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Potato Vine Killing

L. C. Haderlie, J. L. Halderson, D. L. Corsini and R. B. Dwelle

Potato vine killing before harvest is a common practice in Idaho potato production. Killing vines 3 weeks before harvest allows stolons to loosen from the tuber, increases tuber maturity and skin set and decreases vine quantity (Fig. 1). Vine killing has been used to limit seed tuber size and to decrease the spread of disease. Mature tubers with good skin set have reduced water loss during storage and are more resistant to bruising during harvest and handling. Since about 90 percent of Idaho potatoes are stored, either on the farm or by processors and fresh pack shippers, minimizing storage loss is critical. Although vine kill aids potato harvest and tuber storage, it can reduce tuber yield and quality characteristics, such as size and specific gravity.

Several vine killing or desiccation methods are commonly used. Vine death is a natural occurrence when short season varieties are grown or when disease or soil fertility limit full season potato vine growth. In some areas of Idaho, frost is the most common method of vine kill, but most Idaho growers normally use a chemical or mechanical method. About 60 percent of the Idaho potato growers use chemicals, and about 25 percent use mechanical methods. The most common mechanical vine desiccation method is rolling, often used just before a chemical application. The next most popular mechanical method is vine flailing or chopping.

Fig. 1. Potato vines several days after chemical application compared to green, untreated vines. The insert photo shows complete vine desiccation which is the ideal.

Chemical Desiccation

Chemicals used for potato vine killing include dinoseb (dinitro formulations), diquat, paraquat, sulfuric acid, and endothall (Des-i-cate). The most common chemical used in Idaho is dinoseb that comprised nearly 70 percent of chemical use in 1984. Dinoseb has been used since the late 1940s. Diesel oil has been added to dinoseb to speed desiccation. Recently, diesel oil has been partially replaced by crop oils, such as Herbimax, Mor-act, Spray Booster, etc. to reduce cost since they are added at lower rates. Paraquat can be used as a vine desiccant only for potatoes that are processed immediately after harvest. Diquat is a relatively new herbicide for Idaho vine killing, while endothall has been used for several years on a limited basis. The latter is the slowest acting of all presently used chemicals.

All of these herbicides are quite toxic to mammals. They should be used with even greater care and precautions than required by most herbicides.

Rate of vine killing varies with the chemical (Fig. 2). The ranking of herbicides from most rapid to slowest for vine desiccation in southern Idaho experiments were sulfuric acid, dinoseb, diquat and endothall. We have not compared paraquat desiccation rate with the others listed, but others have shown it to be similar to or faster than diquat. Vine killing rate varies according to the amount per acre of chemical used, air temperature, soil moisture and the vigor of potato vines.

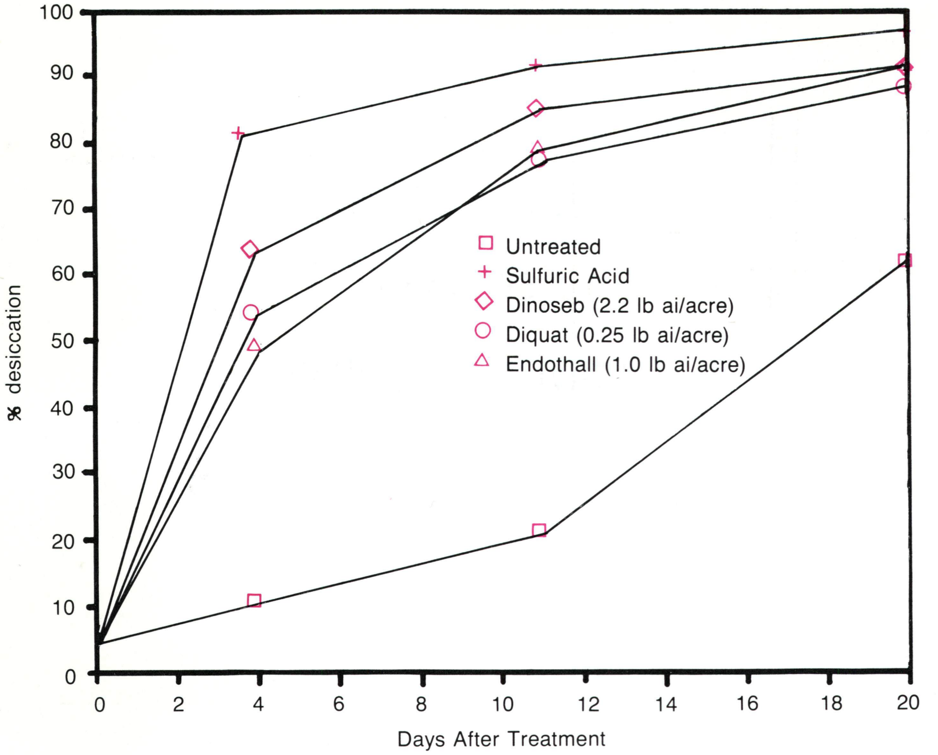

Fig. 2. A comparison of vine desiccation rates after application of several chemicals in southern Idaho as averaged over several experiments.

