Managing Herbicide Drift and Early Results of Simulated Glyphosate Drift to Potato Study

Rick Boydston, USDA-ARS, Prosser, WA

The off target movement of herbicides can injure sensitive crops. Off target movement of spray droplets results from displacement by wind, poor application techniques, or improper settings or operation of application equipment. Applicators should be aware of wind speed and direction, use nozzles and sprayer operating pressures that result in larger spray droplets, keep sprayer boom height to a minimum, know what is in the spray tank, and be aware of neighboring sensitive crops. Small spray droplets under 100 µm diameter are more subject to drift and result from using smaller orifice nozzles and higher operating pressures. It is wiser to anticipate and avoid problems of spray drift than to have to deal with them after the fact.

Potatoes can be sensitive to both drift and carryover (soil persistence) of certain herbicides. An Idaho extension publication, PNW498, contains pictures and descriptions of many commonly used herbicides that can injure potatoes from drift or carryover.

Herbicides that inhibit amino acid synthesis (Roundup, Raptor, Pursuit, Harmony, etc.) often reduce potato leaf size and internode length. New leaves may turn yellow and plant growth is slow. The potato crop may appear to recover, but tubers may have numerous growth cracks and folds, and tubers yields greatly reduced.

Growth regulator type herbicides (2,4-D, MCPA, Banvel, Starane, Garlon, Stinger, etc.) usually cause petiole and stem twisting, malformed leaves, and stem cracking. Leaves are often cupped, wrinkled, with a wavy appearance with twisted, epinastic growth. New leaves tend to exhibit more symptoms than older leaves.

Cell membrane disruptors (Goal, Gramoxone, Aim, Spartan, etc.) often cause spotting on leaves that were exposed at the time of the drift. New leaves are often not affected due to limited translocation of these herbicides within the plant.

Photosynthesis inhibitors (Bromoxynil, Princep, Atrazine, Karmex, etc.) cause chlorosis (yellowing) of leaves followed by necrosis (death) or slow recovery if applied at sublethal rates.

Pigment synthesis inhibitors (Zorial, Callisto, Impact, Laudis, Command, etc.) block carotenoid biosynthesis resulting in whitening (bleaching) of the leaves that may either slowly recover or become necrotic (leaf death).

Various symptoms on potato tubers can develop from herbicide drift depending on the herbicide, rate of herbicide, timing of the drift, and cultivar sensitivity. Tuber folds, cracks, knobs, and reduced tuber size can result from herbicide drift. Other causes of unusual symptoms on tubers that often mimic herbicide drift can result from nutrient shortages, diseases, water excess or drought, wind or frost damage, high temperatures, or other pesticides.

Glyphosate Simulated Drift Study to Potato.

Glyphosate is the most used herbicide in the world and new crops tolerant of glyphosate continue to be developed. As a result, glyphosate drift to sensitive crops is more likely to occur with increased use of glyphosate. In 2008, a simulated glyphosate drift study was conducted on Ranger russet potato at three locations; Ontario, OR (Dr. Joel Felix), Aberdeen, ID (Dr. Pam Hutchinson), and Paterson, WA (Dr. Rick Boydston). At the Paterson location, glyphosate was applied May 9, at 4 inch stage of potato; May 18, 6-8 inch tall potato (stolons swelling, early tuber initiation); May 27, 10 to 15 inches tall, (tuber initiation to 0.5 inch diameter tubers); and

June 13 at row closure (tuber bulking). Glyphosate was applied at 0, 0.0075, 0.048, 0.09, 0.19, and 0.375 lb ae/a in a spray volume of 20 gpa. Roundup Original Max was the glyphosate formulation used and an ammonium sulfate adjuvant (Bronc, Wilbur-Ellis) was included.

Potato foliar injury was rated at 1 and 3 weeks after treatment (WAT) and photos of injury recorded. Leaf discs from treated plants were collected and shikimic acid accumulation measured at 1 WAT by Dr. Ian Burke, WSU-Pullman. Shikimic acid is an intermediate compound that accumulates in glyphosate susceptible plants due glyphosate inhibition of an enzyme involved the synthesis of aromatic amino acids. Potato tuber yield and grade were determined in September and photos of tuber injury recorded. Tubers were held in cold storage and a 20 tuber subsample (10 symptomatic, 10 non-symptomatic) from each plot will be planted in the spring of 2009.

Potatoes treated with glyphosate exhibited chlorosis (yellowing) of the newest leaves at the higher rates of glyphosate tested and few or no symptoms at the lower rates of glyphosate tested. Foliar injury at 3 WAT was greater than at 1 WAT. Potato foliage recovered from most glyphosate applications and grew normally for the remainder of the season except for the higher rates of glyphosate tested. Injury to potato foliage was greatest from May 18 and May 27 glyphosate applications and least with May 9 applications to 4 inch potato. Glyphosate rates of 0.0075 lb ae/a caused very minor or no visual injury and had little or no effect on tuber yield or quality.

Shikimic acid levels in the leaf tissue at 1 WAT were correlated with glyphosate dose following the May 18 application. The complete data set on shikimic acid levels was not available at the time of this report.

