



New cactus species resistant to cochineal scale pest shows promise

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| March 30, 2022



Cactus transportation from harvested fields. In Brazil, some producers are dedicated to produce and sell cactus for dairy farmers to feed their livestock.

Cactus pear is increasingly needed and popular as a food and water source for livestock and humans in the semiarid regions of Brazil because it contains a lot of water and energy-giving carbohydrates, as well as some vitamins and minerals, and is very easily digested by livestock.

Twenty years ago, an insect pest called cochineal scale began to wipe out cactus crops in Brazil—and the race began to breed cactus varieties resistant to the insect.

New *Agronomy Journal* research reports on the agronomic characteristics and nutritional value of a new cactus species that is resistant to cochineal scale.

In the semiarid regions of Brazil, and across the world, it's common to look out on the landscape during a drought and see spots of green adapted to live among the all the brown: cactus. Its ability to thrive in drylands—which account for about 40% of the earth's land inhabited by two billion people—has made cactus pear increasingly needed and popular as a food and water source for livestock and humans.

In Brazil, favored spineless varieties of cactus pear have been used as fodder for livestock for generations, and research began in the late 1950s to improve the beneficial characteristics of cactus pear species. There are almost 1.5 million acres of planted cactus across Brazil.

Then, 20 years ago, an insect pest called cochineal scale began to wipe out cactus crops in Brazil—and the race began to breed cactus varieties resistant to the insect. It took a decade to begin to be able to offer resistant varieties to producers, and researchers in Brazil are still working to optimize their performance.

These researchers include ASA and CSSA member José Carlos Dubeux, a professor at the University of Florida originally from Brazil, and Carlos Vela Garcia, one of Dubeux's doctoral students who lives in Brazil.



Plant height measurement by Carlos Vela-Garcia in the Brazilian semiarid region.

“Scientists tried chemical and biological controls against the scale, but they were not enough, so breeding resistance became the best option,” Dubeux says. “Along with resistance, we have to assess new varieties agronomically for proper nutritive value and digestibility as well as productivity. We have narrowed down to about 12 varieties, some of which are different species than the original one that was popular in Brazil. Our work to assess them continues.”

After finding or breeding a spineless cactus for insect and disease resistance, others begin to study its other characteristics. In a new *Agronomy Journal* paper, lead author Vela Garcia and collaborators report on the agronomic characteristics and nutritional value of a new resistant cactus species (*Opuntia larreyi*). This cactus exhibits resistance to cochineal scale, but there have been no significant breeding efforts with the species.

The study evaluated 11 genotypes of *Opuntia larreyi* in the field, one being the mother plant plus 10 progenies that were the result of open pollination to see if it increased their genetic variability. “This was the first step in evaluating this species in the field,” Vela Garcia explains. “I took a final product from genetic programs to evaluate in the field to see how this new cultivar responded. More research on the agronomics and productivity is needed next.”

Promising Livestock Feed

The research looked at cactus characteristics such as dry matter accumulation, biomass, nutritive value, and plant height as well as the width, length, area, and number of cladodes on the cacti. On cactus pear, cladodes are the ear-shaped modified stems that can perform photosynthesis. Along with being grown from seed, cladodes of cactus can also be planted directly in the ground to produce genetic clones. The first cladode in the ground is called the mother cladode, then the first new set is the

primary cladode, with secondary coming next, and so on. Plant height can be more than 6 ft tall, so there are many orders of cladodes.

Through statistical analysis, Vela Garcia grouped the 11 genotypes into three different groups based on their responses in the field. Group 1 only contained Progeny 1 (P1), and data showed it had overall superior performance compared with the other progenies, even including the mother plant. It displayed favorable cladode area, plant width, dry matter accumulation, crude protein content, calcium content, and more.

“We wanted to see if the open pollination would generate different genetic material and if any would be more productive,” Dubeux says. “What Carlos found in his evaluation is very promising because the variables correlate to good productivity. The take-home message is that this new species of cactus is resistant to scale and some other diseases, and that through these initial evaluations, we can see it holds promise as a productive livestock feed as well.”



Dairy cows feeding on chopped cactus in the Brazilian semiarid region.

Cactus is an ideal fodder in Brazilian semiarid regions because it contains a lot of water and energy-giving carbohydrates, as well as some vitamins and minerals, and is very easily digested by livestock. With its 90% water content, it is extremely useful in very dry areas that do not have much water to offer livestock. It can also be very productive and produce 20 to 30 tons of dry matter $\text{ha}^{-1} \text{yr}^{-1}$ in a raised system, especially when fertilized.

