Garden peppers

Paul G. Smith

The pungent-red pepper was one of the first plants seen by Columbus on his arrival in the New World—a new spice which is now grown in the tropics and subtropics around the world. Imagine the surprise and distress on Columbus' face when he bit into the fruit which was "... violently strong and growing on a shrub no bigger than a goosberry bush." He had found a plant which had long been used by native peoples of the New World and which was cultivated from northern Mexico to southern South America. The quantities of these pungent fruits consumed by the Indians was unbelievable to the Europeans. Many kinds had specific uses, and certain varieties were so esteemed that they were reserved for the exclusive use of the ruling classes.

Peppers were, and still are, an indispensable item in the diet of the people in much of the New World from the southwestern United States south, and now in most of the more tropical parts of the world. Why this is true is not clear; perhaps because the pungency adds flavor to an otherwise bland diet, or perhaps because peppers are an excellent source of vitamins A and C in diets short of these nutrients.

Peppers (*Capsicum* spp.) are members of the potato family (*Solanaceae*) and are found growing wild from the southern edge of the United States to central Argentina. Amazingly, five distinct species were domesticated, and within these the diversity of fruit shape, size, and color and of plant type defies description. The species commonly grown in Mexico, the U.S., Europe, and Asia is *Capsicum annuum*.

In California peppers have a farm value of about $20 million annually. About half are the sweet salad and stuffing type (bell peppers) and the other half are pickled or dehydrated for the manufacture of chili powder and similar flavoring. From an economic point of view, peppers have merited attention by the University of California Experiment Station.

When work was initiated on peppers, the first thing which became apparent was that we knew nothing about these plants. How many kinds of peppers were there, where did one find them, and which ones could be used for the betterment of our cultivated varieties? Without this information, no intelligent effort toward crop improvement could be made.

The confusion can be illustrated by the fact that, during the 1800s, botanists named over 100 distinct "species." In 1898 these were all lumped into two, and in 1923 the noted American botanist, L.H. Bailey, reduced these to a single species, and this was accepted for the next 25 years.

Botanical groupings

Because they are the most stable part of a plant, the reproductive structures—flower and fruit—are the most important parts in deciding botanical groupings of plants. Our common pepper (*Capsicum annuum*) has but one flower per node and it is white with blue to purple anthers. Shortly after the pepper work began, seed lots from various parts of the Americas produced plants which had 2 to 5 yellowish green flowers per node, or plants which had white flowers with bright yellow spots and yellow anthers and still another with striking purple and white flowers and with black seeds.

Attempts to make hybrids between these different kinds met with failure. Using the concept that the separation of species requires both differences in the form of reproductive structures and barriers to hybridization, it was apparent that there were more kinds of peppers than previously thought.

Since our peppers had been obtained from only a few localities, we sent letters to many places in Latin America, visitors and students from there were enrolled in the search, and finally I made a six-month search in many parts of western and southern South America for other kinds of peppers.

While there are many areas which have not yet been explored, we now know that peppers originated in South America in the region of southeastern Peru and Bolivia and sixteen distinct species have been collected and studied. Eleven are strictly wild, and the wild ancestral forms of all but one of the cultivated species have been grown. Through hybridization studies we know which ones can be used for plant breeding. For example, our common pepper can be hybridized—with difficulty, it is true—with *C. frutescens* and *C. chinense* which are found from Mexico to central Peru and Brazil, and from northern South America to southern Peru, respectively. Our domesticated *C. annuum* grows wild from the southern United States to northern Peru, although the greatest number of cultivated varieties are found in Mexico.

Now that we know what species can be utilized for the improvement of our cultivated varieties, and where to look for additional materials should they be needed, pepper breeding can proceed much more efficiently. We now have about 700 collections of peppers at Davis, and these have been shared with the Plant Introduction Service of the U.S. Department of Agriculture so that they are available to scientists around the world.

Disease resistance

Utilizing materials already available, excellent sources of resistance to Phytophthora root rot have been located. Resistance to the tobacco mosaic virus has been demonstrated to exist in several species. High levels of tolerance to the tobacco etch—potato Y virus complex have been located in *C. chinense* and in certain wild and primitive peppers from Mexico and these have been and are now being actively utilized in breeding programs in many parts of the world.

A brown-fruited variety from Mexico was first looked upon as a curiosity until we learned that the chlorophyll did not disappear when the fruit ripened. The brown color results from a combination of the normal red pigments and the green of the chlorophyll. By crossing this with a small white pepper we are on our way to developing varieties which will remain green when fully ripe. These should have considerable value to both growers and processors.

Sources of darker red color have been found and are being bred into varieties suitable for processing.

A possibility, yet to be utilized, is to take the fruiting characteristic of *C. chinense* and transfer it to our pepper. With chinense, 3 to 5 fruit are produced at each flowering node, whereas annuum has only one. The development of annuum types with 2 to 3 flowers per node would result in a more concentrated fruit set, resulting in more uniform maturity and reduced harvest costs.

As work on peppers continues and new needs and problems arise, the basic information and a considerable reservoir of seeds are ready for the scientist to use, without the uncertainty of whether he has 1 or 100 species.

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