

Pomegranate cultivation is promising in arid region of Rajasthan

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Pomegranate is an important minor fruit crop of arid and semi-arid regions. It is very delicious fruit widely cultivated for the sweet-acidic taste of arils. Fruits are highly rich in antioxidants, phenols, flavonoids and minerals. In rural areas, it is said that baskets of pomegranate fruits were offered to dear ones suffering from critical illness or any weakness to help them recuperate fast. This fruit has special significance and reputation in India due to its importance in nutraceutical value, high profit earning in per unit area. During the past many decades pomegranate has shown spectacular growth in the area, production and productivity especially in Thar desert region of Rajasthan, India. A dynamic change in pomegranate cultivation in India took place after 1990 onwards; during this area under cultivation was merely 4.6 thousand ha which have up-surged to 1.97 lakh ha in 2015-16 because of new technology as discussed here.

Key words: Arid region, Cultivation, Pomegranate, Promising fruit

POMEGRANATE (*Punica granatum* L.) is an important arid zone fruit crop grown in India. It is an ancient fruit crop believed to be originated in Iran and some adjoining countries. According to the Ministry of Agriculture and Farmers Welfare, the total area and production of pomegranate in India are 1.97 lakh ha and 23.06 lakh tonne respectively, whereas average productivity is 12 tonne/ha. Maharashtra ranks first in total area as well as in total production followed by Karnataka, Gujarat and Andhra Pradesh. Recently it gained popularity among farmers of western parts of Rajasthan. Popularity graph of pomegranate has risen especially in Thar desert like Barmer, Jodhpur, Jalore, Bikaner and Ganganagar districts of Rajasthan. In the production rank, Rajasthan stands on 8th. Arils of pomegranate fruits are rich in anthocyanin and other phenolic compounds. Fruits of pomegranate used to cure leprosy disease due to its antioxidants properties. It is also rich in potassium (K), phosphorous (P), calcium (Ca),

magnesium (Mg), iron (Fe) and vitamins like ascorbic acid, thiamine. Fresh fruits fetch more prices, around ₹ 90 to 140/kg in the retail market. Pomegranate fruit is the symbol of abundance and prosperity and liked by peoples for its cool, refreshing juice and its ornamental nature of the plant which bears bright red, very attractive flowers. Pomegranate is used for manufacturing many processed products like juice, nector squash, *Anardana* which has high demand in the modern market. *Anardana* is widely used in confectioneries, ice-creams and many other food industries. Now-a-days minimally processed pomegranate arils are gaining popularity among consumers.



Fig. 1. Attractive fruits of pomegranate, Bhagwa Sindoori

Commercial varieties

Mridula, Bhagwa, Jyothi, Jalore Seedless, Kandhari, Phule Arakta, Phule Bhagwa Super and Ganesh etc. are major cultivar of pomegranate. Out of these, Bhagwa is most cultivated variety due to its high demand for domestic as well as export purpose. In western arid parts Bhagwa Sindoori is cultivated which has done really well in farmers' field. This is soft seeded, shiny saffron to pinkish and mid-to late ripening



Fig. 2. Pomegranate orchard at Balotra in Barmer district of Rajasthan

variety. In some parts, Kandhari is also grown by the farmers.

RESEARCH AND CULTIVATION

New technology aspects and its post-harvest handling are discussed here.

Climate and soil

Pomegranate plant requires mainly arid and semi-arid climate for successful cultivation, where cool winter and high dry summer enables quality fruit production. The shrub can tolerate frost to some extent and also considered as drought tolerant. It behaves as deciduous and evergreen under subtropical and tropical conditions, respectively. The optimum temperature for fruit development is 38 °C. The region with 500 m above from sea level is best suited for its cultivation. In respect to soil requirements, it can be grown under the diverse type of soils, ranging from less fertile to high fertile land. It can tolerate soil having an electrical conductivity (EC) 9 dSm⁻¹ and sodicity with 6.78 % exchangeable sodium percentage (ESP). But soil having pH range between 6.5 and 7.5 with EC < 2dSm⁻¹ is ideal.

