

New Developments in Breeding and Cactus Pear Products at D'Arrigo Bros.

Ron Bunch
Plant Breeder
D'Arrigo Bros. Co. of California
Salinas, California

OVERVIEW

D'Arrigo Bros. was started in 1923 for the purpose of shipping sweet anise (fennel) and cactus pears from the west coast of the United States to the east coast. In 1924, the founding brothers were credited with introducing a little-known Italian specialty vegetable called broccoli to the United States. They later became pioneers in the field of consumer marketing of fresh produce with their pink Andy Boy logo on individual unit labels. Today, we farm about 6000 ha of crops in California and Arizona. We grow, pack, and ship more than 30 different fresh fruits and vegetables including the well-known vegetables—lettuce, broccoli, cauliflower—as well as lesser known Italian specialty items, such as fennel, broccoli rabe (an Italian mustard green), and, of course, cactus pears.

CACTUS PEAR PRODUCTS

Although cactus pears are a small part of our business, they are an important item because of the long history of cactus pears at D'Arrigo Bros. and because they are considered an important and profitable Italian specialty item. We currently grow about 120 ha of cactus in the Salinas Valley of California. We grow only the red spineless Italian-type cactus pears and we harvest from August through March. Over the last 15 years, we have averaged 12 T/ha but varied from a high of 25 T/ha to a low of 7 T/ha because of weather and the changing percentage of our acreage turned over from established plantings to new plantings.

All of our fruit is mechanically despined, cleaned, and lightly waxed. Our premium fruit is individually tissue wrapped and packed into our Andy Boy label in 8.2 kg boxes with 50, 60, or 70 cactus pears per box. We also pack the lower quality fruit into a second label or into a generic cactus-pear box. These pears are packed loose and sell at a reduced price. These lower-quality cactus pears may have blemishes, small bruises, or they may be small or poorly shaped. These fruits have become the focus of our latest cactus product research and development. In an attempt to increase the value of these lower-quality fruits and, at the same time, tap into a broader market for cactus products, we have looked at various options for processing the fruit.

David D'Arrigo has been working on the processing of cactus pears for nearly eight years and, in the last two and one-half years, he has concentrated the efforts of our product R&D department on this project. Although processing the cactus pears certainly adds value to the fruit, it also adds considerable cost to the product. The equipment and expertise necessary to produce a consistent and safe juice product are substantial. Of course, quality control and product safety are always top priorities.

Although we will work with our customers to provide the formulation and packaging they desire, we have focused on a frozen puree as the most versatile and stable product. D'Arrigo

Bros. cactus pear puree is also sold through Perfect Puree, a puree distributor. The frozen puree is sold in 30-oz. plastic jars. The puree can be used in any number of beverages and food dishes, as we have seen over the past few years, thanks to the cooking of chefs such as Jay McCarthy.

BREEDING RESEARCH

Two and one-half years ago I was hired by D'Arrigo Bros. to conduct a breeding program for specialty crops. The crops that I currently work with are broccoli rabe, fennel, radicchio, and cactus pears. Besides the goals of increased cactus pear production and better fruit quality, a primary emphasis of the program is to reduce the seediness of the cactus pear because the seeds appear to be a major deterrent to increased consumption in the United States.

The initial phases of my breeding program focus on the collection germplasm and learning the biology of the cactus. Simple, but necessary, studies on how to germinate the seeds and how to make successful crosses have been of primary importance. Several other researchers are working on similar studies and, hopefully, together we will develop methods that will deliver consistent success. Before I joined the company, we obtained several seedlings and one clone from some consulting work of the late Dr. Barrientos of the Universidad de Chapingo. This material serves as the base population for my program. We are currently characterizing the plants that are producing fruit with a major emphasis on fruit quality. This year, we have also obtained several of the most promising clones from the Texas A&M University-Kingsville collection.

In our laboratory we routinely look at fruit shape and record a percentage ripe based on peel color. We weigh the fruit and pulp, then blend the pulp and strain it to separate the puree from the seeds. We compare the puree color to the Royal Horticultural Society color chart, measure the soluble solids, and measure the pH. The seeds are dried and later separated into size classes and weighed.

Germination experiments have included various genotypes, various ages of seed, and several treatments. So far, we have not discovered any treatment that makes fresh cactus seeds germinate. We have found that heat treatment (short periods of boiling or dry 200°F heat) does not help and probably kills the seed. Also, fermentation of the fruit and seeds together appears to kill the seeds. We have confirmed other reports in that genotypes vary greatly with respect to seed germination. This is true among plants of the same variety as well as among species. Dry storage of the seeds for periods of six months and longer can greatly increase germination percentages. This effect and the length of the storage period vary with genotype. It appears that warm temperatures (26°C–30°C) speed and increase germination. Soaking seeds in gibberellic acid has not helped us so far, but has been reported to help germination. We have been successful at germinating some seeds, but not with the consistency we need.

In 1994, I attempted 39 crosses but obtained no seed. In 1995, I attempted 120 crosses and obtained seed in 14 of them, which I thought was terrible, but other researchers have reported that a 10%–15% success rate for *Opuntia* crosses is not uncommon. We have varied emasculation methods, bag types, pollen-collection methods, and kept detailed records of time from emasculation to pollination. It appears that nearly all of my successful crosses in 1995 were from pollinations made 3 to 5 days after emasculation. This year, I expanded the crossing trials to include more crosses and to measure pollen-storage times as well as time from emasculation to pollination.

Our current crossing method includes emasculation of the flower 3 to 5 days prior to opening. We try to get as close to anthesis as possible without pollen shedding. We remove the petals and

sepals, along with a small portion of the receptacle. The protruding stamens are cut away from the stigma. If a small amount of pollen is shed, we wash the stigma with water. Instead of scraping all of the anthers from around the base of the style, we cover them with a piece of tape cut to allow the stigma to protrude through for later pollination. The crossing information is recorded on a white paper bag used to cover the flower. Pollen is collected into a small plastic cup and then brushed onto the stigma of an emasculated flower.

This year, we made about 300 crosses during a three-week period. We obtained seed from 68 of the crosses. Twenty-three percent is not great, but we continue to increase our success rate each year. After analyzing this year's results, we should have a good idea of what to do or, at least, what not to do in the future.

Despite many obstacles in the path to greater success with cactus pears, D'Arrigo Bros. is committed to the cactus industry and continues to look for cactus to be part of our operation for a long time to come. That is, of course, why we consider it important to be a part of this organization.