

DEVELOPMENTS IN NURSERY STOCK PRODUCTION IN ISRAEL

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Horticultural practice in Israel goes back to Biblical times. Five of the seven species mentioned in Deuteronomy 8:8 are fruit trees. "The Lord your God is bringing you to a land of wheat and barley, of vines, fig trees and pomegranates, a land of olives, oil and honey." In Leviticus 19:23 the laws concerning the culture of fruit trees are laid down, "When you enter the land and plant any kind of tree for food, you shall treat it as bearing forbidden fruit. For three years it shall be forbidden and may not be eaten, in the fourth year it shall be a holy gift unto the Lord, and this releases it for use. In the fifth year you may eat its fruit and thus the yield it gives you shall be increased."

The Mishna, which was written in the 2nd century, sets out very definite do's and don'ts as far as grafting is concerned, indicating that our forefathers were very imaginative propagators. I quote from Order Zeraim — (Seeds), Tractate Kilaim Chapter 1, verses 7 and 8.

7. One kind of tree may not be grafted on to another kind, nor one kind of vegetable on to another kind, nor a tree on to a vegetable, nor a vegetable on to a tree. Rabbi Judah permits (the grafting of) a vegetable on to a tree.

8. Vegetables may not be planted in the stump of a sycamore tree, nor may rue be grafted on to white cassia, since that is to graft a vegetable on to a tree. A fig-tree shoot may not be planted in scutchgrass that this may shade it, nor may a vineshoot be trained into a watermelon that this may pour its juice into it, since that is (to graft) a tree on to a vegetable.

In a short presentation we must skip 1800 years and start with the modern nursery industry in Israel which is, in fact, a reflection of the development of agricultural settlement of the land.

It all began about 100 years ago when the first settlers of agricultural land who, amongst other things, planted vineyards and almond groves. This was followed by planting of orange groves and other fruit orchards. Much of this early horticulture was financed by Baron Edmond de Rothschild and was supervised by French farm managers and advisors.

Following World War I and the Russian revolution large numbers of immigrants started arriving in the country, at first

from Eastern Europe and later, in the late twenties and thirties, from Germany. It is in these years that the nursery industry really got going. In addition to fruit tree nurseries, especially citrus, there is record in the early thirties of four large nurseries which produced garden plants and even house plants.

It is impossible to cover even the period of the past 60 years in a short time; I have, therefore, chosen to describe some of the developments from a very specific point of view and I hope that this will illustrate the tremendous changes which have occurred in what is in effect a relatively short period in horticultural experience.

I will begin with citrus — historically and also today our number one export crop. Although oranges were introduced into the country in the 14th century, citrus growing became widespread only in the 18th century. We have records of citrus fruit exports from 1855 onwards; in that year, more than 100,000 boxes of fruit were shipped to Europe. The crop had its ups and downs and both Arabs and Jews planted and cultivated citrus groves. Traditionally, sour orange or sweet lime were sown in the field as rootstocks and these were grafted *in situ*, often on framework branches of 1 to 1½ year-old seedlings.

In the 1920's, methods prevalent in the U.S. were adopted and grafted nursery stock became available. Both *in situ* grafting and grafted stock were used in the great expansion of the citrus acreage in the coastal plain between the years 1925 to 1936. Thirty thousand hectares (75,000 acres) were planted. In 1938, a record 1.5 million boxes of fruit were exported.

World War II, followed by Israel's War of Independence, left their mark of damage in the citrus groves. In 1949 only 10,000 hectares remained alive.

The waves of mass immigration into Israel in the early 1950's brought, in its wake, massive planting of citrus groves. This included replanting of war-neglected orchards as well as the opening up of new areas to citrus growing: the northern Negev, the Bet Shean valley for early grapefruit, and Upper Galilee. All this acreage was planted with nursery-grown stock but the old controversy as to whether nursery grafted or *in situ* grafted trees were preferable arose again.

Inexperienced growers planted either balled or bare-rooted rootstocks which were later grafted by travelling teams of propagators. It is only since the mid-1960's that all planting is done with nursery-produced grafted trees.

Since the late 1920's propagators selected their scionwood from healthy, heavily-bearing trees. Inspection of nurseries for plant health was introduced in 1939 under the laws of the British Mandate and a certification scheme for registered psorosis-free source trees was introduced in 1953.