All of these chemicals, except sulfuric acid, are biochemical inhibitors in the plant, so their activity is dependent on air temperature and plant health. Higher temperatures will accelerate vine desiccation, being most pronounced with dinoseb. If plant senescence (dying) has already started, chemical desiccants will cause more rapid and complete kill than if vines are immature or vigorously growing.

Vigorous vines, such as those that are normal in Idaho seed growing areas, often require the highest labelled rates for the chemical or two applications about 3 to 6 days apart. Vine rolling before spraying will accelerate vine kill. Care should be taken to eliminate drift of these chemicals onto non-target areas, particularly from aerial applications.

Table 1. Potato vine desiccation 7 days after treatment with diquat and dinoseb and various surfactants or oils.

	% vine desiccation[1]	
Surfactant or oil	Dinoseb (2.2 lb a.i./acre)	Diquat (0.25 lb a.i./acre)
1. Herbimax	60	--[2]
2. Mor-act	63	53
3. Wetsol	61	--
4. LI-700	59	52
5. X-77	--	53
6. Untreated	25	19

[1] Surfactants or oils were applied at 16 fluid oz/acre.

[2] No data obtained.

Sulfuric Acid

Our research demonstrated that sulfuric acid was the most rapid and consistent desiccant we tested. Sulfuric acid action is not dependent on air temperature, soil moisture, plant health or other biological conditions. It will, however, more rapidly kill potato vines that have started dying than vigorously growing vines.

Surfactants, Oil or Wetting Agents

Results of testing several surfactants, oils or wetting agents are presented in Table 1. Mor-act was consistently better with dinoseb than other crop oils tested. Recent evaluations did not test diesel oil with dinoseb. Diesel oil has provided enhanced activity with dinoseb, but it is not essential. Vine killing, however, could be increased for immature vines by increasing the dinoseb rate or by adding 3 to 5 gallons of diesel oil per acre.

Diquat and paraquat labels require the addition of an appropriate surfactant. Diquat activity was not different when using X-77, Herbimax, LI-700 or Mor-act (Table 1). Many other surfactants, oils or wetting agents are available but have not been adequately tested in Idaho. Use those that are recommended by the label and/or that have been tested or recommended by reputable dealers. Addition of new, untested surfactants could reduce activity and/or cause tuber quality problems.

Endothall does not require additional surfactants. The herbicide formulation contains enough surfactant.

Mechanical Vine Killing

Flailing or Chopping

Flailing vines by various methods has been done since the 1940s and is still a popular method for vine removal. This procedure has the advantage of even distribution of vine residue in the field and avoids vine interference with harvesters. The instantaneous vine removal initiates tuber maturation. There is a sizeable power requirement

Fig. 3. Potato vine flailer with contoured metal flails.

Fig. 4. Homemade vine roller for 6 rows wide.

for flailing and a relatively low acre per hour capacity compared to sprays. Unless extra care is taken, tubers near the surface can be damaged if the hill shape is not similar to the flail blade contour (Fig. 3). Flailing too high will leave long vine stems that can cause regrowth problems.

Pullers

Vine pullers have been tested in the U.S. and used in Europe for many years, but few are commercially used in the U.S. Vine pulling removes the stolon from the tuber which stops any further movement of plant nutrients (or viruses) into the tuber. Pulling tends to bring tubers out of the ground, so most models have skids that hold tubers in the ground and seal the soil. Flailers have an advantage over pullers in that vines are chopped into small pieces.

Rolling With or Without Chemicals

Vine rolling is the most common mechanical method used in Idaho for preharvest vine management. Rollers crush stems and flatten vines to increase the rate of natural dying (Fig. 4). Our results demonstrated that vine rolling increased rate of vine kill up to 9 percent with or without chemical application. Vine rolling can also aid spray application by reducing the canopy thickness and thus making chemical coverage more uniform. Vine rolling is recommended in combination with chemical application.

Tuber Yield and Quality

Yield

Tuber yields were found to increase 5 cwt per acre per day at the first of September in southern Idaho when averaged over several experiments. Therefore, higher yields will result from delayed or no vine kill. The use of chemical or mechanical vine kill in early September reduced yields an average of 9 percent compared to allowing vines to die naturally in the studies. The yield reduction was greater with immature vines.

Specific Gravity

Vine killing before natural death will reduce specific gravity. Hence, specific gravity generally increases with a longer period of growth in Idaho. Vine pullers tended to maintain higher specific gravity than other vine killing methods. This may be caused by removing the stolons from the tubers.

