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Cultivation of Pomegranate

A. Blumenfeld*, F. Shaya* and R. Hillel**

*Institute of Horticulture, Agricultural Research Organization, The Volcani Center, Bet Dagan, Israel

**Agricultural Research Organisation, The Volcani Center, Gedera, Israel

SUMMARY – This paper describes various aspects of pomegranate cultivation. Tradition, consumption and production target, recommended soil, fertilisation and fertirrigation, most common diseases and treatments, weed control, tree shape and orchard design, pruning, preharvest treatment of fruits, harvesting, packing, storage and needs for the future.

Key words: Pomegranate cultivation, diseases, weed control, preharvest, postharvest.

RESUME – "La culture du grenadier". Cet article décrit plusieurs aspects de la culture du grenadier. La tradition, la consommation et la production cibles, les recommandations quant au sol, à la fertilisation et ferti-irrigation, les maladies et les traitements les plus communs, le contrôle des mauvaises herbes, la forme de l'arbre et la conception du verger, la taille, le traitement pré-récolte des fruits, la récolte, l'emballage, le stockage et les besoins pour le futur.

Mots-clés : Culture du grenadier, maladies, contrôle des mauvaises herbes, pré-récolte, post-récolte.

Tradition and consumption

Pomegranate is one of the "seven kinds" mentioned in the Bible which Israel was blessed with long ago. It grew in the region for thousands of years and is very much adapted to it: it sheds its leaves in the cold of our winters, while it sprouts in early spring when temperatures rise. It ripens at the end of the summer, very close to the beginning of the Jewish New Year. It was and is used for decoration and blessings in ceremonies of the New Year celebrations and the later holidays. It decorated temples in the past and appeared on ancient coins.

Because of its decorative value in Israel, its selection was done mainly for external appearance, not so much for eating quality. Nice colour and crown are very important characteristics of the fruit.

Consumers in Israel do not distinguish pomegranate according to names. Merchants know two groups: sweet and sour cvs. Therefore the price is decided mainly by appearance.

There are objective difficulties in eating pomegranates. The edible grains have to be separated from the hard rind and from the bitter yellow diaphragms. The juice stains hands and clothes. Therefore "tools" are needed to prepare the fruit for eating while many other fruits can be eaten directly. There were attempts to serve the consumers with a "ready to eat" product of separated grains. Those products are hand prepared and have not gained popularity yet because of their high price. We believe that the market for the fruit can be expanded if good products are available to the consumers.

In the past, pomegranates were cultivated in Israel in mixed orchards like many other trees. They still grow this way in home gardens. Modern cultivation is in uniform blocks of 1-5 hectares size, which are cultivated using modern technology, as will be described.

Target

The aim of the growers is to produce more than 30 tons per hectare of high quality fruits. Big fruit obtain higher price than small one. Fruit weight should be more than 400 grams. Small fruits have no market. The fruit should have nice colour, preferably red with a nice crown. Grains should be pink-red, large, sweet with pleasant aroma. The seeds should be soft.

Soils

Except for very calcareous or saline soils the pomegranate can be successfully grown in all soils. Most orchards in Israel are planted in medium or heavy soils with good drainage. In heavy soils ridges are sometimes prepared to have a better aeration of the root system in order to obtain higher production. There is no problem to plant in light-sandy soils as all orchards are well irrigated and can be irrigated even daily with the needed amount of water.

Tree shape and orchard design

The shape and size of the mature trees should influence the orchard design. Generally in Israel the trees are standing alone, producing all around the tree. No hedges are created. As the planting material of pomegranate is very cheap (many people just plant unrooted cuttings), there is a tendency to overcrowd the orchard. In a crowded orchard, production is lowered, fruits are set only at the top of the trees, colouring is bad and distribution of spraying materials is very bad. Therefore the planting distances are generally 6×4 m or 6×5 m, except for the semi dwarf cultivars where planting distances could be somewhat closer like 5×3 m.