At the end of the 1960's, tristeza, the dreaded virus disease which has caused so much damage in many citrus growing areas of the world, was diagnosed in Israel. This changed the whole approach to citrus nursery production. As part of the tristeza suppression programme, it was decided that in order to supply growers with virus-free, especially tristeza-free trees, the nurseries would have to go into insect-free conditions.

It was impossible to move the nurseries into areas isolated from the citrus groves and, therefore, all citrus nurseries are now housed in insect-proof screen houses. The source of propagating material is registered mother trees which are regularly inspected and tested for virus twice a year. Some of these are still in open orchards. There are a small number of registered mother tree collections in insect-proof screen houses and the Ministry of Agriculture is now establishing a citrus repository in an isolated area.

Virus-free material has been produced by shoot-tip grafting at the Agricultural Research Organisation. The first trees so produced are now being tested.

Cultural practices changed rapidly in the citrus nursery during the 1970's. Container growing became common and containers were lifted off the soil onto benches. Sprinklers were replaced by individual pot drip irrigation.

With the necessity of housing all citrus nurseries under expensive insect proof conditions, intensification was required. Shortening the period in the nursery became necessary and increasing the number of plants per unit bench area was essential. This became possible with the introduction of lighter potting mixes combined with regular and frequent irrigation and feeding, much of which is controlled by computers.

Citrus planting has virtually stopped in Israel and our nurserymen are looking for alternatives. Some of them have gone into the production of ornamental, miniature citrus trees. These include calamondin, kumquats, and limequats.

Cuttings are rooted all year under mist with bottom heat giving 28°C in the rooting medium.

Some of the products are grafted to produce a miniature tree as opposed to the traditional bushy American calamondin.

I have mentioned certification schemes earlier and would like to broaden the discussion on this subject because it has bearing on so many of our nursery crops.

Israel is a very small country, with areas of different climatic conditions within short distances. A variety of crops, for example, deciduous fruits and citrus, are grown in close proximity. This gives many pests, and even some diseases, easily available alternate hosts throughout the year.

Being a small country has the advantage that efficient inspection services are relatively easy to implement. Most of our compulsory certification schemes were initiated by growers who put pressure on the Plant Protection Services to make the regulations.

In contrast to many other countries, certification of nursery stock and nursery inspection are compulsory for many crops. These include citrus, grapevines, avocados, deciduous fruit trees, roses, carnations, and gladioli. There are others like mango, olives, and peaches which have voluntary source-tree registration schemes.

I shall briefly describe the grapevine and carnation programmes because these illustrate well how nursery practice changes with a change in emphasis on plant health.

The vine certification scheme is based on one national repository which was planted in an area isolated from commercial vineyards.

Since local vineyards were 100% infected with fan-leaf virus, the source material for the repository was imported as virus-tested material from California and Super Elite material from France. Some of our local cultivars have been added to the collection following thermotherapy.

The canes which come from the repository are cut and graded by machine in the nursery. They are table-grafted in February or early March. No tying is done, the grafts are dipped in a heated plastic compound called 'koffer' and are left to callus in sawdust-filled boxes. There are two methods of planting. Traditionally callused grafts are planted in the field in spring, are lifted at the end of the growing season, and are planted in the vineyard in winter. However, due to the problem of virus-transmitting nematodes, container-grown plants raised off the soil are becoming more common. These are potted in the spring and are planted in the vineyard in summer after only 2½ to 3 months' growth in the nursery.

The older nurserymen still prefer the field-grown plant; however, the demand for container-grown plants is on the increase. Phytosanitary superiority is not the only reason. If

you remember the verse I quoted at the beginning of this paper and the fact that early fruit is forbidden from a religious point of view for consumption or for wine making, summer planting before the beginning of the Jewish New Year in autumn has the advantage of counting for an extra year. The grower may therefore market his grapes one year earlier.

Since the introduction of certified planting material, grape yields have increased markedly — from 30% in some cultivars to fourfold in others.

The compulsory carnation certification scheme grew with the development of the carnation flower industry. Prior to 1972 carnation propagating material was imported from Europe annually. At that time no high quality virus-tested material was available for spray carnations and many diseases were imported with the mother plants. The nurseries grew mother plants in the field, practicing crop rotation with other crops they cultivated.

A “clean stock” research and development program was initiated at the Agricultural Research Organization by the Ministry of Agriculture and the Flower Growers’ Association. Close cooperation between the Departments of Floriculture and Virology brought early results. Meristem culture-derived plants formed the basis of the clean stock programme. Rigorous horticultural testing and a strict “generations” schedule was developed. The scheme is based on three propagation stages. The pattern adopted, as well as the nomenclature, were adapted from that used by the British Nuclear Stock Association.

