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Glyphosate on Potatoes

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Potatoes are susceptible to glyphosate and the exposure of plants to low levels of glyphosate can lead to reduced yield, poor quality tubers, and tubers with herbicide residues in them. Seed potato tubers can store glyphosate residues until the following year, and when planted they can have emergence problems that ultimately can reduce yield.

Glyphosate is a commonly used herbicide in agriculture because of the low cost for effective control of grasses and broadleaf weeds. It is commonly sprayed on glyphosate-resistant soybean, corn, canola and sugarbeets, and as a preharvest treatment for several crops, including small grains and canola.

When these treatments occur next to a potato field or the same sprayer tank is used to treat potatoes, the potential of glyphosate coming in contact with potato plants increases. Each year, numerous cases of glyphosate injury in potatoes are reported. This publication describes the symptoms of glyphosate injury in potato plants, tubers and seed grown with glyphosate residues.

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Potatoes Exposed to Glyphosate

Potatoes can be exposed to glyphosate in a variety of ways. Plant exposure may come from drift of particles from a sprayer (Figure 1), tank contamination, misapplication, inversions, spot treatments in the field, contaminated water or herbicide containers that are not properly labelled.

The most common ways potatoes come in contact with glyphosate are spray drift, tank contamination or misapplication. Spray drift can be mitigated in a variety of ways, including adjustments to carrier volume, nozzle selection, spray pressure, boom height and travel speed. In addition, spraying near a potato field should occur only when wind speeds are low (check the label of product being sprayed) and the wind is blowing away from potato fields. This may include not spraying field borders next to potato fields.

Figure 1. Drift causing glyphosate injury on potatoes.

Spray tanks should be cleaned with the proper tank cleaners and rinsed thoroughly before being used in potatoes. Producers may consider having a spray tank that is dedicated solely for potatoes and never is used for spraying glyphosate. Misapplication can occur when a field is sprayed with glyphosate unintentionally, or more likely, when the spray boom is overextended and the spray solution is applied to the outside rows of a neighboring potato field.

Inversions are caused by vertically stable air and are most common when wind speeds are less than 3 miles per hour and cloud cover is less than 25%. In these conditions, drift potential is highest from three to four hours after the high temperature of the day until two to three hours after sunrise. Spray particles are suspended in the air during inversions, just like dust, fog or smoke can be observed in these conditions. For more information on inversions, see NDSU Extension publication AE1705, Air Temperature Inversions Causes, Characteristics and Potential Effects on Pesticide Spray Drift.

Potatoes also can come into contact with glyphosate when spot treatments occur within the field or around the field edges. Being aware of sprayer setup and environmental conditions can help mitigate off-site movement of herbicides onto sensitive crops, such as potatoes.

Contaminated water that has low levels of glyphosate can cause glyphosate injury. Ensure the water source used for any field operations is free from herbicides. Properly label all herbicide containers, and never put a herbicide into a container with a different label.

Another concern for potato growers is controlling weeds with glyphosate prior to potato emergence. If potato sprouts are cracking through the soil surface, they may encounter spray droplets.

Glyphosate on Plant Growth

When glyphosate comes in contact with potatoes during the growing season, it can cause damage to the leaves and tubers, and reduce yield and marketability of potatoes.

Glyphosate enters the potato plant through the leaves and then translocates to the growing points above and below ground. During daughter tuber development, tubers act as a "sink," or a place to accumulate assimilates produced by the leaves and other exogenous compounds (such as glyphosate) translocated by the plant.

Glyphosate injury can appear as a yellowing or necrosis in young leaves (Figures 2 to 4), and plants can be stunted in growth. Tuber symptomology may include cracking of the skin, deep fissures, malformed tubers and tissue death followed by secondary pathogens invading the tubers (Figure 5 to 12).

As injured tubers progress into the bulking stage, cracks and malformations will amplify. This reduces the marketability of tubers, and glyphosate residues in the tuber can make it unsaleable. Such cracking may be mistaken for growth cracks, but analyzing multiple samples and sending tubers to laboratories to test for herbicide residues can assist in confirming the cause of the injury. When glyphosate is misapplied and high concentrations come in contact with potato plants, foliage and tuber death can occur (Figures 13 to 14).

Figure 2. Yellowing of youngest leaflets caused by glyphosate.

Figure 3. Yellowing of youngest leaflets caused by glyphosate.

Figure 4. Yellowing of youngest leaflets caused by glyphosate.

Figure 5. Elephant hide and cracking of tuber skin caused by glyphosate sprayed on plant leaves.