Generally a tree will have few trunks 3-5 in a modern orchards while there were 5-12 in old orchards. The trees are trained to grow as an open vase. In such a way that light penetrates the trees from between the rows as well as from the inside of the trees. If the main trunks are bent too much, binding them with strong material to the opposite side branches is carried out.

New branches appear on the exposed trunks. They are hand removed few times during the season while suckers are sprayed by "paraquat" or by 24D compounds.

For renewing old trunks, new branches are left one per trunk. They can replace a trunk within 2-3 years of growth.

The light penetration from between the rows depend on the distance between the rows and on the height of the trees. In the previously mentioned distances, tree height should not exceed 3.0-3.5 m. Higher trees will be more expensive to harvest as fruits will be mostly at the top of the trees. All manual treatments will be more expensive, and sprays of pesticides will be less effective.

Pruning

In order to achieve the desired shape of trees they are pruned in the winter, some care is taken also in the summer. In the winter pruning the height of the trees is brought back to the desired height. Broken, bent, and interfering branches are removed. In order to keep the interior of the tree open during growing season, summer pruning is carried out according to needs.

Fertirrigation

All commercial pomegranate orchards in Israel are irrigated, almost all of them by drip irrigation by one or two lines of drippers per row. Microsprinklers can be used too. However, in order not to wash away the pesticides drip irrigation is preferred. Irrigation once a week is widespread, while some growers irrigate more frequently. As all irrigation systems in Israel have some means of control, there is no problem to irrigate twice a week and by this to have the roots closer to the surface and have better production. No experiments were carried out in this subject.

Amount of irrigation per day depends very much on the climate. A general guide is to start with 15 m³/hectare/day in the spring, and raise the daily amount to 50 m³/hectare/day in the summer days close to harvesting. The total amount of water per season is around 6000 m³/hectare, in addition to 4500 m³/hectare of rain. After harvest very little irrigation is carried out.

Fertilisers are supplied via the irrigation system. About 200-300 kg/hectare nitrogen are given

annually with about the same amount of potassium (K₂O). Some growers clean their drip system by phosphoric acid. By this treatments phosphorus is given too.

No fertirrigation experiments were done in Israel. The amounts used are from general knowledge in other plants.

Organic manure

Most orchards were never manured like most other fruit trees in Israel. Some farmers add rotten organic manure below the dripper lines. They claim that by this method the root system becomes slower.

Plant protection

The most important work in commercial cultivation of pomegranate is plant protection mainly against fruit insects (Table 1). If fruits are not treated well every fruit will be infected. Therefore the regular treatment is spraying every 10-14 days with organic phosphor compounds which are gradually replaced in consecutive sprays. While all are effective against virachola only "Karate" is good for cryptoblabs too. The materials used solved problems of other insects also, but are not environmentally friendly.

Table 1. Insect pest of pomegranate, damage caused and possible treatment

Scientific name	Damage	Treatment
<i>Virachola livia</i>	Fruit. Grains rotting	Organic phosphates
<i>Criptoblabos gnidiella</i>	Fruit crown rotting in storage	Insecticide spray every 10-14 days Diazinon B.T.
<i>Planococcus citri</i>	Fruit crown, appearance	
<i>Aphis punica</i>	Growth inhibition of young trees	Dimecron
<i>Tenupalpus granati</i>	Leaves drop	Miticides
<i>Enzophera</i> sp.	Girdling root crown. Severe decline of trees	

The cryptoblabs enters the crown where eggs are laid. If it is not prevented, there is crown rot towards ripening or in storage. The best way to control this insect is by biological control by treating with B.T. (*Bacillus turgeniensis*).

The growth of young plants is infected by aphids. While in mature orchards fruit sprays kill the aphids too, in young orchards a considerable addition of growth was obtained by treating with "Confidur" (Imidacloprid).

There are some orchards where organic methods are applied. There, weed control is only by mowing, while nets cover the orchards. This way, while quite effective, is very expensive. Sometimes shading caused by the nets reduce flower differentiation and reduce yields.

Weed control

Under Israeli growing conditions where water is scare, pomegranate as other orchards are kept clean from weeds.

