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Potato Vine Killing

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Potato vine killing before harvest is a common practice in Idaho. Killing vines 3 weeks before harvest allows stolons to loosen from the tuber, develops tuber maturity,* sets skin and decreases vine quantity (Fig. 1). Vine killing has also been used to limit seed tuber size and to decrease the spread of disease.

Many tuber physiological factors are involved. Maturation of tubers reduces water loss during storage, increases resistance to scuffing, decreases storage decay and increases resistance to bruising during harvest and handling. Since more than 90 percent of Idaho potatoes are stored, either on the farm or by processors and fresh pack shippers, minimizing storage loss is economically very important. Although vine killing aids potato harvest and tuber maturation, it will reduce tuber yield and specific gravity compared to no vine killing.

Several vine killing or desiccation methods are commonly used. Vine death is a natural occurrence when disease or soil fertility limit potato vine growth. In some areas of Idaho, frost is a common method of vine kill, but most Idaho growers normally use a chemical or mechanical method because the short season necessitates completion of harvest before freezing temperatures damage tubers in the soil.

About 60 percent of the potato growers use some type of mechanical method. The most common mechanical vine killing method is rolling. It is most effective if used just before chemical application. Rolling is not recommended as the sole treatment. The next most popular mechanical method is vine flailing or chopping. Vine pulling is used in a few cases.

*Maturity has several definitions but in this application it means such a state of tuber characteristics that subsequent quality loss over time in storage is minimized.

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 diquat, paraquat, sulfuric acid, Enquik (urea-sulfuric acid) and endothall (Des-I-Cate). All have had an increase in use after Dinoseb (dinitro formulation) was banned for use on potatoes in 1987. Crop oils (surfactants), such as Herbimax, Mor-act, Spray Booster, etc. are recommended for use with some chemical desiccants because cost is reduced. 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.

Rate of vine killing varies with the chemical (Fig. 2). The ranking of herbicides from most rapid to slowest for vine desiccation in southeastern Idaho experiments was sulfuric acid, diquat and endothall. Research at Aberdeen has not compared paraquat desiccation rate with the others listed, but other studies have shown it to be similar to or faster than

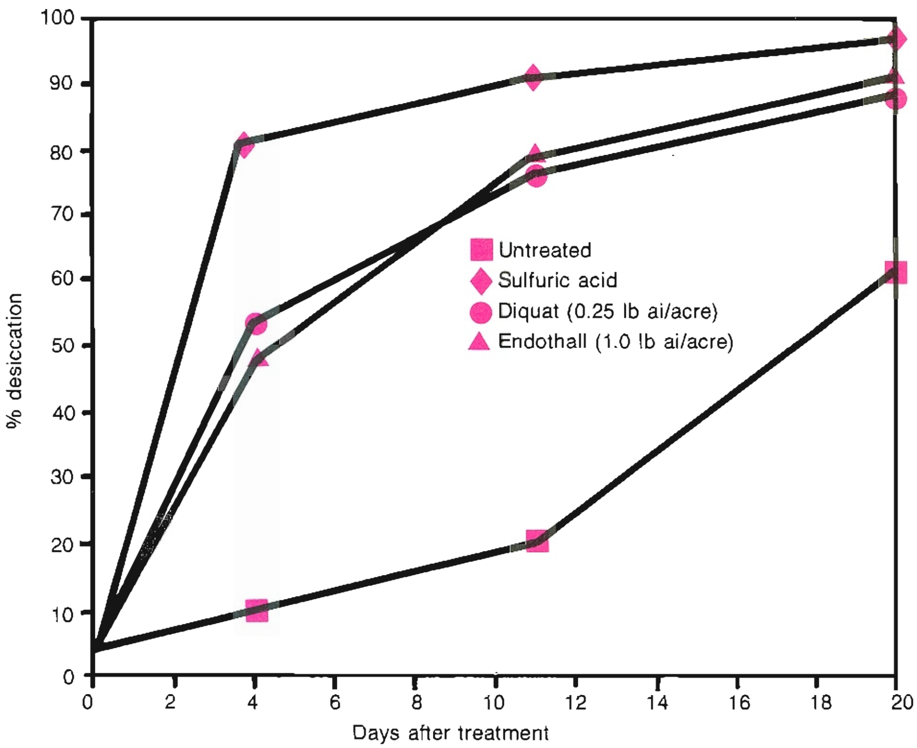

Fig. 2. A comparison of vine desiccation rates after application of several chemicals in southern Idaho as averaged over several experiments.

diquat. Vine killing rate varies according to the amount of chemical used per acre and, except for sulfuric acid, air temperature, soil moisture and the vigor of vines.

