Sensitivity of Grape and Tomato to Micro-rates of Dicamba-Based Herbicides

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Dicamba is a selective herbicide commonly used to control broadleaf weeds in pasture, rangeland and grassy type crops (e.g. corn, sorghum, wheat). With the commercialization of dicamba-tolerant (DT) soybeans, the adoption rate of dicamba for weed control is increasing. However, there are increasing number of cases of un-intended drift of dicamba during application and this is of great concern to many landowners and land managers. Environmental conditions such as wind and temperature inversion during applications can move the spray droplets or volatilized (even 36 hours after application) dicamba off-target, thereby injuring nearby sensitive crops. New dicamba-based products such as Engenia and XtendiMax with Vapor Grip technology were developed to reduce volatility. Reports suggested that these new formulations are much improvement versions compared to the old ones (eg, Clarity, Banvel) , however they still can vaporize significantly, indicating the risk of off-target movement.

Grapes and tomatoes (as well as other fruits and vegetables) are known to be sensitive to dicamba. Grape is an important crop in the United States with over 900,000 acres grown in 2016, yielding 7.7 million tons of fruit. Grapes are also commonly planted in small plots at local acreages and country sides for local markets or home use. However, the off-target movement of dicamba from surrounding fields could be a potential threat to grape production. United States is among the top five producers of tomato globally. In 2016, tomatoes were grown on 364,799 acres with net worth of about $2.1 billion.

We wanted to confirm the level of sensitivity of both crops to low rates of dicamba. Therefore, we conducted studies during summers of 2016 and 2017 at Haskell Ag Lab, Concord, Nebraska to evaluate dicamba's effects on growth of pot grown grape and tomato. "Frontenac" grape and "better boy" tomato were the varieties used for the experiment. A 2 year old grape bare rootstocks (about 12") and tomato seedlings (about 5") were planted into 10 by 10" pots filled with moisture control potting mix and watered as needed. They were sprayed with 3 dicamba-based herbicides (Clarity, Engenia and XtendiMax) at the micro-rates of 0; 1/10; 1/50; 1/100; 1/500; 1/1000 of the label rate. The label rate of Clarity, Engenia and XtendiMax were 16, 12.8 and 22 oz/acre respectively. To help visualize the rates, the 1/10th of the label rate is equivalent of a 3 tablespoons and 1/100th is a 1 teaspoon applied over a size of football field (1 acre). Tomato heights at time of application was 10 inches, while grape vine lengths was 25 inches. Visually rated injuries on the scale of 0 (no injury) to 100 (dead plant) were collected at 7, 14, 21 and 28 days after treatment (DAT). Maximum accumulated vine length of grape, plant height of tomato, and plant biomass of both species were collected at 28 DAT. Plants were not grown for fruit yields.

In general, results had shown that all three dicamba herbicides similarly impacted growth of grape and tomato. The observed injury symptoms in grapes were in the form of leaf and stem twisting, and cupping of leaves (see photos). Visual injury in grapes ranged from 20-64% depending on the dicamba rate. For example, 1/100 and 1/10 of the label rate caused about 35 and 64% respectively at 21 days after treatment (DAT). Reduction in vine length increased from 5-40% with increase in dicamba micro-rates from 1/1000 to 1/10 of the label rate.

Similarly, the injury levels on the tomato plants increased with increase in dicamba micro-rates. The observed injury symptoms in the tomato plants were in the form of stunting, chlorosis, callus-like formation on main-stem, cupping and curling of leaves. The injury levels ranged from 20-80% as dicamba rate increased from 1/1000 to 1/10 of the label rate. The 1/100 of the label rates were enough to cause 50% injury in the tomato plant. Plant height was reduced by 10-50% (~ 3 to 20 inches) by increasing rate of dicamba from 1/1000 to 1/10 of the label rate. For example, application of Clarity at 1/100 of the label rate (0.16 oz/acre) reduced tomato height from 31 inches

to 23 inches. Other dicamba products had a similar impact on tomato plant height. The injury and growth reduction caused by the micro-rates of dicamba products could also reduce tomato yields. Kruger et al. (2012) reported that 1/50 of dicamba label rate caused 25% reduction in tomato yield when applied at early vegetative stage.

In general, our study showed that grape and tomato were very sensitive to micro-rates of all three dicamba herbicides, therefore off-target movement of dicamba must be prevented.

Grape injury caused by 1/10 of dicamba label rate at 21 days after spray

Tomato injury caused by 1/10 of dicamba label rate at 21 days after spray