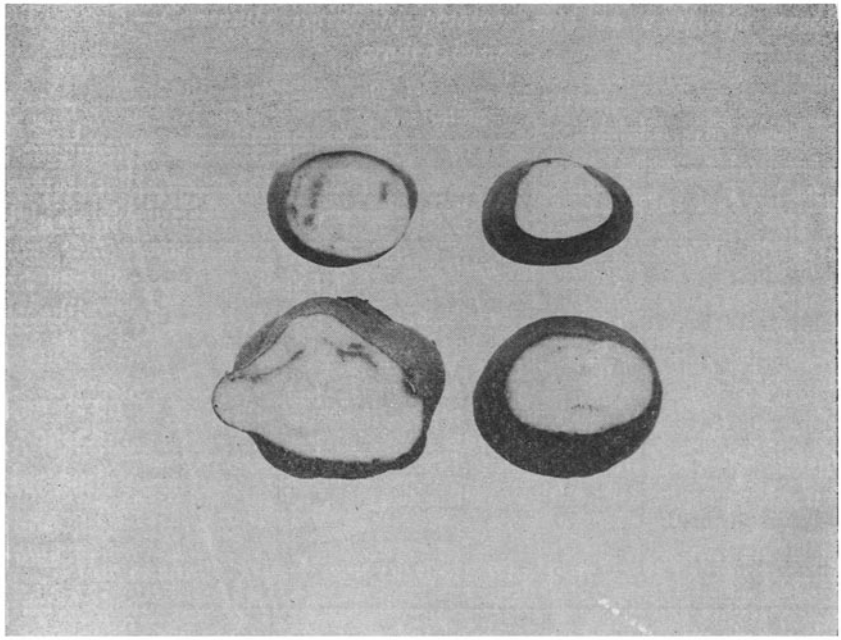

Fig. 1. — Potato tubers showing various degrees of xylem discoloration following the application of certain chemical defoliants to the vines.

*Personal communication from N. S. Wright, Dominion Laboratory of Plant Pathology, Vancouver, B. C., Canada.

[1]Published as scientific Paper No. 884, Agricultural Experiment Stations, Institute of Agricultural Sciences, State College of Washington, Pullman.

stem-end xylem discoloration referred to by Folsom and Rich (5) as stem-end browning, and from several other types of tissue discoloration in potato tubers (1). Why this disorder occurs more frequently in Washington and British Columbia than in the eastern states and eastern Canada is not known. It may be due to climatic conditions, soil variation, varietal differences, or to some other factor repeated or combination of factors. Apparently xylem ring discoloration is not a problem in England, nor did it appear to cause any difficulty in Rhode Island when the writer and commercial growers used sodium arsenite in large scale tests. Regardless of the cause, it has been and still is a real problem in the Pacific Northwest.

In the fall of 1947, a number of chemicals which were available on the market were being used with some success for potato vine killing in other parts of the country. These were applied on Russet Burbanks at Pullman, Washington. The list of chemicals, rapidity of kill, and incidence of xylem discoloration are given in table 1. The potato vines were beginning to mature when the herbicides were applied, which probably accounts, in part, for the small amount of damage to the xylem tissue.

TABLE 1.—*Effect of various chemicals on potato vines and tubers when used as defoliants in Eastern Washington in* 1947.

CHEMICAL	PER CENT OF VINES KILLED		XYLEM DISCOLORATION
	1 day	3 days	
Atlas A 1/30	20	95	Trace
Atlas A 1/15	25	95	"
Atlas A 1/5	40	95	"
Copper Sulfate	10	30	0
Sinox General	80	95	Trace
Chipman General	70	80	"
Check	5	10	0

In the fall of 1948, a more comprehensive test was undertaken with Russet Burbank and White Rose, the two most popular varieties in this area. Table 2 lists the chemicals and concentrations used, and the results obtained are recorded in table 3. There was a marked difference in the rapidity and total amount of defoliation which took place follow-

ing the application of the various herbicides. For example, kerosene killed only 5 per cent of the White Rose vines in two days, while "Shell 30" killed the vines completely in the same length of time. There was also a very marked difference in the amount of injury to the xylem, ranging all the way from a negligible amount to 96 per cent of the tubers seriously affected. The amount of defoliation of Russet Burbank varied from a slight amount to 100 per cent, and the amount of tuber discoloration ranged from 1 per cent to 96 per cent. A more rapid kill was obtained with this variety than with White Rose, and more damage was done to the tubers. In general, herbicides which caused the most rapid death to plants also produced the most damage to the tubers. This appears to be true especially of the phenol compounds. These compounds may be absorbed by the plant and carried down into the tubers; or possibly a substance already present in the plant itself may be responsible for producing the distinct grayish-brown xylem ring, often extending the entire length of the tuber. Discoloration of the tubers following defoliation by flame throwers* or frost would indicate that it may be caused by the latter. The arsenites gave a rather rapid kill with less injury to the tubers.

TABLE 2.—*Chemicals tested as vine killers.*

COMMERCIAL NAME	SCIENTIFIC NAME	CONCENTRATION (100 GAL.)
Atlas A	Sodium Arsenite 40 per cent	
Chipman General	Dinitro-o-sec. Butyl Phenol 45 per cent	1 qt.+10 gal. Diesel oil
Dow Contact	Dinitro-o-sec. Butyl Phenol	2 gal.+10 gal. Diesel Oil
Dow General	Dinitro-o-sec. Butyl Phenol 55 per cent	1 qt.+10 gal. Diesel oil
Sinox General	Dinitro-o-sec. Amyl Phenol	1 qt.+15 gal. Diesel oil
Shell 30	82 per cent Petroleum hydrocarbons, 12.5 per cent Pentachlorophenol	10 per cent (10 gal.)
Cyanamid Aerodefoliant	Calcium cyanamid	100 lbs. dust per A.
X-5	Mono sodium cyanamid	8 lbs.
Blue vitriol	Copper sulfate	10 lbs. $CuSO_4$+10 lbs. NaCl
Arsenite	Sodium arsenite	15 lbs. NaOH+6 lbs. As_2O_3
Sulfate of ammonia	Ammonium sulfate	100 lbs.
Sulfate of ammonia	Ammonium sulfate	200 lbs.

