The cultivated almond originated in central and southwest Asia, and spread into the Mediterranean countries and North Africa, and eventually to California, Australia, and South Africa. Each country and production area has evolved unique and characteristic germplasm materials representing separate evolutionary lines including both seedlings and local cultivars.

Endemic materials are being surveyed and evaluated in France, Spain, Italy, Greece, Bulgaria, Russia, Tunisia, Turkey, Iran, and Israel. Selections have been made for hardy types that produce well under adverse growing conditions: late blooming types have been developed in Russia and Bulgaria; self-fertile cultivars have been discovered in Spain and Italy.

The foreign collection at UCD is incomplete, but source material may be available by exchange with various Mediterranean countries.

■ Species and species hybrids. The cultivated almond is believed to have originated from three wild species—*Prunus bucharica, P. fenzliana,* and *P. ulmifolia.* Other species or subspecies growing from Yugoslavia and across southern Russia to Afghanistan and Iran, and extending into Israel, contain a range of tree and fruit characteristics. These species usually cross readily with almond.

P. webbi, P. argentea, P. bucharica, P. mira, P. fenzliana, P. scoparia, as well as some unidentified species, are currently growing in the UCD collection. Hybrids have been produced between some of these species and almond.

The peach crosses readily with almond and has provided a genetic source of self-fertility which has been incorporated into almond through backcrossing. The peach-almond hybrid produces a potentially promising rootstock for almond, peach, and plum. Immunity to nematodes can also be transferred from peach to this hybrid. Easy-to-root hybrid clones have been selected and are being tested for possible commercial use.

The collection also contains some species of the almond-like American *Prunus* from the deserts in the southwestern United States.

Dale E. Kester is Professor, Department of Pomology, and Pomologist in the Experiment Station; Richard N. Asay is Staff Research Associate, Department of Pomology; University of California, Davis.

Large size gerbera developed through germplasm selection.

Greenhouse gerberas

Thomas G. Byrne ■ James Harding ■ Robert L. Nelson

Cut flowers are a sizeable commodity in California. Last year, according to the U.S. Department of Agriculture Crop Reporting Board, the three major greenhouse species alone—carnations, chrysanthemums, and roses—were valued in excess of $83 million at the nursery. In addition, about 50 other species, including field-grown, accounted for perhaps another $50 million. It appears that most of these flowers were initially selected for commercial culture for reasons other than flower productivity.

Color, "showiness," ease of culture, stem length, ability to survive the rigors of marketing—these are the kinds of things breeders have been looking for. And, although there have been some yield improvements, it is likely that most of these have been fortuitous. Now, however, growers are taking a closer look at flower productivity as fuel, shipping, and labor costs escalate. They are also looking for less labor-intensive crops. *Gerbera jamesonii* hybrida (Transvaal daisy) shows promise of filling the bill on both accounts.

Many crops have been selected for yield to the extent that their genetic variance for this character has been greatly diminished. Further selection for productivity, therefore, might not be expected to be readily effective. But this may not be the case for flower crops that have been selected primarily for their decorative value.

Gerberas were selected for night openness and other desirable commercial cut-flower traits at the University of California at Los Angeles beginning in 1960. Commercial producers, however, have made no serious attempts as yet to develop marketable clones. A major obstacle may be the low productivity of certain selections that have shown promise in other respects. Assuming that low productivity *is* an underlying reason for propagator and grower resistance, and assuming further that gerberas have not had a long history of selection for this character, it follows that mass selection might be an approach to overcoming the problem.

A study was begun, therefore, to determine how genetic resources could be readily assessed and whether flower yields can be increased appreciably through selection without an accompanying genetic deterioration in flower or stem acceptability and vase life. We also wanted to develop production data for selected genetic types grown under quasi commercial conditions in California.

Our genetic "pool" originated

several years ago from seeds obtained from commercial sources in the Netherlands, Germany, and the U.S., and from the Hebrew University in Israel. Plantings typically were being grown from seed and reportedly exhibited a high degree of variability. Average flower production was low and losses from diseases often high. However, seedlings from this "pool" appeared to exhibit all of the characters deemed necessary for a California-grown crop. One, later designated G-1, produced large numbers of long-stemmed yellow flowers that stayed open at night and kept well in the vase, and whose semi-quilled petals were resistant to bruising, tangling, and shattering during post-harvest handling operations. Other desirable seedlings were subsequently selected and crossed to this plant. More recently, 21 highly diverse progeny were selected to serve as parents of our experimental population.

