

Herbicide Injury to Grapes

Herbicides are the primary tool used to control weeds in Iowa corn and soybean fields, and they are also widely used in turf and other settings. The risk of injury to non-target plants varies widely among herbicides; many can be used adjacent to sensitive plants with little risk of injury, whereas others pose a risk to adjacent areas whenever they are applied. Grapes are especially sensitive to the growth regulator (GR) herbicides, a group of widely used products in Iowa. This paper will provide background information on these herbicides and their impacts on grape production.

Growth regulator herbicides: The era of chemical weed control began with the introduction of 2,4-D and related herbicides in the 1940's. The products are widely used in corn, turf, pastures and non-crop areas. There are three major classes of GR herbicides, and most products are sold under a variety of tradenames and as assortment of combinations (Table 1). For example, Trimec is a widely used turf herbicide that is a combination of three GR herbicides. Using a combination of GR herbicides provides a broader spectrum of weed control and allows lower rates of individual products to be used.

Table 1. Examples of growth regulator herbicides

Phenoxy	Benzoic	Pryidine
2,4-D (many trade names)	dicamba (Banvel, Clarity,	picloram (Tordon, Grazon P&D)
2,4,5-T (no longer marketed)	Distinct, Vanquish, Status,	triclopyr (Garlon, Remedy)
MCPA	many others)	clopyralid (Stinger, Transline, Hornet)
2,4-DP (diclorprop)		aminopyralid (Milestone)

GR herbicides mimic the action of the natural plant growth hormone auxin (indole acetic acid). The herbicide molecule is able to bind to auxin receptors due to their chemical similarity to auxin, and when bound to the receptor trigger a broad range of physiological reactions. Plants are able to closely regulate the concentration of auxin, therefore controlling the activity of this hormone. However, since plants are unable to regulate the concentration of GR herbicides, a wide range of plant responses occur when plants are exposed to these chemicals. At high concentrations GR herbicides are phytotoxic, whereas at low doses they produce a myriad of abnormal growth responses.

Although GR herbicides can be absorbed both by roots and leaves, grapes are injured primarily through foliar absorption since the amount of herbicide that moves off-target is typically insufficient to have soil activity. GR herbicides are systemic, moving from the site of absorption to areas of rapid growth via the phloem. Injury symptoms typically are most severe on foliage or other plant parts that are initiated within a few weeks after exposure to the herbicide. Foliar symptoms include small, fan shape leaves with parallel veins, alteration in shape of the leaf sinus or teeth, or cupped leaves. Fruit set may be reduced and maturation delayed. Vines may become brittle and overwintering ability reduced.

GR Use Patterns in Iowa: Dicamba and 2,4-D are the main GR herbicides used in Iowa crop production. The primary use of 2,4-D is as a burndown herbicide in no-till crop production, thus the majority of 2,4-D used in corn or soybean is applied in mid- to late-April or May. Dicamba is primarily applied postemergence in corn, with the majority being applied when the corn is 4 to 16" in height, although applications are made to larger corn. This application period occurs at the time when grapes are at their most sensitive stage of development (flowering and fruit set). The risk of dicamba vapor drift increases as corn size increases since volatilization is greater from corn leaves than from soil. GR herbicides are also widely used in pastures, turf and roadsides, with peak applications typically being in late spring or in the fall.

Off-target herbicide movement: All herbicide applications are susceptible to off-target movement, but the GR herbicides pose a much greater risk of damaging non-target plants than other products because they can cause

significant injury at fractions of typical application rates. Most other herbicides must contact plants at concentrations close to the label rate to cause a significant response.

GR herbicides can leave the target site either by drift of spray droplets or volatilization. Spray drift occurs when spray droplets are intercepted by wind currents and are carried directly from the target site. The most important factors influencing particle drift are wind speed and droplet size. With good management practices (proper sprayer setup and good judgement) less than 1% of the herbicide leaves the target site and poses little threat to adjacent vegetation.

Herbicide volatilization (vapor drift) occurs after the spray droplet containing the herbicide lands on the target. A portion of the herbicide may evaporate from the surface it lands upon and then move from the treated field with wind currents. Only herbicides with relatively high vapor pressures are prone to volatilization, so the risk of vapor drift varies widely among herbicides. The risk of volatilization is directly related to air temperatures, and as temperatures exceed 85° F the potential for off-target movement increases. The majority of volatilization occurs within a few days of application.

The phenoxy herbicides (2,4-D, 2,4-DP, etc.) are available as ester or amine formulations. The amine formulations are non-volatile, whereas ester formulations are prone to vapor drift. Most ester formulations available today are referred to as low-volatile (LVE), and pose much less of a risk than products sold in the past. Dicamba is available in several formulations, some less volatile than others but all having the risk of vapor drift.

The majority of problems with off-target herbicide injury involve susceptible vegetation immediately adjacent to the area of application. The risk of injury decreases rapidly as distance between the application site and vineyard increases. However, because of grapes' extreme sensitivity to GR herbicides, injury to vines several miles from the application site have been documented.

Minimizing Risks to Grapes: Unfortunately, due to widespread use of GR herbicides in Iowa, it is likely that every vineyard in Iowa will be exposed to these chemicals sometime during their lifespan. However, through good planning and communication this risk can be reduced significantly. The first step should begin with site selection for vineyards. Establishing buffers between the vines and areas likely to be sprayed with GR herbicides will reduce the risk of GR exposure. Planting a windbreak of evergreen trees between the vines and adjacent fields may reduce movement of herbicides into the vineyard. Grape varieties differ in their tolerance to GR herbicides. Selecting varieties with a high tolerance to the GR herbicides will reduce the severity of injury that occurs when the vines are exposed to these compounds.

Communication with farmers and other persons responsible for applying herbicides in the vicinity of the vineyard is critical in minimizing problems. Visit local ag-chem/fertilizer dealers and others involved in pesticide application and provide maps of the location of the vineyard. Farmers have a wide range of herbicides available for use in corn and soybean, and in many cases will be able to use herbicides with a lower risk of causing injury to grapes than GR products. Notify the county person responsible for roadside spraying of the vineyard. This is especially important if roadsides in your neighborhood are infested with Canada thistle or other noxious weeds that are frequently targeted for roadside sprays.