

HERBICIDE CARRYOVER IN POTATO SOILS

by
Gary Q. Pelter,
WSU/Grant-Adams Cooperative Extension
Ephrata, Wa.

Herbicides applied to a crop can, under some circumstances, persist to cause injury in a following crop. This carryover effect may occur in the same growing season or several years from the season of application, depending upon the herbicide, the soil and environmental conditions.

Herbicides differ in their potential to persist due to differences in chemical composition. Some are readily degraded by chemical and biological reactions in the soil which results in shorter persistence. Breakdown by soil-dwelling microorganisms is generally believed to be the most important factor in degrading pesticides. The rate at which a herbicide is applied also affects carryover. The higher the rate, the longer the period needed for breakdown and thus greater potential to affect succeeding crops.

Soil characteristics such as texture, amount of organic matter and pH also influence herbicide carryover. Texture describes the relative proportion of sand, silt and clay making up a soil. Clays are a major binding site for many herbicides. Herbicides which are bound to clay particles are not available for plant uptake and therefore unlikely to cause plant injury. Organic matter in the soil has even greater potential to tie up herbicides than does the clay fraction. Note that crop residues do not constitute organic matter although after time, such residues contribute to the organic fraction of the soil. The ability of clays and organic matter to render herbicides unavailable to plants is also the reason for differences in recommended rates of application for soil-applied herbicides. Soils with more clays, that is, heavier textured soils and soils with greater organic matter content normally have higher recommended rate. Soil reaction or pH also affects herbicide carryover by influencing the rate of herbicide breakdown. Most herbicides break down more slowly as the pH increases above neutral (pH 7.0). The majority of soils in the Columbia Basin are close to or above pH 7.0.

Environmental conditions, notably temperature and precipitation, influence the rate at which herbicides degrade in soil. Temperatures above about 40 degrees F. are essential for activity of the herbicide-degrading soil microorganisms. These organisms also require adequate soil moisture to function. Under dryer than normal conditions, such as experienced in the fall and winter of 1989-1990, less herbicide breakdown might be expected.

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In fact, a number of carryover problems experienced in the 1990 growing season may well have been influenced by inadequate soil moisture.

Cultural practices such as irrigation and tillage also affect herbicide carryover. Irrigation supplements normal precipitation to encourage microbial breakdown of herbicides in soils. Tillage reduces the effective concentration of herbicides by incorporating the materials in a greater volume of soil. Moldboard plowing is more effective than disking for this purpose. The removal of crop residue, such as straw, after harvest is another cultural practice that can reduce herbicide carryover problems.

Herbicide carryover problems experienced in Central Washington potato fields are due to a number of causes. Symptoms of growth regulator herbicides, such as curling or cupping of new leaves, have been found to result from carryover in potato seed in some situations. Although some such cases may be due to spot weed control efforts in seed potato fields, others may be due to herbicides applied in the crop prior to seed potatoes. The herbicide Banvel has been sometimes implicated in such cases.

Investigations of growth regulator herbicide symptoms on potatoes in 1990 suggest that carryover is occurring due to application of soil amendments which contain herbicides. Mint slugs (plant residue following the distillation process) from fields treated with Stinger herbicide in the previous season caused plant injury when incorporated into soil prior to planting potatoes. The Stinger label cautions that carryover may occur in plant residues that have not fully decomposed. It appears that livestock bedding from a crop treated with Banvel herbicide in 1989 caused potato injury when applied to soil in the winter prior to planting.

Carryover in soils due to herbicide application in a previous crop is probably the most frequent cause of problems in potato fields in the Columbia Basin. The persistence of some herbicides such as atrazine, Banvel and Tordon has been noted for some time to cause crop injury. More recently, Assert, clopyralid (sold as Curtail, Curtail M or Stinger) and Glean herbicides have caused potato injury when applied for weed control in a previous crop. The Glean herbicide label notes that this herbicide can remain in the soil for 3 to 4 or more years and cause injury to crops other than cereals. The Assert label requires a 15-month interval between application and planting of potatoes while the clopyralid products require 18 months. The herbicide Velpar, commonly applied to alfalfa, and Karmex, used for field border weed management have caused potato injury through soil persistence. In addition, Command, Oust, Pursuit and Sinbar herbicides have potential for carryover injury.

Reducing herbicide carryover injury to potatoes is possible by considering the following:

1. Read Herbicide Labels Carefully. Recropping intervals are listed as part of each registration. Pay particular attention to new herbicides that will be applied in crops preceding potatoes.

2. Maintain Pesticide Records. The new Washington regulations requiring maintenance of pesticide records may have benefits in refreshing your memory or by providing information on land before renting for potato production.
3. Plant A Tolerant Crop. If you find yourself faced with a potential carryover problem before soil fumigation, consider another season planted to a tolerant crop listed on the label. In addition to allowing more time for microbial breakdown in the soil, some of the herbicide will be metabolized in the crop. Removal of the crop residue will further reduce the herbicide returned to the soil.
4. Maintain Conditions to Favor Breakdown. Chopping existing crop residue as finely as possible will hasten decomposition. Tillage, especially moldboard plowing dilutes the herbicide in a greater soil volume. Irrigate fields after harvest of the crop(s) preceding potatoes in rotation. Each of these cultural practices hasten microbial breakdown in the soil.
5. Consider a Bioassay. Growing a susceptible crop either in the field or in the greenhouse with field soil to observe potential crop injury is a bioassay. It is desirable to plant potatoes in the actual field situation, but in many cases this is not practical. This requires sampling the soil in the field quite thoroughly to accurately measure crop injury potential (see References for bioassay publication). Several newer herbicide labels require or will soon require a bioassay prior to planting susceptible crops.

References

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3. Chlorsulfuron Persistence and Response of Nine Rotational Crops in Alkaline Soils in Southern Alberta, July 1990, Moyer, Esau and Kozub, Weed Technology, Volume 4: 543-548.
4. Problems Observed from Herbicide Carryover, October 1990, Parker, Spud Topics, Volume XXXVI, No. 10-A.