Crosses were made at Davis each spring, and flower production recorded for six months of the ensuing fall, winter, and spring. The most productive plants were further selected first for flower and stem acceptability and then for vase life. The survivors became the next generation's parents. Some of the more desirable ones were also cloned and grown alongside the next generation of seedlings. This procedure allowed later yield comparisons between different generations and between selected clones from different generations without the confounding effects of different years. Parents were also self-fertilized to determine the feasibility of developing inbred lines. In addition, a number of selected parents were evaluated for a year at the San Jose Field Station—a facility located in a flower-producing area.

Annual flower yields were relatively high for the selected parents grown at San Jose. The highest producer was the third generation plant P-813 which yielded 84 flowers per square foot in the 12 months beginning June 10. The lowest producer was P-265, a second generation selection, which averaged 39 blooms. For comparison, G-1 produced 27 flowers, a figure which agrees with those obtained for this clone in earlier tests at San Jose.

Secondary selection to avoid genetic deterioration of flower quality was apparently successful, based on subjective ratings and color frequency. Percent doubles and semi-doubles decreased from 38 to 21 in three generations but stem length remained satisfactory. Secondary selection to avoid genetic deterioration of vase life was also apparently successful. Mean vase life was 14 days for generation three at Davis and 11.8 days for all selections at San Jose. A single generation of self fertilization, on the other hand, resulted in a mean inbreeding depression of 40 percent. Many selfs died although one did yield more flowers than one of the original parents.

This study shows that gerberas can be selected for much higher yields without appreciable losses in flower acceptability, stem length, or vase life. More intense selection for flower form could undoubtedly increase the percentage of doubles in the population if this were considered by growers to be important. Genetic variance for yield was not diminished after three generations, and it now appears that 125 to 150 blooms per square foot per year may not be an unreasonable goal for breeders to pursue.

The genetic resources necessary for yield (or other) improvement ought not to be difficult to reproduce from commonly available seed sources. Gerberas are grown extensively from seed for use as landscape plants, and a great deal of genetic variation is maintained simply because many of the characters judged to be deleterious in cut-flower clones are either not thought of as detrimental in the landscape or are considered too unimportant to cause them to be eliminated. In fact, diversity of characters within a seedling population often appears to be advantageous.

This may not be the case in other flower crops where specific forms are popular and "off-types" are considered unaesthetic. And if certain characters that are not now considered important or in vogue suddenly become necessary for the commercial continuance of the crop, a gene "pool" to provide the necessary source of genetic variation for further selection may be hard to come by. It does not seem to be realistic to expect that such a pool is, or will be, maintained by commercial breeders. They operate within economic parameters that would appear to limit their ability to act as "banks" for the maintenance of unused genetic materials. Most likely, the university would be an appropriate repository for the conservation of ornamental plant germplasm that might otherwise be lost or, at best, difficult to recover.

Thomas G. Byrne is Specialist, James Harding is Professor, and Robert L. Nelson is Staff Research Associate; all of the Department of Environmental Horticulture, University of California, Davis.

Cultivated alfalfa and its closely related wild relatives are probably native to the Middle East, particularly what is now Iran. It is said to be the only forage crop cultivated before recorded history.

From its original home in Iran, alfalfa spread westward to Greece, Italy, and North Africa, and then to Spain, probably carried by conquering armies as feed for their horses. The Spaniards brought it with them in their conquests in the New World, where it became an established crop in Chile and Peru.

Except for the humid tropics, alfalfa is now distributed world-wide, indicating considerable variability in its germplasm. This variation can be attributed to the fact that it is cross-pollinated and is a tetraploid plant; that is, it has four sets of chromosomes rather than the usual two.

Alfalfa may have been used at some of the southern missions in California; it was established in northern California during the Gold Rush days. There is a record of a planting made at Benicia in 1851. Alfalfa is now grown in nearly every county in California, and ranks high in both acreage occupied and cash value. It is particularly important to the poultry and dairy industries, and as a soil improving crop.

Although the alfalfa introduced into California was well adapted to this climate due to its Mediterranean origins, by the 1920s growers began to notice that the life of their alfalfa stands was becoming shorter. Efforts to control bacterial wilt disease, identified as a major cause of stand decline, were responsible for the initiation of several alfalfa breeding programs, in California as well as other states. Alfalfa introduced from Turkistan in 1898 and from Ladak province in India in 1900 contained plants with a high level of resistance to the disease. This resistance was transferred to the California-adapted variety California Common by a backcross program. The new variety, named Caliverde, was the