Effect of Glyphosate Residues on Daughter Seed Potato Growth

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Seed potato (Solanum tuberosum) plants exposed to low levels of glyphosate during the growing season can store the glyphosate in the daughter tubers resulting in delayed emergence when they are planted the next growing season (1). Glyphosate is the one of the most widely used herbicide in the United States because of the rapid adoption of genetically modified crops, low cost, and effective control of weeds. In North Dakota, 31% of crop acreage was treated with glyphosate in 2008 (2).

Seed potato fields can unintentionally come into contact with glyphosate by contamination of spraying equipment, inversions, physical drift, or misapplication. The level of glyphosate that comes into contact with potatoes will vary, but often the low levels of glyphosate during bulking do not cause visible foliar symptoms. This can make early detection of glyphosate toxicity in daughter tubers difficult to determine. Because glyphosate is phloem mobile, it will translocate throughout the plant reaching highest levels within four days in the meristematic tissues (3). The amount translocated will vary by the amount of glyphosate coming in contact with the potato plant and the temperature, with greater absorption of glyphosate at higher temperatures (4).

Symptoms of glyphosate carryover in seed pieces include: an erratic and slow emergence; bending, twisting, and yellowing of new leaves; multiple shoots coming from a single eye; ‘candelabra’ formation of shoots; ‘cauliflower’ formation of shoots around an eye; enlarged shoots; and reduced rooting (1) (Figs. 1 and 2). Less is known about the effect glyphosate residues in potato seed have on the yield of potatoes planted the following year. The purpose of this study was to compare normally growing plants with plants affected by glyphosate residues in the seed grown from a commercial seed field.

Two commercial fields planted in 2012 were identified in North Dakota and Minnesota and confirmed to have glyphosate residues in the seed tubers. Glyphosate contamination was suspected based on symptomology in foliage and tubers in the field and confirmed in tuber samples sent to a commercial laboratory for analysis using a liquid chromatography with tandem mass spectrometry detection. Levels ranged from 0.015 to 0.036 ppm glyphosate. The potato clones from each field were grown on commercial seed potato farms in North Dakota in 2011. The potato cultivars were Dark Red Norland and Red LaSoda. In each field 10 arbitrarily selected adjacent plants were flagged to compare a normally growing plant to a glyphosate-affected plant that was delayed in emergence by approximately three weeks (Fig. 3). After vine kill, potato hills were hand harvested and yield and tuber number were recorded. Data were subject to a paired t-Test with the use of the SAS TTEST procedure (SAS Institute Inc., Cary, NC) to test for differences between glyphosate affected seed and normally growing seed. The means were considered different at $P \leq 0.05$. 