The old system of cultivation in two directions is expensive. When irrigation systems of either drip or microsprinkler lines exist, the land is cultivated in one direction only or is not cultivated at all. Weed control is done by herbicides.

Annual weeds are controlled mainly with preemergence weed killers such as simazine. After germination, weeds are controlled by "Round up" (there might be a damage in young plants) for monocotyledone plants, and with 24D derivatives for dicotyledones. The combination of both is used when needed. For contact killing of some plants minute amounts of "Goal" are added when necessary.

Preharvest treatments of fruit

In order to obtain big fruits of high quality, there is a need to thin fruits. As in many other fruit species there is a negative correlation between the number of fruits and their size. Even distribution of fruits on the branches is desired: about 5 fruits on a group of small branches with a good (20 cm) distance between the fruits. Where a group of fruits develops, the touching fruits are removed. If fruits touch each other, the touching place has favourable conditions for development of insects.

From their local experience, farmers know how much they can load the tree without influencing fruit size. For example when a farmer has 400 trees per hectare (6×4 planting distance) and is aiming for 30 tons of 500 g fruits each, he will need 150 ½ kg fruits per tree at harvest. The fruits should be well distributed in the canopy. Some farmers thin more than once.

In order to obtain fruits without damage to the rind and with good colour, some farmers clean the small branches around the fruits which might scratch the fruit. By doing this they also expose the fruit to sunlight. There is an idea to use reflective plastic sheets underneath the foliage to improve colour. This has not yet been experimented.

Physiological disorders

The main disorder which causes a severe economic impact is splitting of ripe fruit. The damage can be even of half of the yield.

Regular irrigation can decrease the damage. However regular irrigation as is done in the commercial orchards in Israel does not prevent it completely.

Some growers claim that if they leave more fruits on a tree the phenomena is bigger, and that thinning helps to reduce it. Another explanation is that when they leave more fruits per tree and wait for it to attain regular size, the grains swell and crack the rind.

Another damage is the sunburn on fruit rind which reduces its value. The damage happens only at a certain physiological stage of fruit development. In cvs which have a willowy canopy there is no damage.

Harvesting, packing and storage

As mentioned before, more than in other fruits, pomegranates are used for decorative purposes. Therefore the most important criteria for beginning of harvesting is the external appearance, mainly the colour but also the "fullness" of the fruit.

For some reason the sour cvs are red, while the sweet ones are more pinkish or greener. Generally when a cv. starts to be harvested in Israel its eating quality is not good enough. It is improved later on. Fruits of early cvs are harvested selectively, while late cvs are harvested all together.

When harvested, stalkless fruits are arranged in plastic boxes so that the stalk will not damage it's neighbouring fruit. As the fruit crown should be kept unharmed the fruits are put manually on the

weighting plate of the grading machines – avoiding the elevator and singulator parts. After careful observation of external appearance fruits are packed according to size in 2½ kg cardboard boxes for export and around 8 kg for the local market.

When supply is bigger than the demand, and for prolonging the season, fruits can be stored in cold storage. Fruits are kept at 7°C and 90% R.h. Only clean fruits with no insect damage, especially clear of *Cryptoblabes gnidiella* damages, are stored. Fruits damaged by the insect may rot in storage.

Fruits can be easily stored for a period of 3 months. If the stored fruit is not mature, external browning of the rind occurs. Pomegranates can be stored in the ambient conditions for quite a long time. The rind dries and turns brown but the inside grains are kept well.

Needs for the future

In many countries, the pomegranate which is a traditional crop, or a new crop, needs more investment in research and development. In order to base the knowledge on sound ground, such are the needs for fertilising, for irrigation and for other horticultural practices.

More environmentally-friendly plant protection practices have to be developed, as the markets demand cleaner (from pesticides) fruits, than it obtains today.

Better cultivars, of higher internal quality of fruits, have to be cultivated. Standards of quality are needed in the markets.

Cooperation in research, development and exchange of the existing knowledge are some of the first steps towards better production and products.