Potato tuber yield was reduced most by glyphosate applications on May 18, whereas tuber quality was reduced most by glyphosate application on May 27. Tubers produced from potato plants treated in May had a high percentage of growth cracks, folds, and small sized tubers. Glyphosate applied at potato row closure in June tended to cause more scaly skin lesions on tubers and growth cracks on tuber ends.

Figure 1. Potato injury following glyphosate applications on May 9 (left) and May 27, 2008 (right).

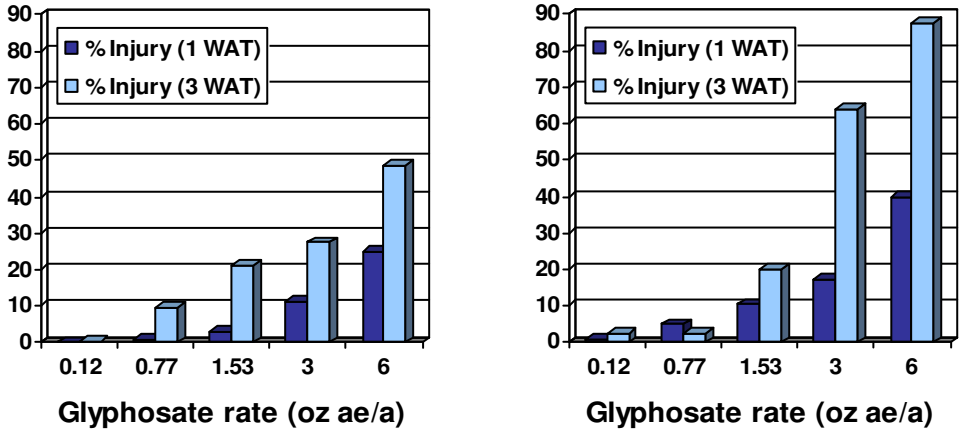

Figure 2. Potato U.S. #1 tuber yield as a function of foliar injury ratings at 3 WAT after treating with simulated drift rates of glyphosate.

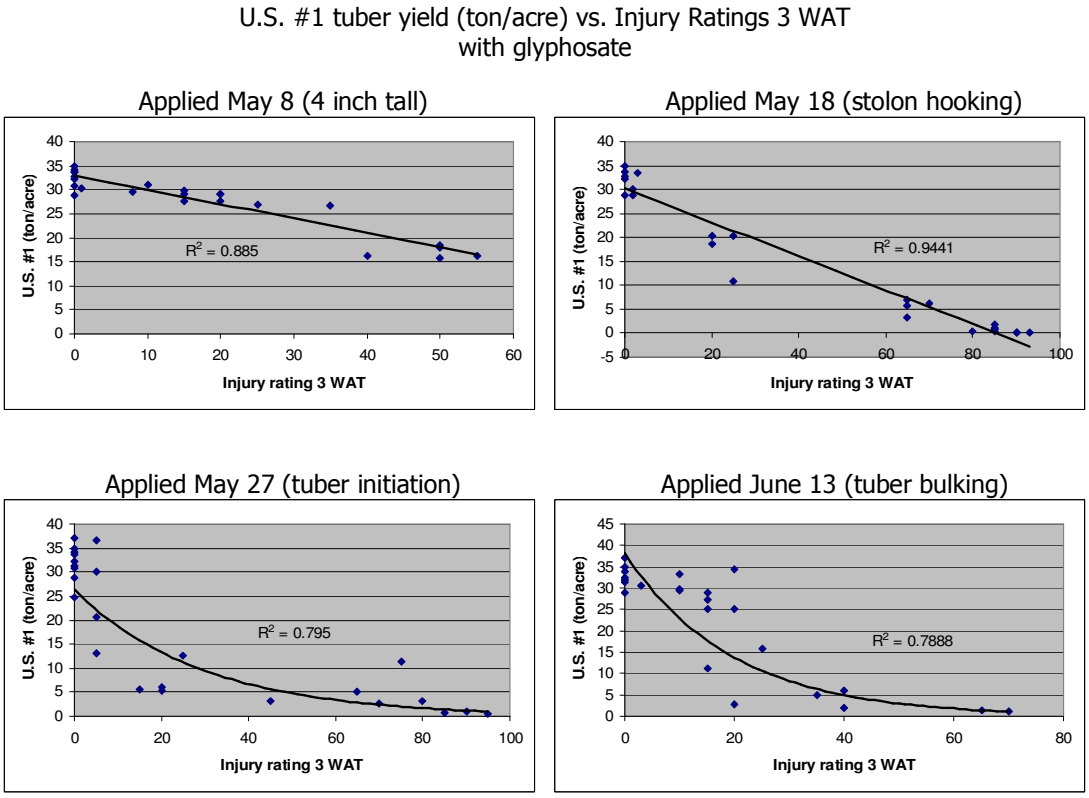

Figure 3. Potato tubers harvested from plants treated with low rates of glyphosate on May 27, 2008.