DOI: 10.15740/HAS/AU/12.4/657-665
Agriculture Update
Volume **12** | Issue 4 | November, 2017 | 657-665
Visit us : *www.researchjournal.co.in*
e ISSN-0976-6847

RESEARCH ARTICLE :

Recent advances in the production of pomegranate fruit crop

MADHURI SHRIKANT SONAWANE

ARTICLE CHRONICLE :
Received :
14.09.2017;
Revised :
23.09.2017;
Accepted :
10.10.2017

SUMMARY : India is the world's largest producer of pomegranates produced over 1.31 lakh ha area with an annual production of 13.46 lakh tonnes and productivity of 10.27 t/ha. In spite of this, India exports only 2.55% of its total production. There is a tremendous potential for exports of pomegranate from India. In India, Maharashtra is the main pomegranate producing state. It observed decreasing trend in area, production and productivity since 2009-10 owing to mainly the oily spot infestation and various other reasons. Since 2012-13, an increasing trend is witnessed. In the present study, efforts have been made to present and discuss recent technologies followed in the production of pomegranate fruit crop, various concepts and techniques of growing the pomegranate fruit crop *i.e.* propagation methods, planting systems, flowering and fruiting aspects of crop regulation, training and pruning, stress factors and their management, water and nutrient management, total quality management, etc.

How to cite this article : Sonawane, Madhuri Shrikant (2017). Recent advances in the production of pomegranate fruit crop. *Agric. Update*, **12**(4): 657-665; **DOI : 10.15740/HAS/AU/12.4/657-665.**

KEY WORDS :
Pomegranate, Planting systems, Crop regulation, Training, Pruning

Author for correspondence :
MADHURI SHRIKANT SONAWANE
School of Agricultural Sciences, Yashwantrao Chavan Maharashtra Open University, NASHIK (M.S.) INDIA

BACKGROUND AND OBJECTIVES

International scenario :

The pomegranate is thought to have been first cultivated in Iran about five to six thousand years ago. Historic knowledge and growing research on the health benefits of pomegranates have inspired its cultivation from Iran (*i.e.* its native region) to Northern India as well as throughout the Mediterranean regions of the USA, Africa and Europe. Iran is the world's largest producer and exporter of pomegranates with an estimated annual production of 670,000 tons, In addition to Iran, other countries including India, Turkey, Spain, Tunisia, Morocco, Afghanistan, China, Greece, Japan, France, Armenia, Cyprus, Egypt, Italy and Palestine also cultivate this product.

Although, the exact figures of area and production in the world are not available but as per approximate global estimates (Table 1), pomegranate production is around 20.55 lakh tonnes from an area of 3.00 lakh ha. At the global level, India is the world's largest producer of pomegranates (743.1 thousand tonnes) followed by Iran (650 thousand tonnes), Turkey (218 thousand tonnes), USA (100 thousand tonnes) and; Afghanistan and Spain (60 thousand tonnes each) during 2011-12. During 2013-14, it was produced over 1.31 lakh ha with an annual production of 13.46 lakh tonnes and productivity of 10.27 t/ha in

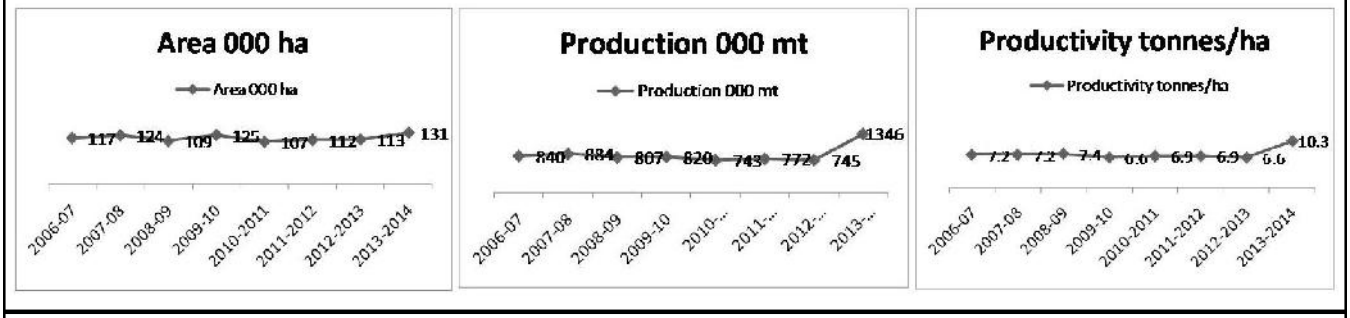

Fig. A : Area, production and productivity of pomegranate (NHB database, 2008-14)

India (Vision 2050, 2015)

Export of pomegranate has upsurged from 6303 tons in 2002-2003 to 21,670 tons in 2006-2007. This is more than 300% increase in exports from India. Actually there is tremendous potential for exports of pomegranate from India. This is evident from the fact that Spain exports about 75% of its estimated production of 1,20,000 tons, whereas Iran exports about 20% of its estimated production of 1,20,000 tons and India exports only 2.55% (21,670 tons) of its total production of 8,49,100 tons. This is inspite of the fact that India is leading producer of pomegranates in the world. Moreover, India produces finest edible quality pomegranates which are available almost throughout the year. The major markets of India's pomegranate during the year 2011-12 were UAE, Bangladesh, Netherlands, UK, Saudi Arabia and Russia.

