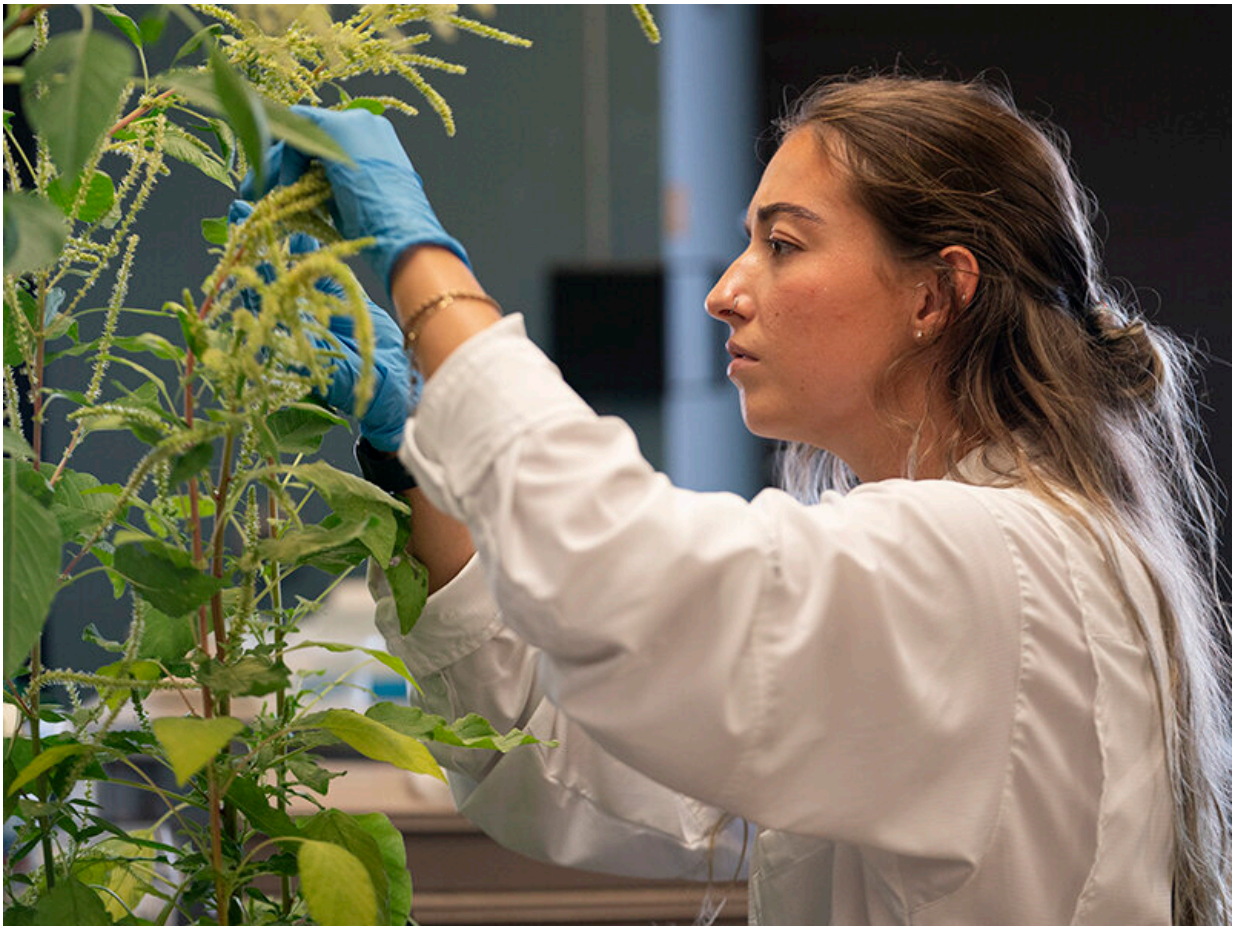
Fighting weeds in a changing world

January 17 2022, by Eric Hamilton



Sarah Kezar evaluating and observing Palmer amaranth in the lab. Palmer amaranth is a weed that is invading crops, stealing their nutrients and sunlight. Kezar recently presented her research about the weed at the 2021 ASA-CSSA-SSSA Annual Meeting. Credit: Sam Craft, Texas A&M Agrilife

The world is warming. And fast. By 2050, it's likely the planet will have warmed by about 3.6 degrees Fahrenheit compared to before the Industrial Revolution. That warming brings substantial changes. Storms will be stronger. People will run their air conditioners more. It will even change when and where our crops grow—and how well they perform.