Figure 6. Tuber cracking as a result of the mother plant being exposed to glyphosate.

Figure 7. Cracking of Ivory Crisp tuber caused by glyphosate sprayed on plant foliage.

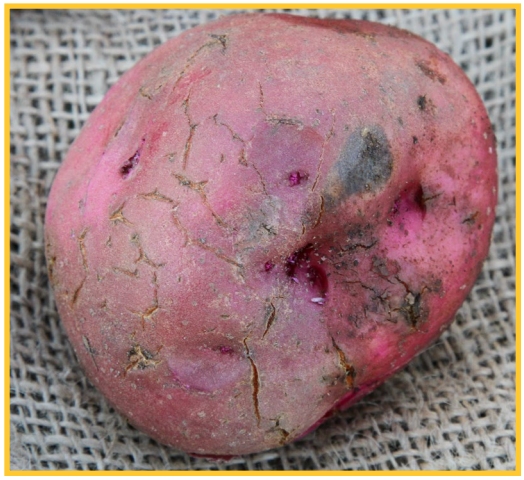

Figure 8. Cracking and necrosis of tuber tissue of Dark Red Norland caused by glyphosate exposure on plant foliage.

Figure 9. Severe fissures caused by glyphosate injury to mother plant tissue.

Figure 10. Malformed, cracked and poor skin quality caused by glyphosate exposure to plant tissue.

Figure 11. Malformed tubers caused by spraying glyphosate on mother plant.

Figure 12. Necrotic lesions in tubers caused by a lethal dose of glyphosate on the potato plant. The affected regions were invaded by secondary pathogens as tubers died.

Figure 13. Potato plants dying from glyphosate misapplication.

Figure 14. Potato plant death caused by glyphosate from airplane hose breaking.

Effect of Glyphosate Residues in Seed Potatoes

Seed potato fields that are exposed to glyphosate can express the symptomology previously mentioned. What is more difficult to detect is when glyphosate comes into contact with potatoes in late bulking or early senescence stages because little, if any, symptomology is observed on the leaves or tubers. Tubers may have a normal physical appearance but have glyphosate residues in the seed that can cause germination problems the following year.

High level of glyphosate residues in potato seed tubers can:

- Completely inhibit sprout growth
- Cause "cauliflower" formation of sprouts around potato eyes (Figure 15)
- Result in multiple small sprouts from an eye (Figure 16)

Moderate levels of glyphosate may cause:

- Erratic and slow emergence (Figure 17 to 18)
- Enlarged sprouts (Figure 19)
- Multiple sprouts coming from a single eye with no dominant sprout (Figure 20 to 23)
- "Candelabra" formation of sprouts (Figure 24)

Low amounts of glyphosate in seed potato may cause:

- Weakened plant that has bending, twisting or yellowing of new leaves (Figure 25 to 26)
- Reduced rooting of fibrous roots (Figure 27 and 28)
- Slow emergence

Differences in levels of rooting may be the result of the glyphosate concentration, environment or the potato cultivar. Slow or delayed emergence will reduce growth and development of plants, which can lower tuber size, tuber number and yield. Size profiles are often widely distributed as plants with no or low levels of glyphosate have large tubers, while those with prolonged emergence have small tubers. The extent of this effect will depend on the growing conditions, the amount of glyphosate in the potato seed and seed lot, and the amount of time that emergence is delayed.

Once plants from potato seed with glyphosate residues begin normal leaf growth, plants seem to be able to detoxify or metabolize the glyphosate. Thus, glyphosate residues are not known to remain in granddaughter tubers.

Figure 15. "Cauliflower" formation of sprouts around eyes as a result of glyphosate residues in potato seed.

Figure 16. Glyphosate residues in potato seed can cause multiple sprouts from a single eye when planted the next year.

Figure 17. Glyphosate residues in seed cause slow emergence.

Figure 18. Seed tubers with glyphosate result in erratic and slow emergence.

Figure 19. Enlarged sprouts caused from glyphosate residues in seed tuber.

