Reprinted from: Perspectives on new crops and new uses. 1999.
J. Janick (ed.), ASHS Press, Alexandria, VA.

Ornamentals: Where Diversity is King—the Israeli Experience

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In the increasingly competitive international cut flower and pot-plant market, novelty of crops plays an important role in maintaining and expanding market share. The ornamental industry is unique among the agricultural industries in that novelty is an important attribute. Customers always seek "something new." Although the standard major ornamental crops will continue to constitute an important part of the market, a distinct trend towards increasing the share of "new crops" is clearly evident in recent years. These new products normally fetch higher prices than the traditional crops for a certain period, but quite often the prices drop when the market is saturated, and the attraction novelty lessens. By that time new products should be ready to enter the market. Research on introduction of new ornamental crops is therefore an endless project.

The floriculture industry in Israel is relatively new. Until about 30 years ago cut flowers and pot-plants were only produced on low-scale for the limited domestic market. In recent years ornamental plants became a major agricultural exportable product of over 250 million US$ per annum. Israel is now second only to Holland in flower export in Europe.

Initially Israel produced and exported mainly the major traditional cut flowers, such as carnations, roses, and gladiolus. Gradually the share of these crops declined and those of new minor crops increased, so that the "new crops" now constitute over 60% of the exportable cut flowers (Fig. 1). None of these "new crops" has become a major crop as roses or carnations, but together they are and will certainly continue to be the major part of our exportable ornamental products.

Introduction of new crops includes many research stages that begins with the initial search and screening and is concluded when the product is introduced commercially.

The introduction and adaptation of new exportable crops normally includes the following stages:

1. Searching for optional crops.
2. Selection and improvement.
3. Developing propagation methods.
4. Studying the growth and flowering physiology and developing practical means for their control.
5. Evaluation of horticultural practices.
6. Studying postharvest physiology and developing practical methods for postharvest handling, transport, and storage.
7. Semi-commercial export shipments to markets abroad.

Some important cut flowers (in European markets), which we introduced and developed in Israel, were "new crops" about 25 years ago such as Gypsophila and Geraldton wax flower. The development of these and other crops are described in the following examples of successful introduction projects.

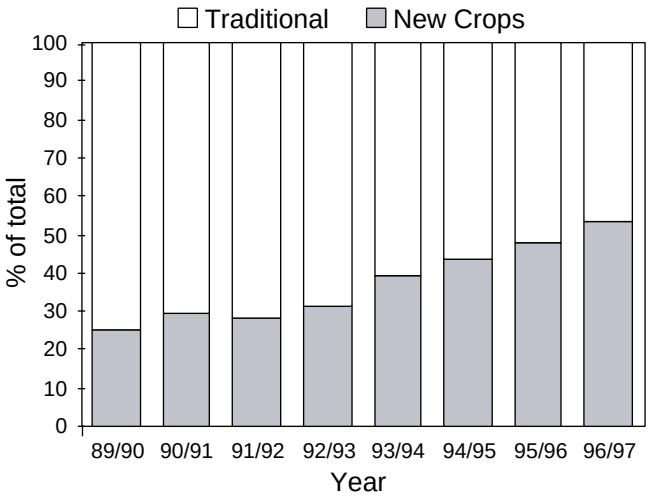

Fig. 1. Relative percentage of "traditional" and "new" cut flowers exported from Israel from 1989/90 to 1966/7.

GYPSOPHILA (BABY'S BREATH)

Gypsophila (*Gypsophila paniculata* L., Caryophyllaceae) is really not a new crop. It has been cultivated for many years as a minor field crop for harvesting in the natural summer flowering season. Today, Gypsophila is a major cut

flower in Israel, grown in over 200 ha of greenhouses for the autumn to spring export season. It is now the main flowering shoot used as a "filler" in flower arrangements, in both Europe and the US.

The introduction and development of this crop involved many aspects (Shillo and Halevy 1982; Shillo 1985b; Shillo et al. 1985).

