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Vine Kill Give and Take

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Growers…does your sense of urgency rise as harvest time approaches? Sense of urgency can be thought of as stress driving performance timing and quality. Some of that stress is relieved by setting potato vine kill date related to desirable harvest date. Not necessarily "set it and forget it," but, in general, potato harvest occurs when tuber skin is set which usually occurs two to three weeks after vine kill product application. Of course, the date for vine kill is also scheduled depending upon end-use for the crop, speed of desiccation needed, and specific variety characteristics. Other needs sometimes considered include late season weed control and desire to kill in order to prevent disease translocation from foliage and stems to tubers.

The need for speed: University of Idaho research has shown that currently available products can provide close to 100% overall vine kill, measured as leaf and stem kill, as soon as 3 days (sulfuric acid), one week (diquat; Reglone® and others), or two or more weeks after application of glufosinate-ammonium (Rely® and others), Aim® (carfentrazone), or Vida® (pyraflufen-ethyl). Speed from fast to slow is Sulfuric acid > Reglone > Rely + Aim or Vida (or Reglone) > Rely alone > Vida alone.

No endorsement of named products is intended nor is criticism implied if similar products are not mentioned.

There's more…What about blackspot bruising and stem end discoloration (SED)? Shouldn't choice of vine-kill date also depend upon the impact of vine-kill speed on potato tuber susceptibility to blackspot bruising and SED and whether vine kill speed should be different for immature vs mature tubers?

A blow to a tuber during harvest operations damages internal cells where enzymes and substrates react to create discoloration i.e. a physical impact, followed by a chemical reaction causes the discoloration. Many factors can impact a tuber's susceptibility to blackspot bruise at harvest time including tuber hydration and temperature as well as soil moisture conditions. Free tyrosine is the substrate responsible for the black pigment that forms after a bruise. Tissue of more mature tubers is lower in sucrose and higher in starch and tyrosine than tissue of immature tubers. Sugars in the tuber convert to starch over time as the tuber matures. Higher black pigmentation and dark bruising occur when tuber starch/tyrosine is relatively high compared to sucrose level. In contrast, when tuber sucrose is high and starch is low, then SED is higher than when the opposite occurs. In other words, mature tubers are more susceptible to bruising and immature tubers are more susceptible to SED. Talk about being caught between a digger and a cellar floor!

But wait…There's that harvest = skin set = two to three weeks after vine kill. Fields are harvested according to a schedule, but tuber maturity can differ from field to field and as the harvest season progresses. Perhaps

vine kill speed on immature tubers impacts bruise and SED differently than vine kill speed on more mature tubers, that is, a rapid kill of green vines/immature tubers stops conversion to starch more quickly than a slow vine kill, and as a result, the likelihood of blackspot bruise is reduced with the rapid kill at that time. It is likely, however, that the same vine kill product is being used in all of a given grower's fields.

Answers…An interaction between vine-kill speed and vine/tuber maturity at time of application occurred in a preliminary University of Idaho trial conducted on Russet Burbank. Fast –sulfuric acid vs. medium Reglone vs. slow Vida vine kill products were applied to vines with less than 5% natural senescence or more mature vines with 40% or greater natural senescence. Application at either timing was made mid-day. Harvest for each treatment occurred two weeks after overall desiccation reached 95%. Treatment harvest was not always on the same date. A nontreated control was harvested at each treatment harvest-date. Blackspot bruising was assessed.

Vine kill speed: Speed of application to basically green vines from fast to slow was sulfuric acid > Reglone > Vida.

- The number of days it took to reach 95% overall vine kill after application of sulfuric acid, Reglone, or Vida at the early timing was 17, 22, 36, respectively.
- Average time to 95% overall vine kill was 25 days.

Relative vine kill speed of more mature vines was sulfuric acid = Reglone ≥ Vida.

- The number of days to 95% vine kill of 40% senesced vines was more similar: 21, 21, and 27, respectively.
- Vine kill speed by Reglone was similar with the two timings while sulfuric acid slowed slightly, and Vida was quicker when vines were mature than when vines were immature at application time.