Propagation method

Pomegranate plant can be propagated through hardwood cutting, air layering and tissue culture. Hardwood cutting is easy but it requires protected structure for hardening. Cutting selected from one-year-old tree of 9 to 12 inches (25 to 30 cm) long having 4-5 buds are better for higher rooting and survival. But stem cutting method is not popular among farmers and success rate is lesser in comparison to goottee. Air-layering is most common practice by farmers for

raising new plants. For air layering, 2 to 3 years old plants are selected and air-layered followed by IBA (1,500 to 2,500 ppm) treatment for better rooting. From a single plant around 150 to 200 rooted cuttings can be obtained. Rainy season is best suited for layering. It takes around 30 days for rooting. After 45 days, the layered plants should be detached from the mother plant. Most of the farmers' judge detach time by the colour of roots when it starts to turn brown the layered cuttings are separated. These are grown in polybags and kept for hardening up to 90 days under shade net or greenhouse.

In vitro propagation:

Tissue culture is a rapid technique of multiplication of plants. By this technique, one can obtain diseases free planting material within a short span. If tissue cultured plants become more susceptible to diseases, if don't harden properly. This is skill and cost intensive technique. The tissue culture protocols have been standardized only in few varieties like Ganesh, Mridula and Bhagwa using nodal stem segments of a mature tree.

Pit preparation and planting:

Ninety-days old plants ready for transplanting into the main field in pits. A suitable size of the pit is 60 cm³. Most ideal planting distance followed by farmers is 10 to 12 ft (3 to 3.6 m) between plants and 13-15 ft (3.9 to 4.5 m) between rows. Some farmers maintain a distance of 1.8 to 2.4 m under high-density orcharding, but due to intercultural operations hurdles, it is not feasible. During monsoon, pits are filled with farmyard manure (10 kg), neem-cake (1 kg), single superphosphate (500 g). The optimum time of pomegranate planting is the rainy season (July-August) when ample soil moisture is available for optimum growth of plants.

Manures and fertilizers

Although pomegranate can be grown even in less fertile soil, recommended dose of chemical fertilizers should be incorporated in the pit for better production and

quality of fruits. The dose of manures and fertilizers varies according to types of genotypes, soil fertility, region to region etc. Chemical fertilizers for better growth and development should be given as per following recommendations:

Table 1. Manures and fertilizers management in pomegranate

Manures/ fertilizers	1 year-old-plant	5 year-old-plant
Farmyard manure	50 kg	50 kg
Urea	15-20 g	500 g
Single super phosphate	200-300 g	1-1.2 kg
Muriate of potash	100-120 g	150-200 g

For *Mrig Bahar* fruits, fertilizers should be given during May and for *Ambe Bahar* fertilizers should be given in December.

Foliar spray of micronutrients

Micronutrients such as Zn, Mn, Fe, B, Mo etc. play important role in various enzymatic activities ranging from cell division to respiration, photosynthesis, chlorophyll formation, enzyme activity hormone synthesis, nitrogen-fixation and reduction. Sometimes deficiency of these micronutrients, may lead to major maladies in plants. These also enhance uptake of major elements. Spray 0.4% zinc sulphate + 0.4% boric acid + 0.4% ferrous sulphate to increase in dia of fruit, fruit weight, fruit volume, number of arils per fruit, fruit per cent, number of fruits/plant and yield.

