

News Column  
Stacy Campbell

K-State Research & Extension

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## **Very warm temperatures may decrease efficacy of HPPD-inhibitor herbicides**

For several years, K-State Research & Extension Weed Management specialists have observed that Callisto products and other HPPD-inhibitor herbicides could be a little inconsistent in controlling Palmer amaranth and other pigweeds at times.

When a herbicide isn't controlling its target weed as it should, the first thing most producers suspect is that the weed has become herbicide-resistant. This may be the case. But environmental conditions or application methods could also be at play.

In this case, K-State Weed Specialists have confirmed that there are populations of Palmer amaranth with resistance to HPPD-inhibitor herbicides. However, environmental conditions are also a factor in the inconsistent control being achieved.

Even with populations of Palmer amaranth that are susceptible to HPPD-inhibitor herbicides, control is sometimes poor. In general, these herbicides seem to be more effective on Palmer amaranth under cool conditions. In the field, HPPD-inhibitor herbicides have generally been more consistent when used in corn than when used in grain sorghum production. And they have been a little more consistent when applied in the early morning hours as opposed to applying them in the heat of the afternoon during late spring and early summer.

To verify this and explain what is going on, K-State Weed specialists conducted a series of growth chamber tests applying mesotrione (Callisto) at different rates to 3- to 5-inch tall Palmer amaranth under three temperature schemes:

- Low (77 degrees F daytime high and 59 degrees nighttime low)
- Optimum (90.5 degrees F daytime high and 72.5 degrees nighttime low)
- Elevated (104 degrees F daytime high and 86 degrees nighttime low)

They also studied what was happening to mesotrione within the Palmer amaranth plants, and how the plants reacted physiologically under the different temperature schemes.

First, they found that temperature did have a significant impact on the effectiveness of mesotrione on susceptible Palmer amaranth plants.

Under the coolest temperature scheme Palmer amaranth was controlled satisfactorily at the recommended label rate. Under the two higher temperature schemes, Palmer amaranth survived even at 2X and 4X rates of mesotrione.

In looking at the physiology of the plants, they found two primary factors involved in this temperature effect.

1. The plants were able to metabolize mesotrione more readily at the higher temperatures. This means Palmer amaranth can essentially deactivate the herbicide within the plant, before the herbicide can control the plant, to a greater degree when temperatures are very warm.

2. At the same time, Palmer amaranth is able to increase HPPD gene expression under very warm temperatures compared to when it grows under cool temperatures. Mesotrione and other HPPD-inhibitor herbicides kill plants by binding and stopping the activity of HPPD enzymes within the plant. These enzymes indirectly produce compounds needed by the plants to remain alive. By ramping up the HPPD gene expression, as well as increasing the herbicide metabolism, when temperatures are very warm, Palmer amaranth is making it very difficult for HPPD-inhibitor herbicides to do their job.

These findings are important because it provides a solid basis to explain what is happening. The temperature effect on HPPD-inhibitor herbicides is real.

To increase the efficacy of HPPD-inhibitor herbicides on Palmer amaranth, it should be applied under the coolest conditions possible. It is very likely that tall waterhemp and other pigweeds react in the same way as Palmer amaranth to HPPD-inhibitor herbicides and temperatures.

Besides Callisto, other HPPD-inhibitor herbicides include the corn herbicides Laudis, Capreno, Armezon, Impact, Balance Flexx, and Corvus. Huskie has a mode of action similar to the HPPD-inhibitor herbicides. Therefore, it is very possible that Huskie is also more effective on Palmer amaranth when applied under cool conditions for the same reason that HPPD-inhibitor herbicides are more effective under those conditions.

Information provided by Curtis Thompson, Extension Weed Management Specialist and Mithila Jugulam, Weed Physiologist.