Weather fluctuations alter weed control results

When Mother Nature throws the most extreme weather conditions at Midwest corn growers, those growers know first-hand how challenging it can be to win the battle against weeds. As more severe rain and heat events occur every year, researchers and growers alike are seeking tools to minimize how these weather extremes affect weed control.

Kansas State University agronomist Mithila Jugulam and her colleagues compiled a 2016 research literature review paper, "Impact of Climate Change Factors on Weeds and Herbicide Efficacy." The research review showed that weeds have better survival mechanisms than crops like corn and soybeans under changing climate because of greater genetic variation and physiological adaptability. Also, herbicide properties are significantly influenced by environmental conditions before, during and after application.

Unfortunately, there's limited research to predict how global weather pattern changes affect weed management under field conditions. Further research by Jugulam and other scientists will help identify weed control measures to cope with aggressive weed growth and possible increased herbicide resistance in a changing climate.

Unanswered questions

Jugulam believes the biggest takeaway for farmers from this research is the potential impact of climate change on herbicide efficacy. "There are many unanswered questions about how environmental factors such as CO_2, light, temperature, relative humidity and soil moisture will impact herbicide modes of action and change overall weed management."

In the 1990s, researchers like USDA-Agricultural Research Service Plant Physiologist Lewis Ziska and colleagues studied climate change impact on weeds, plant biology, food security and public health. Jugulam wanted to look further at specific problem weeds and their interaction with herbicide chemistry in response to higher application temperatures and other climatic factors.

"In 2014 discussions with my colleague and Extension Weed Scientist Curtis Thompson (now retired), we started our research to examine herbicide efficacy on problem weeds under different growth chamber temperatures," Jugulam says. "We wanted to know what's going on inside the plant in terms of herbicide uptake, movement and metabolism and the uptake of the herbicide when subjected to high or low temperatures of plant growth conditions."

Impact of temperature variations

So far, Jugulam and her colleagues have conducted three temperature studies: the sensitivity of Palmer amaranth to mesotrione, the efficacy of 2,4-D or glyphosate on common and giant ragweed and the effectiveness of 2,4-D on common waterhemp. She has also conducted similar work on other problem weeds such as kochia and lambsquarters.

Her takeaways:

- Palmer amaranth was more sensitive to mesotrione at low temperatures (77° F during day/59° F at night) and less sensitive at high temperatures (104° day/86° night) compared to the optimum temperature (90.5° day/72.5° night).
- Improved control efficacy on common and giant ragweed with 2,4-D or glyphosate occurred at high temperatures (84.2° F during day/62.6° F at night) rather than low temperatures (68° day/51.8° night), regardless of susceptibility or resistance to glyphosate. High temperatures increase the absorption and translocation compared to cooler temperatures.
- Improved control of common waterhemp (both 2,4-D-resistant and non-resistant weeds) is achieved at cooler temperatures (75.2° F during day/50° F at night) compared to warmer temperatures (93.2° day/68° night). In addition, both 2,4-D-resistant and non-resistant weeds rapidly metabolized 2,4-D at high temperatures compared to low temperatures, increasing the level of resistance during high-temperature applications.
- In kochia, dicamba efficacy was improved when applied at low temperatures (77° F during day/59° F at night) because of increased herbicide movement. Additionally, the efficacy of glyphosate on kochia control was also increased at the same low temperature regimes because of higher uptake.
- Improved control of common lambsquarters with glyphosate was found when plants were grown at cooler conditions (77° F during day/59° F at night).

"One of the big takeaways for growers is to pay attention to temperature fluctuations at the time of application," Jugulam says. "Future studies need to confirm findings in a field environment, along with understanding how multiple stresses like drought, humidity, soil moisture and other variables add up to impact weed management."

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