Stem-end Discoloration

Several early reports (1940s and 1950s) indicated that certain chemicals caused increased tuber stem-end discoloration (SED) (Fig. 5). Some of these reports concluded that rapid vine desiccation was the reason. Certain varieties were more susceptible than others. Recent research has shown that speed of vine killing alone does not increase SED in Russet Burbank potatoes in southern Idaho. Three years of extensive studies have shown no difference in SED among vine kill methods (Table 2). Although physiological causes of SED (other than from leaf roll virus) are not yet known, some indication exists that very dry soil at the time of rapid vine killing might increase SED. Research has also shown that immature vines at the time of vine killing contribute to higher SED.

Fig. 5. Tubers showing various amounts of stem-end discoloration from none (left) to severe (right).

Table 2. Stem-end discoloration (SED) as affected by several potato vine killing methods in Russet Burbank. Data are means of 12 experiments over 3 years in southern Idaho.

	% SED	
Treatment	Severe[1]	Total[2]
Natural death	2.2	15.8
Dinoseb	2.2	14.8
Diquat	1.7	13.5
Sulfuric acid	1.6	13.3
Mechanical removal	2.0	13.3

[1] Severe = proportion of tubers in rating category 3 and 4 of scale 0 to 4 where 0 = none and 4 = most severe.

[2] Total = proportion of tubers in rating categories 2, 3 and 4.

About the Authors

Lloyd C. Haderlie is an associate professor of weed science in the Department of Plant, Soil and Entomological Sciences stationed at Aberdeen; James L. Halderson is an associate professor of agricultural engineering stationed at Aberdeen; Dennis L. Corsini is an affiliate professor of plant pathology, USDA-ARS, stationed at Aberdeen; Robert B. Dwelle is an associate professor of plant physiology stationed at Aberdeen and temporarily now at Moscow.

Seed Vigor

Potato seed vigor can be reduced slightly by certain types of vine killing. Dinoseb has shown the greatest seed vigor reduction of any chemical, but this result was not consistent over the 3 years of testing in Idaho.

Recommendations

1. **Herbicides available for vine killing.**

Name	Trade name	Recommended additions[1]
Dinoseb	Several	Add crop or diesel oil
Diquat	Same trade name	Non-ionic surfactant
Endothall	Des-i-cate	None
Paraquat	Paraquat or Gramoxone	Non-ionic surfactant
Sulfuric acid	Sulfuric acid	none

Do Not Use Paraquat for Potatoes To Be Stored

[1] For rates, see herbicide label.

2. **Time of vine killing.** Vines should be killed 3 weeks before harvest for best skin set.

3. **Immature vines.** Use one or more of the following for fast, chemical desiccation.
   a. Roll vines before spraying.
   b. Use maximum rate of herbicide.
   c. Add diesel oil to dinoseb.
   d. Spray twice — second time 3 to 6 days after first.

4. **Soil moisture at vine kill.** Reduced soil moisture will start natural death and improve vine kill effectiveness, but very low soil moisture at vine kill might increase stem-end discoloration. Soil moisture should be at least 50 percent of field capacity at vine kill.

5. **Vine distribution after harvest.** Distributing vines evenly across the field without vine piles will help prevent crop injury from herbicide residue the next year. Metribuzin (Lexone or Sencor) and trifluralin (Treflan) or pendimethalin (Prowl) herbicides are used in potatoes and can remain in the vines at harvest. As vines degrade, the herbicide will be released to the soil and can cause injury to subsequent crops.

6. **Sulfuric Acid.** Sulfuric acid is registered as a potato vine desiccant. Our data show that it was a very effective vine desiccant which did not cause increased SED. Our data also show that the addition of urea to sulfuric acid will not reduce vine killing effectiveness. Wear full protective clothing when working with sulfuric acid.

Table 3. Comparison of vine killing methods.

Vine kill method	Rate used (lb a.i./acre)	Rate of desiccation[1]	Mammalian toxicity	Power requirement	Approximate cost $/acre[2]
Rolling	—	13	none	low	2
Endothall (Des-i-cate)	1.00	8	toxic	low	10
Diquat	0.25	6	toxic	low	11
Paraquat	—	6	toxic	low	11
Dinoseb (Dinitro)	2.20	5	toxic	low	11
Sulfuric acid	18 gal	4	very caustic	low	18 to 20
Flailing	—	0	none	high	15
Pulling	—	0	none	intermediate	18[3]

[1] Desiccation rating: 0 = instantaneous removal, 15 = same as natural death.
[2] Includes custom application at $4.00 or $5.00 per acre.
[3] Assuming a 6-row commercial puller.

Trade Names

Trade names are used in this publication to simplify the information presented. Such use does not imply endorsement of any product nor criticism of similar products that are not mentioned.

Chemical Recommendations

The chemical recommendations are based on the best information available at the time of printing. Before using any pesticide, read the instructions on the label. Follow all precautions and restrictions for safe product use.

The grower is responsible for residues on his crops. He also is responsible for drift from his property to adjacent properties or crops.

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