We have nuclear stock stage foundation nurseries and certified nurseries. All stages in this certification scheme are inspected by the Seed and Nursery Inspection Services of the Ministry of Agriculture.

The nuclear stock and foundation nurseries are in insect-proof screen or glasshouses. Nuclear stock is grown as individual plants in pots. They are tested for virus three times a year and all cuttings supplied to the foundation nursery are indexed for *Fusarium*.

Nuclear stock and foundation stock cuttings are all rooted in Speedling trays. Some of the certified nurseries supplying the flower grower also use Speedling trays for rooting.

Foundation nurseries, as said before, are in insect-proof structures, the benches are raised, and clones within a cultivar are kept separate. The certified nurseries are all under cover now and the plants are grown in detached beds or raised benches. Only drip irrigation is permitted and all growth media are sterilized.

The great boom in expansion of carnation acreage in which areas under this crop doubled for three years running, has come to an end. A recent development in our carnation propagation nurseries is the search for an alternate crop to fill the rooting benches in quiet periods and even out the work schedule of the staff. Pelargonium cutting production fits in well with carnations.

Carnation mother plants are planted in October. Cuttings are marketed in June and July for local planting.

Nurseries which export carnation cuttings do so mainly between December and April, their peak marketing period being from February onwards. Pelargonium mother plants are planted at the end of June and cuttings are marketed from November to February. In this way "all-year-round" production is achieved.

I have put great emphasis on changes in nursery practice following the efforts made to produce healthier plants. There are, of course, many developments not directly connected with certification schemes and I shall have to leave many sides of nursery production uncovered. To finish off, I should like to mention very briefly a small number of newer nursery practices which are in use in Israel.

Softwood cuttings of stock which has traditionally been known as difficult-to-root are rooted under mist. One example is the local apple rootstock, 'Hashabi'. Clonally selected mother plants grown in the greenhouse are pinched frequently. Cuttings are taken every three weeks. To save labour, a bunch of cuttings is harvested without paying attention to the position of the cut or the size of the cutting, as long as it has at least three pairs of leaves. The cuttings are inserted into a very light medium as a bunch, saving the time of individual striking. Rooting percentage is somewhat lower than individually struck cuttings but the time saved well compensates for this. Some of the Malling-Merton apple rootstocks are treated similarly but here etiolation is required. A method adapted from avocados is being used.

Olives, which traditionally were planted as grafted trees, are all being propagated by rooting cuttings under mist.

Peach hardwood cuttings are rooted during winter in situ for high density meadow orchards.

Tissue culture is used for propagation of many plants, especially house plants. Material which is in short supply in the country, like apple 'MM 104' rootstock, or new cultivars of bulb and corm crops bred in Israel, are being bulked up. Similarly, new introductions, especially plants with floricultural

tural potential from the southern hemisphere are being propagated in tissue culture laboratories.

Hydroponics for propagation: The Ein Gedi system is used for growing-on of tissue-culture derived plants. Market size plants of philodendron, for example, were obtained in a shorter time than under conventional growing-on conditions. Furthermore, the system is used for growing of mother plants. The number of dieffenbachia or dracaena cuttings produced per unit time and area is considerably larger than under normal greenhouse conditions. Rooting of cuttings has also been found to be faster.

I have said nothing so far about nurseries producing garden plants or forestry nurseries. We, of course, have these too and progress is being made in their production methods. However, developments here are generally slower and perhaps less dramatic. This is probably due to the fact that to date, their products have not been geared to export and they are not part of horticultural food production.

Israel's nursery industry is dynamic. It is continually changing with progress in horticultural practice and with the need to adapt to changing attitudes to our environment, and changing trends in our export market.

ORNAMENTAL NURSERY STOCK PRODUCTION — WHAT IS ITS FUTURE?

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MARKET POTENTIAL

We must first consider what is the market potential of our industry. I firmly believe that this can be described as good, as so many factors point to an increased size of market. A number of factors will increase the size of the market:

- a) Increased leisure time.
- b) Increased awareness of the environment and the role of plants in that environment.
- c) The introduction of fashion to gardening, which will make the public want to change their gardens to keep up with the Jones's.
- d) Introduce new dimensions to the garden, such as night lighting and tub gardening. The recent introduction of peat