Irrigation

Pomegranate is a drought tolerant fruit crop, which can sustain under water scarcity for some extent. Based on irrigation, crop regulation is decided. Regular irrigation is also important to reduce fruit splitting which is the major disorder of fruits. During winter irrigation should be applied at 10 to 12 days of interval whereas during summer at 4 to 5 days interval. Most of the farmers supplied water through drip irrigation which helps in saving of water and convenient to apply fertilizers. Generally, *Ambe Bahar* is suggested where irrigation facility is available, otherwise, *Mrig Bahar* is

Table 2. *Bahar* seasons in Pomegranate

Particulars	<i>Ambe</i>	<i>Mrig</i>	<i>Hasta</i>
Flowering time	January-February	June-July	September-October
Harvesting time	June-September	December-February	March-April
Fruit quality	Attractive colour and quality	Inferior quality fruits	Very attractive rind with dark-coloured arils
Remarks	Suitable in areas having irrigation facility	Suitable for rainfed condition	Export quality fruits but yield is low

preferred for irrigation.

Training and pruning

It is one of the promising techniques to control vegetative growth and maintain shape and size of trees in such a way so that it can enable proper light penetration in the centre of the tree, ease in cultural operations, spraying and harvesting of fruits. There are two types of training system followed in pomegranate.

(i) In *single stemmed* system, only one main shoot is remained, by removing other shoots, but it is highly susceptible to pests like stem borer and shoot hole borer.

(ii) *Multi-stemmed system*, the bush shape of the tree is maintained by keeping 3-4 shoots/tree at base level. This system is popular and commercially adopted because, even after shoot borer, one shoot may provide yield instead of the complete loss.

Crop regulation (*Bahar* treatment)

Pomegranate also belongs to the group of guava and citrus, whereas three bearing seasons have been observed in India, called *Bahar* seasons viz., *Ambe* (February-March), *Mrig* (June-July), and *Hasta* (September-October), Table 2. So, instead of low yield with poor quality fruits during the whole season, it would better to regulate flowering season, so that desired quality fruits and better production can be obtained. It can be done by withholding irrigation water by two months prior to start desired *Bahar* season, root exposure and by use of chemicals.

Plant-protection

Anar fruit fly or pomegranate butterfly is a major pest, which bore into the developing fruits, feed inside and making fruit susceptible to

fungal and bacterial infection. It can be controlled by bagging young fruits at the early stage with polyethene bags, spray phosphamidon 0.03 % or sevin @ 4 g. Stem borer is another damaging pest. Caterpillar is the damaging stage, making holes on the main trunk and forms networks of tunnels inside it. Feeding on bark during nights and fill it with excreta. It can be effectively managed by plugging the hole with cotton dipped in petrol or kerosene, chloroform, carbon bisulphide followed by covering with mud. Now-a-days bagging of fruits is also practised by the farmers. This helps up to a certain extent and also improves fruit quality.

Bacterial leaf spot or oily spot (*Xanthomonas axonopodis* pv. *punicae*): Recently this disease has occurred as epidemic in Maharashtra, Karnataka and Rajasthan, leads to the reduced export potentiality of the crop to the foreign countries. It is most severe in the rainy season. It is characterized by the formation of small-dark brown water-soaked spots on leaf, twig, stem, and fruits. Cracking can be observed with the shining appearance at a severe stage of infection. It can be measured at some extent by spraying of streptocycline @ 0.5 g/litre and mixing with copperoxychloride @ 2 g/litre on three consecutive days.

Fruit cracking or fruit splitting is one the most severe disorder due the irregular irrigation, boron deficiency and sudden fluctuation in nocturnal and diurnal temperatures, fruits are cracked, which is a common problem in pomegranate. Spraying of boron @ 0.1% and GA₃ @ 250 ppm disease can be minimized to some extent. Besides, maintaining proper soil moisture level; selecting cracking tolerant genotypes are some preventive measures.

Sunburn is also a major problem, if fruits are not harvested at proper

stage. A blackish round spot appears on the upper surface of fruits. It reduces the cosmetic appeal of fruits. Bagging of fruits maintains colour and attack of fruit flies.