TABLE 3.—*Effect of various methods of defoliation on White Rose and Russet Burbank potatoes in Eastern Washington in* 1948.

DEFOLIANT	WHITE ROSE				RUSSET BURBANK			
	DEFOLIATION 1 day	DEFOLIATION 2 days	Per cent 7 days	Per cent xylem discoloration	DEFOLIATION 1 day	DEFOLIATION 2 days	Per cent 7 days	Per cent xylem discoloration
Atlas A	20	75	100	3	50	100	100	5
Chipman General	5	10	25	5	90	100	100	64
Dow Contact	90	95	100	17	90	95	100	59
Dow General	5	20	25	21	75	95	100	48
Sinox	75	90	95	11	90	95	100	47
Blue Vitriol	10	40	75	6	10	50	90	2
Kerosene	5	5	10	5	5	20	50	3
Cyanamid	0	10	50	6	0	10	50	7
X-5	10	10	10	1	10	20	50	4
Shell 30	95	100	100	96	95	95	100	98
Arsenite	80	95	100	4	80	95	100	7
Sulfate of Ammonia 1:1	10	25	50	Trace	10	25	50	3
Sulfate of Ammonia 2:1	25	70	95	Trace	25	70	95	2
Vines cut	100	100	100	10	100	100	100	6
Vines pulled	100	100	100	5	100	100	100	1
Frost	-	-	-	-	-	-	-	12
Check	0	0	0	5	0	0	0	4

Kraus and Dietz (7), working in Idaho, reported that 1 pound of ammonium sulfate dissolved in 1 gallon of water and applied at the rate of 100 to 200 gallons per acre gave a satisfactory kill of Bliss Triumph potato vines in about 10 days. However, it was not satisfactory when applied to Netted Gems. It will be noted in table 3 that doubling the amount of ammonia increased markedly the rapidity of kill without causing an increase in tuber discoloration. This material also has the advantage of being non-poisonous, non-inflammable, readily available, and a nitrogen carrier.

Sulfate of ammonia, and copper sulfate were compared on a rather large scale at Colville in the fall of 1948. Sulfate of ammonia was more effective than copper sulfate, killing over 50 per cent of the vines within a day or two, and eventually killing most of the others. About a week after the two chemicals were applied a heavy frost killed all the vines. Tuber samples from the areas killed with the sulfate of ammonia, copper sulfate, and by frost alone were collected, cut, and examined. About 30 per cent of the tubers from the vines killed by frost showed slight xylem discoloration, whereas only 15 per cent of the tubers from the vines which were partially or wholly killed by either of the two chemicals were similarly discolored. None of the tuber discolorations in this lot was serious enough to impair the seed value. It is possible that sulfate of ammonia may find wider use than heretofore as an herbicide.

In western Washington where dews are frequent and heavy, Cyanamid Aerodefoliant has been used with fair success by the seed potato growers. However, mechanical devices (Rotobeaters), which defoliate the plants and partially shred the vines, are gaining in popularity. A survey of the 1948 crop indicated that neither the Aerodefoliant nor the mechanical beaters caused any appreciable amount of xylem discoloration.

Summary

Two years' results with various methods of killing potato vines are discussed. Most chemicals which killed the vines rapidly also produced an objectionable xylem discoloration in the tubers. This was especially true of the phenol compounds. Ammonium sulfate killed the vines fairly rapidly when applied at the rate of 200 pounds per acre in 100 gallons of water. The xylem discoloration was not serious. Mechanical vine shredders are gaining in popularity and may replace chemicals as a means of hastening maturity. A survey showed a negligible amount of tuber discoloration as a result of this method of killing the vines.

Literature Cited

1. Blodgett, E. C. and Rich, A. E. 1949. Potato tuber diseases, defects, and insect injuries in the Pacific Northwest. Wash. Agr. Exp. Sta. Popular Bull. 195.

2. Bonde, R. and Schultz, E. S. 1945. The control of potato late blight tuber rot. Amer. Potato Jour. 22:163-167.

3. Callbeck, L. C. 1947. Killing potato tops with chemicals. Add. and Proc. Ont. Crop Imp. Assn. Potato Sec.: 11-20.

4. ———. 1948. Current results with potato vine killers in Prince Edward Island. Amer. Potato Jour. 25: 225-233.

5. Folsom, D. and Rich, A. E. 1940. Potato tuber net-necrosis and stem-end browning studies in Maine. Phytopath. 30: 313-322.

6. Hoyman, W. G. 1947. Observations on the use of potato vine killers in the Red River Valley of North Dakota. Amer. Potato Jour. 24: 110-116.

7. Kraus, J. E. and Dietz, C. F. 1943. Hastening potato tuber maturity by killing the vines. Univ. of Idaho Coll. of Agr. War Circ. No. 26.

8. Steinbauer, G. P. 1946. Potato vine killing. Maine Agr. Exp. Sta. Mimeo. Report.

9. Wilson, A. R., Boyd, A. E. W., Mitchell, J. G., and Greaves, W. S. 1947. Potato haulm destruction with special reference to the use of tar acid compounds. Ann. Appl. Biol. 34: 1-33.