National scenario :

The pomegranate is a common table fruit and is very much liked for its refreshing juice which has a high medicinal value. Pomegranate (*Punica granatum* L.) belonging to the family Punicaceae is a favourite table fruit of tropical and subtropical regions. The fruit is native of Iran.

India is the world's leading producer of pomegranate. The total area under pomegranate in India in 2012-13 was 113 thousand hectare and production was 745 thousand tonnes with productivity of 6.6 metric tones/ hectare. The total production of pomegranate is concentrated mainly in the Western Maharashtra, Karnataka, Andhra Pradesh, Gujarat and to a smaller extent in Rajasthan, Tamil Nadu and Himachal Pradesh.In India, production share of pomegranate was 0.9 % in 2012-13. (NHB database, 2013)

In India, pomegranate is commercially cultivated in Maharashtra followed by Andhra Pradesh, Karnataka, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Tamil Nadu, Punjab and Haryana. The prominent pomegranate producing districts in Maharashtra are Solapur, Nashik, Sangli Ahmednagar, Pune, Dhule, Aurangabad, Satara, Osmanabad and Latur. Maharashtra state accounts for 54.8 % of total production of the country. Among different states, Maharashtra is the main pomegranate producing state where the area under pomegranate cultivation is about 78000 ha with the production of 4.08 lakh tonnes and productivity as 5.2 tonnes/ha.

Objectives :

Following are the objectives of this study

– To review various concepts and techniques of growing pomegranate fruit crop.

– To discuss the various technologies related advances in the production of pomegranate fruit crop.

RESOURCES AND METHODS

This is descriptive study based on secondary data. Various research journals, books, websites and various reports which is related to technologies followed for advances in the production of pomegranate fruit crop, various concepts and techniques of growing the pomegranate fruit crop *i.e.* propagation methods, planting systems, flowering and fruiting aspects of crop regulation, training and pruning, stress factors and their management, water and nutrient management, total quality management, etc were studied to draw the conclusions.

OBSERVATIONS AND ANALYSIS

In this paper different concepts related to technologies followed for advances in the production of

pomegranate fruit crop, various concepts and techniques of growing the pomegranate fruit crop *i.e.* propagation methods, planting systems, flowering and fruiting aspects of Crop regulation, training and pruning, stress factors and their management, water and nutrient management, total quality management, etc are discussed as follows.

Recent advances in pomegranate propagation :

Pomegranate plants raised from seed vary widely and are undesirable. Therefore, they must be raised vegetatively. Among the vegetative methods of propagation, cuttings are universally used for raising pomegranate plants on commercial basis.

Cuttings :

Pomegranates can be propagated from soft- wood or hardwood cuttings. Hardwood cuttings are the preferred means of propagation, but softwood cuttings collected in early fall can be used with varying degrees of success. A tree from a hardwood cutting will bear fruit in year two after planting, while it will take at least three years from seed. Trees will reach matu- rity in five to seven years, and can live upto 200 years.

For hardwood cuttings, remove approximately 10 inches of one-year wood in late fall or early winter. Cuttings should be approximately ¼ to ½ inch in diameter, or about the same width as a pencil. Suckers from the base of the plant or from the interior of the canopy often make some of the best wood for cuttings. Cuttings can be propagated either in a pot containing a modified soil or soilless media or directly in ground, spaced about a foot apart in a nurs- ery row. Stick the cuttings, leaving only 2 to 3 inches of the top of the cutting exposed. It is preferable to have at least three nodes un- der the surface. Rooting hormones, mist bed and root zone heating (75°F) will increase the success rate but are not required. Allow the cuttings to grow for the season. The following spring, transplant the cuttings bare root into the orchard at proper spacing.

Saroj *et al.* (2008) studied two types of cutting, *i.e.* hardwood and semi-hardwood with five concentrations of IBA, *i.e.* 50, 100, 200 as prolonged dip and 2,500 and 5,000 ppm as quick dip (5 min.). Among various concentrations of IBA, 2,500 ppm has given best response in term of rooting and number of roots/shoot in semi-hardwood cutting. The number of roots/shoot was maximum at 2500 ppm in both type of cutting but length of roots reduced with increasing concentrations of IBA. From this investigation, it is concluded that July is the best time for planting of cutting under mist system by using both semi-hardwood and hardwood cuttings after treating with 2,500 ppm IBA. This treatment (IBA 2,500 ppm) also induces fibrous root system, which is essential for better establishment of plants under field conditions.

