Crossroads for Chile Research

Jeff Silvertooth

Collaboration in Cochise County increases yields, quality

By Susan McGinley

Thousands of red chiles gleam in the sun on Ed Curry's farm on an early November afternoon. The harvest is underway, with workers loading sacks of peppers into wagons in the fields. Paprika, ancho, cayenne—these and other varieties go onto conveyors at the on-site processing plant, where a separator divides them into vats of pulp, dryers full of dehydrated skins and piles of washed, sifted, highly valuable seed.

The flavor, degree of hotness and general quality of these chiles all depend on their basic genetic traits, breeding choices and crop management practices. There is an art and science in developing a chile variety, in knowing which pepper to choose to fit industry needs, and how to plant, irrigate, fertilize, protect and harvest it in response to conditions in the local environment.

Canneries, dry processors and groceries want consistency in the quality and amount of chiles they buy from growers, but until recently farmers hoping for a perfect combination of growing factors had few resources to predict the crop results. Curry has addressed this constant challenge through an aggressive breeding and crop management research program on his farm, Curry Chile & Seed Company, in the Sulphur Springs Valley near Pearce, Arizona—about 75 miles southeast of Tucson. He has conducted numerous trials and projects with more than a dozen scientists from the University of Arizona, New Mexico State University and Texas A&M University.

For the past five years, University of Arizona agronomist and soil scientist Jeff Silvertooth has been testing and refining an integrated crop management plan (ICM) that can build more consistency and predictability into the quality and quantity of the chile harvest. Based on a proven method Silvertooth helped develop nearly 20 years ago for monitoring and predicting distinct stages in cotton plants—which has now become a standard procedure for many cotton growers in Arizona and the desert Southwest—the plan focuses on measuring heat units accumulated after planting (HUAP) for specific growth stages of the plant. These stages include leaf and crown formation, peak bloom, early pod set, pod maturity and the fruit's transition from green to red.

Joanne Littlefield

Mature red chiles at the Curry Chile & Seed Company Farm in southeastern Arizona

For example, a pod may begin to develop at 1200 heat units and reach maturity at 2400 HUAP. Heat units in general are a measure of "thermal time," which is what a plant responds to as a primary growth factor. People follow calendars but plants respond to and internally record heat conditions, or HUs, according to Silvertooth. He and his colleagues, including Ph.D. graduate student Roberto Soto from Mexicali, who is working as a research technician, and son David Silvertooth — a UA engingeering student working as a research assistant — are establishing baseline figures for the HUs accumulated at these stages. They then correlate those measurements with the amounts of water consumed by the plant and with nutrient uptake requirements. The system also emphasizes pest management factors and chile genetics—the traits different chiles inherit and exhibit, such as flavor, degree of hotness, pod structure and other characteristics.

Curry, whose breeding expertise is well-known in the chile industry, is combining his active chile breeding program with the ICM method on about 600 acres of irrigated chiles. In partnership with renowned breeder Phil Villa, Curry has developed almost all of the standard varieties used for canned green chiles in the United States, including the famous "Arizona 20." He supplies most of the seed for the green chile industry, and is breeding and refining lines of red chiles as well. The chile crop mix on his farm includes cayenne, jalapeño, paprika, ancho and several long green chile types, including Arizona 20.

Traditional chile cropping methods typically follow a calendar schedule, where the seed goes in the ground in the spring and matures in the fall. As with any crop, growers vary the planting dates depending on air and soil temperatures. They also base their decisions on past experiences with a crop and their familiarity with their local soil and weather conditions. The technique Silvertooth and Curry are developing and testing builds on those principles by taking a closer look at the way the plants respond to outside stimuli (such as temperature) as they grow.

"The dynamic nature of the chile plant is that it's indeterminate—it's very sensitive to environmental and management decisions," says Silvertooth, who also heads the Department of Soil, Water and Environmental Science in the UA College of Agriculture and Life Sciences. "For example, chiles will retain or abort fruit in response to current conditions. In particular, managing the vegetative and reproductive balance in a chile plant is critical. You need to know what is normal, how you measure it and what you should do about it. This is usually an 'artistic' skill for growers. We are trying to quantify the process and develop a more systematic way of evaluating and managing a chile crop."