Other studies have shown that desiccation of mature vines with vine kill products is usually faster than when the same are applied to immature vines.

Blackspot bruise: As expected, since mature tubers have more starch than immature tubers, harvest after vine kill products were applied to mature vine/tubers, resulted in more tubers with bruising than when harvest occurred after these products were applied to immature vines/tubers which likely had lower starch and higher sucrose.

- The differences in bruising occurred even though sulfuric acid with fast vine kill speed or Vida with slow speed was applied.
- *The same was expected for bruising in the medium vine kill speed Reglone treatments*, ***however*****,** Reglone applied to immature vines/tubers resulted in a much greater % bruising than bruise in the nontreated, as well as the fast-kill sulfuric acid and slow-kill Vida treatments.

NOTE: According to the current Reglone® label, the recommended application time of day for potato vine kill with Reglone is early or late i.e. not during the bright light of mid-day.

What happened? Light is required for Reglone activity.

- Reglone inhibits photosynthesis by interfering with electron flow in one of the photosystems in plants ultimately resulting in highly reactive, superoxide radicals destroying, among other things, cell membranes.
- Rapid leaf wilting and desiccation follows.
- Localized destruction limits the already limited movement of Reglone in the plant.

Reglone applied in full sunlight can result in appearance of symptoms within hours.

- *Application in a low light environment could slow the destruction which could increase spread of the product and overall desiccation,* hence the label recommendations for low-light application timing.

In the preliminary research trial, Reglone application to immature vines occurred mid-day in full sunlight.

- Could this incredibly fast production of the superoxide radicals in the full light environment cause more than rapid desiccation?

Perhaps the mid-day Reglone application "shocked," greatly stressed the potato plants resulting in greater than expected bruising.

- Application in low light as stated in the label, would have slowed the initial superoxide radical production and activity level i.e. not have resulted in the shock.
- READ and FOLLOW the LABEL!

Interestingly, vine kill speed ranking of sulfuric acid > Reglone > Vida in this trial was not different than that seen in multiple University of Idaho vine-kill trials conducted in a wide range of sunlight/environment conditions. The hypothesized shock did not change the relative speed of vine kill by Reglone.

Overall take-to-the-field messages

Vine kill speed:

In general, potato vine kill speed from fast to slow is sulfuric acid > Reglone > Rely + Aim or Vida (or Reglone) > Rely alone > Vida alone.

- In the vine kill speed x vine/tuber maturity trial mentioned in this article, time to 95% overall vine kill by Vida was less when applied to mature than to immature vines.
- Expectations for faster vine kill with sulfuric acid and Reglone when vines were more mature than when immature were not met.
    - Time span for Reglone was similar regardless of vine maturity.
    - Sulfuric acid vine kill speed was slightly greater on immature vs. mature vines at application time.

Blackspot bruise give and take:

As previously mentioned, many factors can affect susceptibility to blackspot bruise at harvest including starch and tyrosine levels in the tuber. Higher starch levels in mature vs immature tubers can potentially cause higher blackspot bruising in mature vs immature tubers.

- Except for Reglone, level of blackspot bruise was less when vine kill occurred on immature vines vs when on mature vines.
    - Applications at either timing were made mid-day in full sunlight.
- Unexpectedly, bruising in the early-timing Reglone treatment was greater than bruising in the early-applied sulfuric acid and Vida.
- Desiccation response to Reglone is faster when applied in full sunlight vs. application in low light, due in part to the quick production of highly reactive, superoxide radicals in the full light situation.
- This speed can localize desiccation, and slow overall vine kill.
- Perhaps the greater than expected bruising occurring when Reglone was applied to immature vines/tubers was caused by intensity of the radicals shocking – highly stressing the plant and tubers.
- READ AND FOLLOW THE REGLONE label and apply the product for potato vine kill early morning or later evening when light levels are low.

Proposed future research will be conducted with the varied vine-kill speed products and tuber maturity timing and will also include such factors as measurements of sugar levels in tubers at application time and harvest. SED occurrence will be assessed. Meanwhile, impact of tuber maturity in a given field at vine kill time on blackspot bruising should be kept in mind when choosing the most appropriate vine kill product and timing.