However, it does lack enough fiber and protein to be a complete feed option, so it needs to be supplemented. Dubeux says even low-quality hay has been shown to provide enough extra fiber. By thoroughly evaluating new cacti like *Opuntia larreyi*, researchers are able to know not only what it lacks, but in turn, what it would take to properly supplement it.

“In particular for cattle, introducing cactus and its high carbohydrates can affect their metabolism,” Vela Garcia says. “That’s why there are other studies on adding a fiber source. Researchers look at how animals respond to a diet of cactus. Some are also evaluating fertilizer’s effects on cactus crops.”

Another benefit of cactus is that it is extremely water efficient, just needing 50–100 kg of water to produce 1 kg of dry matter. This is thanks to the plant’s unique physiology that results in its stomata only opening at night when under water deficit, shielding the water inside from evaporation by heat of the daytime sun.

Common Forage, Improving Market

In Brazil, it is commonplace to use cactus pear as a forage, especially compared with other countries like neighboring Peru where it is more commonly used as a fruit.

Resistant cultivars are released to producers, usually as cladodes, to plant in their fields. Even smallholder farmers work with cactus, and the production is typically very intensive because they do not have a lot of land, Dubeux says. Manure is usually added as a fertilizer. Cactus is harvested every other year, rather than every year.

As a forage in Brazil, it's usually cut from the field by hand and then processed using machinery. Because it is typically a spineless variety, the processing is minimal, and chunks of the cactus are mixed with supplemental fiber and protein sources and fed to livestock.

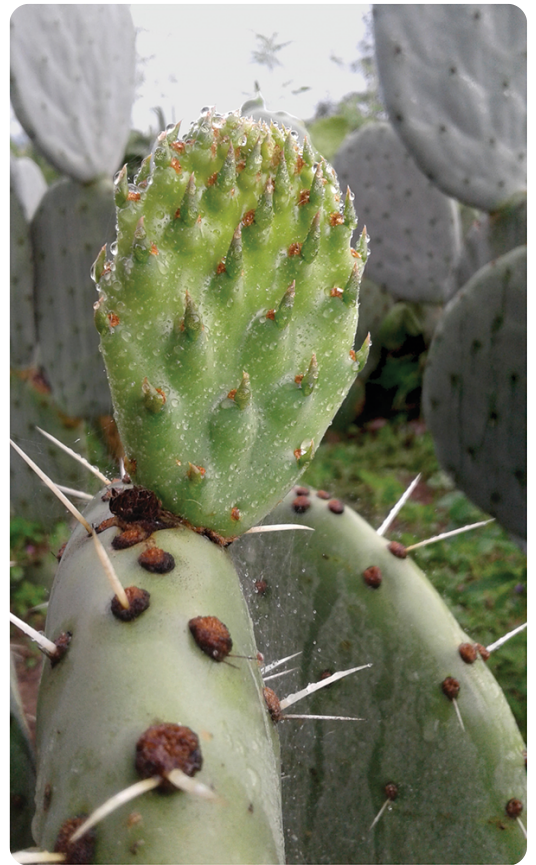
It's also common for some producers to just grow cactus and not own livestock, so they can sell it as a commodity to those who do.

"The market is getting better and better, not only selling the forage but also selling cladodes of improved varieties to other people to plant," Dubeux says. "Animal products like milk and meat are, of course, a

huge market, so we are able to use cactus as a feed source to produce high quality food for humans. There is a lot of value in cactus crops, especially as we have more and more severe droughts."

It's these needs to confront droughts and feed a growing population that has many eyes on the future of cactus as a crop. In addition, other nations with drylands such as across Africa, are now experiencing outbreaks of cochineal scale. Researchers in Brazil are conducting studies abroad and also shipping their resistant varieties to other countries for testing.

"Cactus and the contributions of drylands will only become more vital as we need to feed more and more people with less and less water," Dubeux says. "Even a small



New cladode sprouting from mother cladode of Opuntia larreyi.

amount of cactus crop can take pressure off natural resources. The goal of all this work is to broaden and assess the genetic base of cactus pear to be prepared for the next killer drought, insect, or disease.”

Dig deeper

Read the original *Agronomy Journal* study, “Agronomic Characteristics and Nutritional Value of Cactus Pear Progenies,” here:

<https://doi.org/10.1002/agj2.20868>.

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