All of the vine-killing chemicals, except sulfuric acid, are biochemical inhibitors in the plant, so their activity depends on air temperature and plant health. Higher temperatures will accelerate vine desiccation. If plant senescence (dying) has already started, or other stress is present, chemical desiccants will cause more rapid and complete kill than if vines are 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 split applications about 5 to 6 days apart. Vine rolling which will accelerate vine death is recommended before spraying. All of these herbicides are quite toxic to mammals. They should be used with greater care and precautions than required for most herbicides. Care should be taken to eliminate drift and misapplication of chemicals onto nontarget areas, particularly from aerial applications.

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

Surfactant or oil	% vine desiccation[1] Diquat (0.25 lb a.i./acre)
1. Mor-act	53
2. LI-700	52
3. X-77	53
4. Untreated	19

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

Sulfuric Acid

Our research demonstrated that sulfuric acid was the most rapid and consistent desiccant we tested. Sulfuric acid action does not depend 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. Our studies have shown that rapid vine killing does not cause stem-end discoloration. Proper application equipment and the use of full protective clothing is strongly recommended when applying sulfuric acid.

Surfactants, Oil or Wetting Agents

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

Mechanical Vine Killing

Flailing

Flailing vines by various methods has been done since the 1940's. Flailing of vines has increased considerably since the Dinoseb ban. This procedure has an advantage of even distribution of vine residue in the field and reduces vine interference at harvest. Instantaneous vine removal initiates tuber maturation as effectively as any other procedure according to currently available data.

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

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

Flailing has a sizeable power requirement and a relatively low acre per hour capacity compared to sprays. Unless care is taken, tubers near the soil surface can be damaged, particularly if the hill shape is not similar to the flail blade contour (Fig. 3). Flailing too high will leave long vine stems and increase regrowth but regrowth has not been documented as a problem in Idaho. Regrowth also occurs when vines are killed with chemicals. When vines are flailed, harvesters need to be equipped with blowers to remove the many small pieces of vines.

Pullers

Vine pullers have been tested 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. Pulling tends to cause a small increase in specific gravity compared to other vine killing methods.

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 dying (Fig. 4). Our results demonstrate that vine rolling increased the rate of vine kill up to 9 percent with or without chemical application. Vine rolling can also aid spray effectiveness by reducing canopy thickness and thus making chemical coverage more uniform. Vine rolling is recommended in combination with chemical application but not as a sole treatment.

Tuber Yield and Quality

Yield

Tuber yields were found to increase about 5 cwt per acre per day at the first of September in southeastern Idaho when averaged over several experiments. Therefore, higher yields will almost always result from delayed or no vine kill.

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

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 percent yield reduction was greater with immature vines.

Specific Gravity

Vine killing will reduce specific gravity because 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 and controlling moisture uptake by the tubers.

Stem-end Discoloration

Several reports in the 1940's and 1950's 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 determined to be more susceptible than others. Recent research has shown that speed of vine killing alone does not increase SED in Russet Burbank potatoes in southeastern Idaho. Several years of extensive studies have shown no difference in SED among vine kill methods (Table 2). Although causes of SED (other than from leaf roll virus and *verticillium* sp.) are not yet known, some indication exists that very dry soil ($<$ 50 percent field capacity) at the time of rapid vine killing might increase SED. Recommended practices for high yield and quality preclude soil this dry, however.

Recommendations

1. Herbicides available for vine killing.

Name	Trade name	Recommended surfactant additions[1]
Diquat	Diquat	Non-ionic surfactant
Endothall	Des-I-Cate	None
Paraquat[2]	Gramoxone	Non-ionic surfactant
Sulfuric acid	Sulfuric acid	None
Urea-sulfuric acid	Enquik	None

[1]For rates, see herbicide label.

[2]*Do not use Paraquat for potatoes to be stored.*

2. **Time of vine killing** — Vines should be killed approximately 3 weeks before harvest (for development of sufficient tuber maturation). It is anticipated that this period can be reduced when more is known about maturation factors.

3. **Immature vines** — Use either of the following after rolling for fast, chemical desiccation.
   a. Use maximum rate of herbicide.
   b. Spray twice (each at ½ the labeled rate) — second time 5 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. Dust on vines will tend to deactivate diquat.
5. **Vine distribution after harvest** — Distributing vines evenly across the field without vine piles will help prevent crop injury the next year from herbicide residue. 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 is a very effective vine desiccant which does not cause increased SED. It is equally effective during widely varying weather conditions. Our data also show that the addition of urea to sulfuric acid does not reduce vine killing effectiveness. **Wear full protective clothing and use proper equipment 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 to 3
Endothall (Dis-I-Cate)	1.00	8	toxic	low	26
Diquat	0.25	6	toxic	low	13
Paraquat	-	6	toxic	low	13
Sulfuric acid	18 gal	4	very caustic	low	23
Enquik (urea-sulfuric acid)	20 gal	4	caustic	low	28
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 to $5.00 per acre (except rolling).
[3]Assuming a 6-row commercial puller.

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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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