"Globally, temperature and moisture stresses drastically affect crop productivity leading to substantial yield losses," says graduate student, Sarah Kezar. "Under the changing climate, minimizing agricultural losses caused by these stresses have become a major challenge and has created a global concern to assure food security."

But it's not just our crops that will be affected. For as long as humans have farmed crops, we've also fought weeds. These pesky plants fight for water, light and nutrients with the crops we use for food. By their very nature, weeds are typically more robust than domesticated crops. How will the permanent race between weeds and crops change in a warming world?

"The response of crops to anticipated changes in temperature and available water has been well documented, but little has been studied with weed species," she says. So, to complement research on the changing growing conditions for crops, Kezar and her team have been focusing on how weeds will adapt as well. They've discovered that pernicious weeds may grow stronger compared to most crops.

Comparison of Palmer amaranth leaves from no temperature and moisture stress (left) to increasing temperature and moisture stress (left to right). Kezar's research found that this weed is especially tolerant to various weather conditions – helping it compete against food crops. Credit: Sarah Kezar

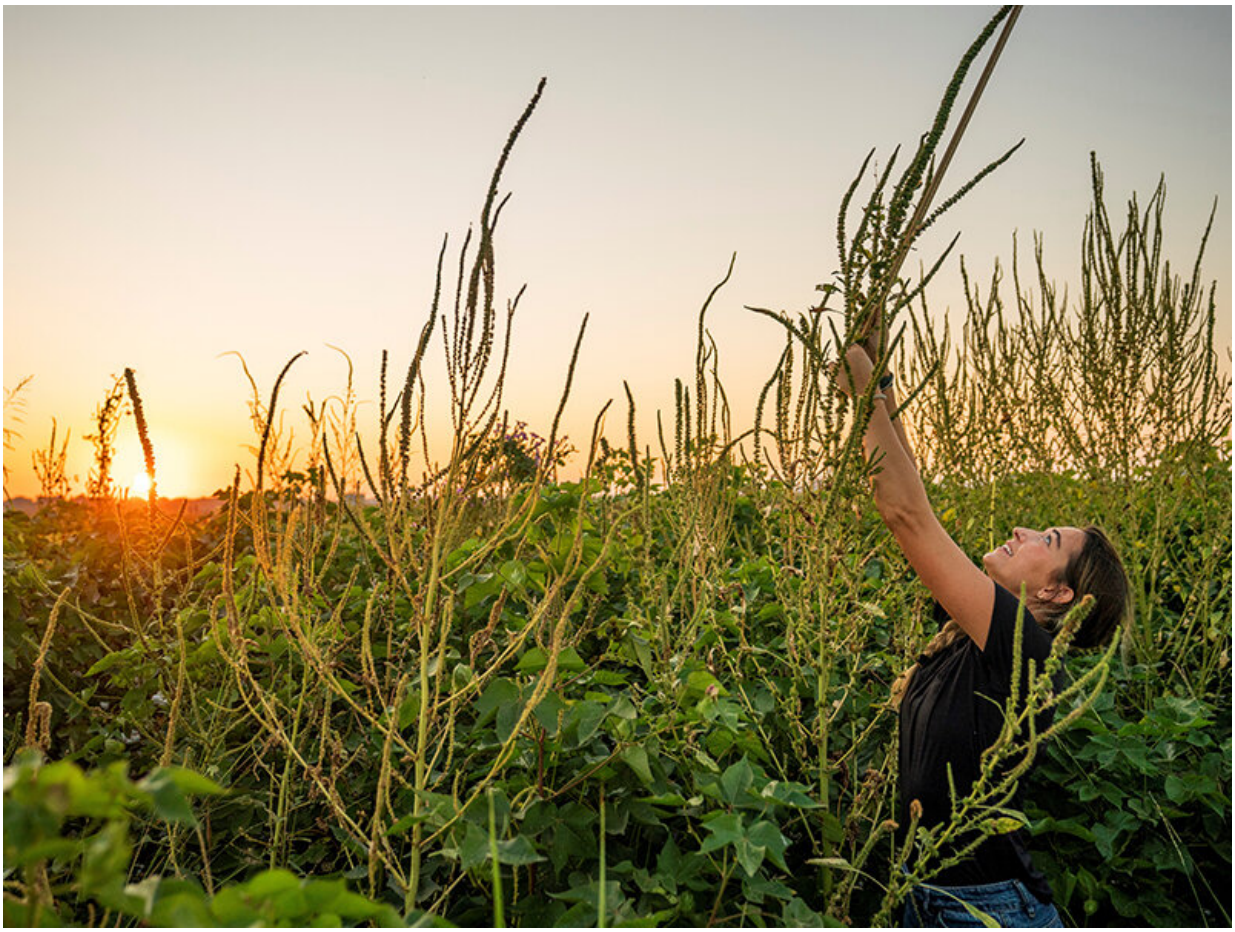
That's not good news. But the knowledge of weeds' strengths can help scientists plan for better ways to combat them as our world continues to change. Kezar presented her research at the 2021 ASA-CSSA-SSSA Annual Meeting, held in Salt Lake City.