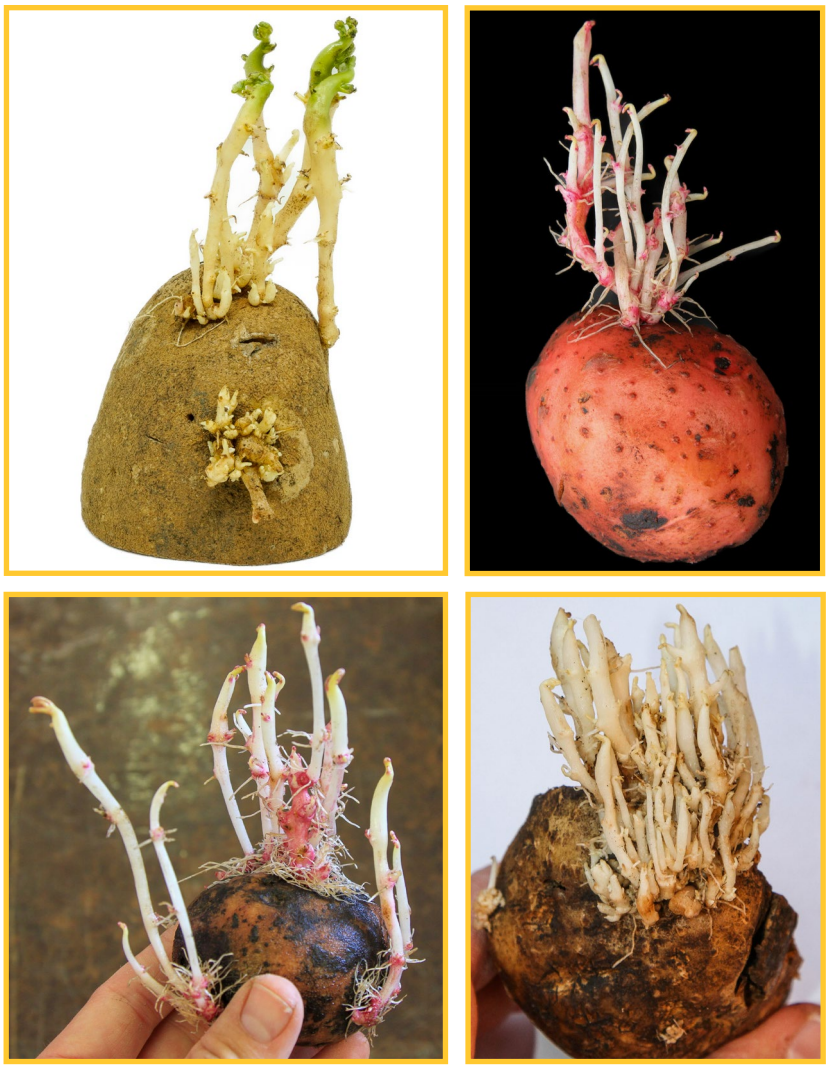

Figure 20 to 23. Multiple sprouts coming from a single eye with no dominant sprout.

Figure 24. Seed with glyphosate residues with a “candelabra” formation of roots.

Figure 25. Potato seed with glyphsoate residues can cause leaves to bend and twist.

Figure 26. Potato seed with glyphosate residues can cause sprouts to bend.

Figure 27 and 28. Reduced rooting of fibrous roots caused by glyphosate residues in seed tuber.

Confirming Glyphosate in Potato Plants

If glyphosate is suspected to have contacted a potato crop during the growing season, examine the field for injury typical of glyphosate as previously described. Document the injury by making a record of all possible information, including injury symptoms observed, making a map of the area where injury occurs and taking high-quality photographs. Promptly contact all parties and insurance companies involved so visits can be made to the field to validate information. Review your state's law requirements for seeking the right to pursue reimbursement. For more information on documenting herbicide injury, see NDSU Extension publication WC751, Documentation for Suspected Herbicide Drift Damage.

If glyphosate residues are suspected in potato seed, carefully examine multiple plants in the field for the previously described symptomology. Seed issues will show no pattern of injury in the field because seed affected by glyphosate is mixed at harvest, in storage and at planting with seed pieces that might not be contaminated with glyphosate. Potato plants affected by glyphosate will express various levels of the symptomologies because seed pieces often have different levels of glyphosate in each tuber.

Affected leaves and tubers can be sent to certified laboratories to confirm glyphosate residues. To increase the likelihood of herbicide detection, select tubers or leaves with the greatest damage shortly after an herbicide injury is observed. Keep in mind that laboratory analysis may take a number of weeks to complete and field symptomology may subside by the time results are received. See the current North Dakota Weed Control Guide (W253) for information on laboratories that test for herbicide residues. For the best results, use a laboratory that can detect glyphosate residues down to 0.01 part per million (ppm). For more information on how to sample potato fields for herbicide injury, see NDSU Extension publication A2051, Sampling for Herbicide Injury in Potatoes.

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