Because this practice is new in chile production and information on water and nutrient uptake in chiles is limited, Silvertooth is generating a representative database that is regionally specific. He has conducted regular sampling of plant growth and development to get data at four locations in Arizona, including Curry's farm, and one in New Mexico.

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During the growing season he takes plant measurements at 14-day intervals, including crown formation, node number, plant height, branch lengths, number of fruiting branches formed, primary fork numbers, flower counts and chile counts. So far Silvertooth and his team have been able to map HU standards for first bloom, early bloom, peak bloom, fork and pod development, drymatter accumulation patterns, development of and production for green and red chiles and a harvest index for several chile varieties. He has also been measuring the amount of water and nutrients, including nitrogen, phosphorus and micronutrients the plant uses at each stage. That information will eventually give chile farmers a blueprint for predicting when each stage will take place.


Joanne Littlefield

Ed Curry displays a sack of his specially bred red chiles.

"Jeff's out here every week, commonly even on Sunday afternoons, working to come up with a very accurate measurement of water usage throughout the growth cycle of the chile," Curry says. "His students usually are in the field once per week as well."

"The plant is basically revving up full blast right before you get to peak pod set on chiles," Silvertooth says. "We've found that it uses the most water right before peak bloom and then begins to drop off at color change." The idea is to offer a crop production outline Curry and other growers can follow for timing irrigations, fertilizer applications and other operations.

"Once you know the system and the basic patterns, you can adapt and respond according to the results you get from the monitoring," Silvertooth says. "The plant tells you what to do." Curry notes that he has seen a direct correlation that the chile appeared to need more water early on.

"This research of Jeff's is very pertinent to the chile industry. As we understand how many heat units it takes to develop a pod, we'll know how much nitrogen to use and how much water to apply, Curry says. "And we can then speed up or slow down the plant's maturity, which is important in growing red chiles. At least that's our goal."

The value of chile pepper production in Arizona totaled more than $9.7 million in 2004, planted on 5,600 acres. In Arizona jalapeños are grown in the low desert (below an elevation of 1,000 feet) and red/green chiles are grown in the southeast savannah area where Curry's farm is located, commonly at about 3,500 to 4,500 feet elevation.

Thanks to Curry's passion for research, which encompasses numerous other aspects of his crop, including disease control for the fungus *Phytophthora*, sprinkler versus drip irrigation, and other projects, Silvertooth has had access to a full-scale commercial operation to test his methods, a living laboratory for scientists and students alike. He has invited Curry to present guest lectures for his classes on the practical aspects of chile growing and breeding and he brings students to Curry's farm for field trips every year. Curry is now interested in having a student intern from the UA come out during the summer to participate first-hand in solving some of the production problems he's addressing with Silvertooth and other scientists.

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A founding member of the New Mexico Chile Task Force, Curry holds annual field days to demonstrate the results of his farm research to scientists and growers from across the Southwest "Chile Belt." The region spans southeastern Arizona, New Mexico, the Rio Grande Valley in Texas, and northern Chihuahua, Mexico. The ICM program for chiles has been a part of these field days, and Silvertooth has also presented it at other chile-related field days, workshops, conferences and grower meetings. He notes that funding has been hard to find for chile research, but he has secured some support in cooperation with the New Mexico Chile Task Force and the Fluid Fertilizer Foundation. He says chile ICM is a classic example of research that uses very scientific techniques, but the end result is that it's designed for application in the field—a true example of the land-grant mission of research and extension education in action.

"Jeff's work here is making a very real difference in the production of pepper across the southwestern U.S. and even in Florida," Curry says. "It's actually going to help growers produce more yield of peppers, paprikas, jalapeños, cayenne and green chile. And the research we do isn't just about money—it also affects people's lives. We're helping family farms become more productive."


Marvin Clary, Deming, N.M.

UA agronomist Jeff Silvertooth and grower Ed Curry confer during chile field day at Ed's farm in Cochise County, Arizona. They are testing an integrated crop management plan that helps build more consistency and predictability into the quality and quantity of the chile harvest.

Contact

Jeff Silvertooth
520-621-7228
silver@ag.arizona.edu