Kezar explained how Palmer amaranth grows in hotter and drier conditions like those the U.S. faces in the future. Palmer amaranth is a

giant weed, growing over six feet tall if left unchecked. The weed can produce as many as a million seeds from a single plant. It originally hails from the desert Southwest. But it has recently spread far and wide, reaching 28 states. Palmer amaranth's range is likely to expand as the warm conditions it prefers spread northward.

To assess how Palmer amaranth will fare in the future, Kezar set up an experiment under highly controlled conditions. She tested growth at four different temperatures, which ranged up to daily high temperatures of 104 degrees Fahrenheit. Kezar also varied how much water the weed received, to simulate wetter and drier conditions.

"Palmer amaranth growth was affected by elevated temperature and moisture stress conditions in terms of magnitude, but this weed was still able to grow," says Kezar. "The fact that Palmer amaranth…maintained adequate growth under high temperature and moisture stress shows that Palmer amaranth can still remain highly competitive by exhausting soil water and nutrients available to crops to impact yield."



Sarah Kezar evaluating and observing Palmer amaranth in the field. The weed can grow very tall – over 6 feet – and produce up to a million seeds from one plant. Kezar's research shows that this weed is still efficient under stress conditions, informing future research on how to combat it. Credit: Texas A&M Agrilife

Palmer amaranth has an advantage growing under these conditions. The weed has a highly efficient metabolism, like corn and sorghum. These types of plants are better at capturing energy from the sun (photosynthesis) under hot weather. Most crops don't have this ability. The scientists saw evidence of the weed's special abilities in their experiments. "We did see that Palmer amaranth actually had an increase

in photosynthetic capabilities," Kezar says.

Research like this can help farmers and scientists plan for the future. By knowing which weeds will outperform crops, we can better prepare systems in place to keep them at bay.

"Developing improved management practices are important for effective control of this species in the face of climate change," says Kezar. "When we think about climate change impacts on the future of agriculture, we need to keep weed responses in the conversation."

More information: Kezar, S., Bagavathiannan, M., & Maity, A., Growth Response and Adaptations of Palmer Amaranth (Amaranthus palmeri) in the Face of Environmental Changes. scisoc.confex.com/scisoc/2021a … lim.cgi/Paper/136532

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