Study suggests warmer temperatures could lead to a boom in corn pests

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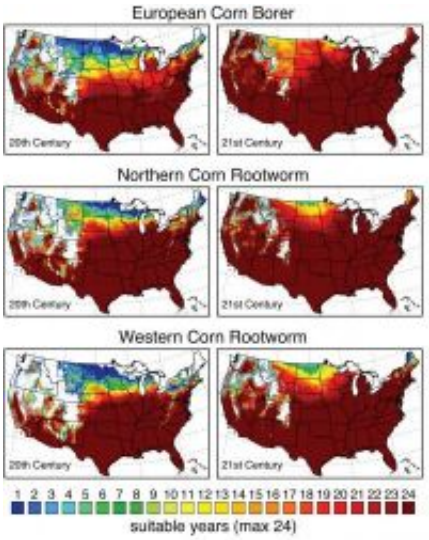

The left panels show the potential range of three corn pests based on the present temperatures of the United States. The right panel shows the potential ranges based on projected temperature changes for the late 21st century. Each color represents the number of years (out of 24) that the temperature was found to be suitable for each pest.

Corn pests media. Courtesy of Noah Diffenbaugh

Climate change could provide the warmer weather pests prefer, leading to an increase in populations that feed on corn and other crops, according to a new study.

Warmer growing season temperatures and milder winters could allow some of these insects to expand their territory and produce an extra generation of offspring each year, said Noah Diffenbaugh, the Purdue

University associate professor of earth and atmospheric sciences who led the study.

"Our projections showed all of the species studied spreading into agricultural areas where they currently are not endemic," said Diffenbaugh, who is interim director of the Purdue Climate Change Research Center. "The greatest potential range expansion was seen with the corn earworm, which is known to infest other high-value crops such as sweet corn and tomatoes. Warming could allow populations to survive the winter in the upper Midwest, the key region for corn production, as well as areas of the West where other high-value crops are grown."

The United States is the largest corn producer in the world and contributes almost half of the world's total production, according to the U.S. Department of Agriculture. Within the United States, corn and corn syrup are used in common food items such as cereal and soft drinks, as well as being used as feed for livestock. Outside of the United States, struggling countries depend on U.S. corn crops to feed starving populations.

"The world depends on U.S corn production for a variety of uses," Diffenbaugh said. "Ethanol production and a growing world population are increasing demand for corn. Expansion of the pests' ranges could have substantial impacts through decreased yields and increased costs for seed and pest management."

Diffenbaugh collaborated with Purdue professors Christian Krupke, an entomologist, and Corinne Alexander, an agricultural economist, as well as with Michael White from Utah State University. The team incorporated the survival temperature thresholds of each species with a highly detailed climate change model for the United States. A paper detailing their work was recently published online in *Environmental Research Letters*.

"Basically, we examined both the number of days warm enough for the pests to grow and the number of days cold enough to kill the pests, assuming the pests' documented climate tolerances remain the same," Krupke said. "This tells us what could happen in projected future climates. However, the model cannot take into account the dynamic nature of any ecological system. There are significant additional factors that could come into play such as interaction of the pests with the environment, relocation of corn and other crops and changing human management of the pests."

The research team studied the potential end-of-the-century distributions of the corn earworm, Heliothis zea; the European corn borer, Ostrinia nubilalis; northern corn rootworm, Diabrotica barberi; and western corn rootworm, Diabrotica virgifera virgifera.

The team used the physiological thresholds for each species coupled with models of development to determine how each would respond to projected climate change scenarios.

For example, the pupal stage of the corn earworm overwinters and cannot withstand more than five days at temperatures below 14 degrees Fahrenheit. It also requires six days at a temperature of about 55 degrees Fahrenheit to complete development. By including these parameters in the climate model, the team was able to project future temperature-based distributions for each pest, Diffenbaugh said.

Krupke said the insects in this study should not be adversely affected by temperature increases.

"The limiting factor for these pests is usually cold tolerance, specifically their ability to overwinter and re-infest the crop the next season," he said. "Increases in temperatures, even summer temperatures, generally benefit these pests. An effectively longer season, or more days

exceeding their minimum temperature range, provides them with additional time to feed, mate and reproduce."

The corn earworm is of particular concern because it is migratory and pesticide resistant, he said.

"The corn earworm is an established global pest, and particularly in the Southern U.S., where it has proven difficult to manage," Krupke said. "It is resistant to several existing pesticides, and adult moths are capable of being transported long distances in the jet stream to infest new crops."

Alexander said a reduction in corn yields could have substantial economic and social impacts, including higher food prices and reduced food supply.

"Losses due to insect pests, including the resources required to control them, is the biggest cost for corn production," Alexander said. "The European corn borer has been estimated to cost the United States around $1 billion annually, and the corn earworm is responsible for destroying about 2 percent of the corn crop."

Low corn reserves add to the impact of a poor growing season. The 2007-08 30-year low inventory resulted in the United Nation's Food and Agricultural Organization Food Price Index increasing by 47 percent, with cereal prices increasing 62 percent, she said.

"With increasing demand and a limited supply, even small reductions in yield, for example from a pest expanding its range by 60 miles, could result in substantial economic and social consequences," Alexander said. "In addition to loss of yields, the variation in yields could drive up the costs of insurance and disaster relief for farmers."

The research team next will look at a broader range of crops and will

work to create a more complete modeling framework, Diffenbaugh said.

Source: Purdue University