OPINION: Wild relatives of pearl millet can take the heat

It can get stinking hot in Agra, in India’s north. Average summer temperatures hover around 46°C. With temperatures that high you might assume you could rule out any kind of agriculture, since the crops would wilt away under the intense sun.

But scientists from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) are making significant progress in developing pearl millet varieties (*Pennisetum glaucum*) which not only tolerate high temperatures and drier conditions but also resist the devastating blast disease. The ICRISAT scientists and their partners in the private sector and universities are working on a project to provide beneficial genes from its wild relatives that will be used to improve cultivated pearl millet varieties. Ultimately, the scientists hope that farmers will be able to grow one of the world’s most important cereals in marginal environments despite a changing climate.

A smart food for millions

“More than 90 million people in about 30 countries depend on pearl millet for food and income,” said Dr. Shivali Sharma, the Pre-breeding Theme Leader at ICRISAT. Pearl millet is a dependable source of energy for those people, and also a good source for other dietary needs, especially micronutrients. Pearl millet is used to make a flour which is used for porridge or as an ingredient in flatbreads like chapatis. Pearl millet grows in marginal environments where other crops suffer. It can produce yields in temperatures up to 42°C, whereas other cereals like maize (40°C) and rice (32°C) and wheat (30°C) just can't handle the heat. But climate change means farmers need crops which are tolerant to more heat waves and less rainfall, not to mention new and emerging diseases.

Crop wild relatives help build tolerance to heat and resistance to blast

“Pearl millet is facing high heat stress during the summer season in north-western India where it is widely grown,” said Shivali. “If productivity is going to rise as our climate changes, we will need to increase heat tolerance by breeding improved crops.” The genetic diversity in domesticated pearl millet is limited, so breeders need to look to closely related species in the wild. These distant cousins may have developed the heat tolerance which breeders need.

Shivali and her team had a considerable amount of genetic diversity to choose from. ICRISAT’s genebank holds nearly 24,000 seed samples of pearl millet, including 794 samples of wild relatives. “Crop wild relatives are an excellent reservoir of valuable genes that hold resistance to stresses caused by climate change,” Shivali said. “For example, the wild cousin of domesticated pearl millet, called subspecies *violaceum*, grows in the very hot and dry conditions of the Sahel region of Africa. Using pre-breeding techniques we hope to be able to exploit some of its traits for heat tolerance and introduce them into domesticated pearl millet.”

“We evaluated selected pearl millet samples in different locations for heat tolerance in western and northern India where the air temperature is more than 42°C at the time of flowering and much higher in heat waves,” Shivali said. The researchers measure success for heat tolerance by determining how many seeds form (known as “seed set”) in the panicle, or the cluster of flowers, of the plant. “We set a benchmark at 70% seed set at 42°C as this is what the best commercial hybrids achieve. We were able to identify 50 pre-breeding lines across five locations which could equal or better this benchmark.”

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