Maturity indices, harvesting and yield

Pomegranate is a non-climacteric fruit which should be harvested after proper ripening. It takes 160 to 180 days from flowering to fruit maturity. However, it depends on genotype, climatic condition and growing region. Harvesting of fruits should be done at optimum maturity stage because early harvesting results insipid, immature and improper ripening of fruits whereas late harvesting leads to more prone to the attack of disorders. There are several harvest indices used to assess the maturity and harvesting of pomegranate fruits. Dark rose pink colour should develop on the surface and dark pink aril mostly preferred by the consumers. The calyx at the bottom of fruits gets turn inward side is also a maturity index. Aril should be turned in deep red or pink. Fruits of pomegranate should not be over ripened. Fruits should be harvested with help of secateurs or clippers, because manual twisting may cause damage to fruits in clusters. A good tree can produce up to 12 to 15 kg/plant yield during the first year. From second year onwards, yield from per plant is around 15 to 20 kg.

Postharvest handling

It follows the given steps.

Cleaning and washing:

After harvesting, fruits should be sorted out. Diseased and cracked fruits should be removed and healthy fruits are selected for further treatment. After sorting, fruits should be washed with sodium hypochlorite @ 100ppm followed by tap water. This treatment will be helpful to reduce microbial contamination and to maintain longer shelf-life.

Pre-cooling:

It is an essential operation prior to storage of fruits. It helps to remove vital heat and field heat of produce which results in shelf-life enhancement of fruits. For

pomegranate fruits, the forced air cooling system is used for pre-cooling. The pre-cooling temperature should be maintained around 5°C with 90% relative humidity.

Grading of fruits:

It is an important practice to meet the demand of destination country. Graded fruits are attracting and appealing to the consumers which fetch higher price from domestic as well as international markets. Grading of fruits is done on the basis of shape, weight, size and colour. Pomegranate fruits are generally graded on the basis of their size and weight. However, grading standards are varying country to country.

However, grade specifications as per National Horticulture Board for the export purpose are:

Table 3. Grade size of pomegranate

Grade name	Fruit weight
Super size	750 g
King size	500-700 g
Queen size	400-500 g
Prince size	300-400 g

Packaging

The packaging material is also important to maintain quality and shelf-life of produce. Type of packaging material, size and



Packaging of fruits for market

cushioning material are important which to be considered while selecting a packaging material. Pomegranate fruits are packed in wooden boxes, plastic crates for domestic and local markets.

For the international market, mainly corrugated fibre board boxes are used.

The capacity of the box should be 4 kg or 5 kg. According to AGMARK specifications dimension of boxes are 375×275×100 mm³ for 4 kg capacity box whereas 480×300×100 mm³ for 5 kg box is required.

Storage

Temperature is the most crucial factor for pomegranate shelf-life. As pomegranate fruits are perishable in nature so an optimum temperature is required for long-term storage. The very low temperature may induce chilling injury in fruits. An ideal temperature for storage of fresh

pomegranate fruit is 6° to 7°C and 90 to 95% Relative Humidity. At this temperature, fruits can store up to 3 months.

Transport and marketing

For local and inter-state markets rail and trucks are used for transportation. Export purpose airfreight used as transport. In domestic markets, fruits can sale at a wholesale rate of ₹ 60 to 80/kg fruits whereas in distance market it fetches higher price i.e. around ₹ 90 to 150/kg fruits.

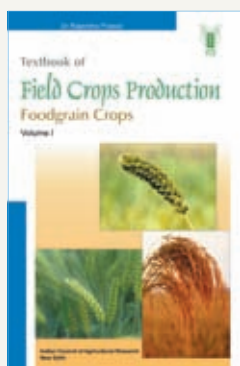
SUMMARY

The present article sums up the prospect of pomegranate in Thar desert. Because of its low cost inputs and high nutritional value, demand of pomegranate has been increased tremendously. Integration of pomegranate cultivation into existing farming system in such undulated and less fertile areas could bring high return and better productivity. It could be a viable option for poor farmers for getting livelihood and nutritional security.

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TECHNICAL SPECIFICATIONS

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