1. Selection of superior clones for controlled cultivation.
2. Development of in vitro meristem culture method to obtain disease-free mother plants.
3. Propagation of clean, uniform commercial cuttings in controlled insect-free greenhouses.
4. Study the physiology of flowering and development of practical methods to control flowering. It was found that Gypsophila is an absolute long day plant, with quantitative response to vernalization. The methods developed to control flowering include cold storage of rooted cuttings prior to planting and supplementary night illumination. Spraying with gibberellic acid is also used to promote flower and shoot breaking and elongation.
5. Development of specific cultivation methods, such as pruning, watering, and feeding.
6. Study the postharvest physiology of the flower and development of methods for postharvest treatment of the flowers prior to shipment, to ensure their longevity and quality. When 15% to 30% of the florets are open, flowering shoots are harvested, treated with silver thiosulfate (STS) to protect them from internal and external ethylene, followed by pulsing the flowers in sugar (7% to 10%) and germicides until about 2/3 of the florets are open.

The flowers of commercial *G. paniculata* plants are sterile and do not produce seeds. This prevented real breeding of this plant. Recently this obstacle was overcome and real new varieties were introduced by Dan Nursery in Israel. A major success is the cultivar Million Stars that was introduced last year, and is already grown this year on over 40 ha in Israel and over 100 ha worldwide.

GERALDTON WAX-FLOWER

Geraldton wax-flower (*Chamaelaucian uncinatum* Schauer, Myrtaceae) is a native shrub in Western Australia. It was introduced to southern California and grown outdoors as a minor cut flower. Most of the initial physiological and horticultural research was carried out in Israel, a fact that facilitated the rapid development of the plant as an important commercial crop (Shillo 1985a; Shillo et al. 1985; Halevy 1994). More recently important research is also conducted in its native country, Australia. In Israel this plant is currently a major commercial ornamental crop, grown on ca. 300 ha. It is used mainly for cut flower production, but also for cut shoots with flower buds, cut foliage, and flowering pot plants. Israel became the main exporter of wax flowers to Europe in the winter.

Plant material of native plants in Australia, as well as breeding, enabled the establishment of a wide assortment of various plant colors (pink, purple, white, lilac, and bicolors), which bloom from November to May. The selected plants are propagated by semi-woody vegetative cuttings in order to form uniform varieties. Recently, virus-free mother plants have been produced by meristem in vitro culture.

Studies on the physiology of flowering revealed that the wax flower is an absolute short-day plant under conditions of mild temperatures. At very high and very low temperatures no flowers are produced. At medium-low temperature some flowers are formed regardless of photoperiod. To advance flowering in the autumn, plants of several cultivars are covered in the field at the end of the summer to create artificial short days. An interesting physiological phenomenon, revealed for the first time in this plant, was that the young flower buds produce a factor that inhibits the formation of new flowers, even under inductive conditions (Shillo et al. 1984).

For production of flowering pot plants, plants are heavily pruned to promote branching and then treated with growth retardants (CCC or paclobutrazol). Controlled photoperiod is employed to extend the flowering period.

Abscission of individual flowers during shipment and handling is a problem of the cut flowering shoots. This problem can be ameliorated by dipping the cut flowering shoots in auxin (NAA) solution and hydrating them in cold water.

PEONY

Peony (*Paeonia lactiflora* Pall., Paeoniaceae) has been in cultivation in China for thousands of years, and have been grown as garden and outdoor cut flower plants in Europe and the US for many years. Cut flowers were, however, available only for a few weeks a year during the natural flowering season in late spring. Until recently, however, very little was known on the flowering physiology of the plant. We have found that flower bud initiation starts after the old leaves senescence in the summer and continues until late autumn when they become dormant. Release from dormancy requires a period of low temperatures, and can be accelerated by GA treatment. After the release from dormancy the plants may start growing and blooming under mild-warm temperatures (Wilkins and Halevy 1985; Byrne and Halevy 1986). This basic information enabled the development of a practical method for extending the flowering season and obtaining cut flower production in the winter, 2–3 months before the natural flowering season (Halevy et al. 1995). Plants are grown under ambient natural cold temperatures of the early winter. After sufficient cold units are accumulated, the structures are covered with polyethylene at mid-winter and the plants are drenched with GA solution. Sprouting and flowering soon follow.

The introduction and improvement of this "new crop" is actually developing new horticultural techniques for flowering control of a very old ornamental plant. One of the obstacles of rapid development of peony as a commercial crop is the slow rate of natural propagation by division of crowns. We are now developing a tissue culture propagation method that should solve this problem.

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