In an experiment conducted by Singh *et al.* (2009) to study the influence of planting time and IBA (Indole Butyric Acid) on rooting and vegetative growth on cuttings of pomegranate 'Ganesh' during the year 2007-2008, it was observed that treated cuttings were synchronized with better root formation and shoot growth potentialities. Moreover, IBA 100 and 2000 ppm were found to be most efficacious in encouraging rooting and invigorating shoot growth. The cuttings treated with IBA 100 ppm (slow dip) and 2000 ppm (quick dip) planted in the month of January exerted positive effect with regard to sprouting percentage, rooting percentage, number of roots per cutting, longest root, root weight, plant height and shoot girth.

Damar (2013) in his investigation found that most of the shoot and root characters of cuttings were significantly influenced by the different treatments of biofertilizer as well as growth regulator as compared to control. But the combination of PSB and 2000 ppm IBA was found best for maximum rooting, growth and success of pomegranate cuttings followed by combination of *Azotobacter* and 2000 ppm IBA.

Air- layering :

Air –layering (Gooti) is also a successful method. Application of 1000 ppm IBA with lanolin paste at the upper side of the ring and covered with moist moss grass and white polythene gives better rooting in air –layers. Layering is more successful during the rainy season. The layers can be separated after about 30-90 days and are set in the nursery for proper root development before planting in the field. This method is commercially used in Maharashtra for large scale multiplication of plants.

Tomar (2011) conducted field trials during 2005-06 and 2007-08 at Research Orchard of Horticulture, College of Agriculture, Gwalior to study effect of different concentrations of IBA and NAA on rooting and survival percentage of pomegrante (*Punica granatum* L.) air layers in sandy clay soil. The study revealed that growth regulator IBA is better than NAA. and IBA with 2000

ppm is best for successful propagation of pomegranate air layers.

Tissue culture :

Attempts for developing tissue culture method indicated successful callus formation with different explants such as root, stem, shoot tips and leaf segments. Shoot proliferation, elongation and rooting could be achieved using shoot tip and nodal segment explants and the hardened plantlets showed 50 % survival in mist chamber.

Naik *et al.* (1999) has outlined a rapid and efficient procedure for *in vitro* clonal propagation of an elite cultivar of pomegranate (*Punica granatum* L. cv. GANESH) using nodal stem segments of a mature tree. Murkute *et al.* (2004) studied an *in vitro* regeneration in pomegranate using shoot tip and nodal segment explants from selected mature pomegranate trees. They obtained shoot proliferation on MS basal medium supplemented with BAP 1.0 mg l^{-1} + NAA 0.5 mg l^{-1}. The elongated shoots were separated and subcultured for rooting individually on half-strength MS basal medium supplemented with 0.5 mg l^{-1} either NAA or IAA. The plantlets were transferred to vermicompost + soil mix (1:1) and were hardened in mist chamber with 50% survival.

Singh *et al.* (2013) observed maximum percentage establishment of cotyledonary node explants on Murashige and Skoog (MS) medium + 1.0 mg/l 6-benzylaminopurine (BAP) + 0.5 mg/l naphthalene acetic acid (NAA). The maximum frequency of multiple shoots in cotyledonary explants (86.33 %) was observed on treatment MS + 1.0 mg/l BAP + 1.0 mg/l kinetin + 200 mg/l activated charcoal. *In vitro* rooting of regenerated shoot was found in half strength MS medium supplemented with 0.5 mg/l NAA + 200 mg/l activated charcoal, which recorded the maximum number of root/shoot (4.17) and root length (3.87 cm).

Planting systems :

High density planting :

Generally, pomegranate plants are planted in a square or hexagonal system. Pits of 60x60x60 cm size are filled with 20-25 kg of FYM or compost, 1 kg of super phosphate and good soil mixture. The plants are planted at a distance of 6m x6m. In square system and will accommodate 275 plants per ha. In deeper soils the planting distance can be reduced to 5mx5m. The best time of planting pomegranate in Northern India is dormant period *i.e.* January to mid February and in south India during monsoon season.

Planting density is the most important yield contributing factor which can be manipulated to attain the maximum production per unit area. The optimum spacing is important for the maximum utilisation of land and good income over a long period. At MPKV, Rahuri it was observed that as the plant density was increased, yield per hectare also increased without affecting fruit quality.

A density of 1000 plants per ha gave 2-3 times higher yield and 2.44 times more profit as compared with normal plant population of 400 plants per ha. It was also recommended that for higher yields for the first four to five years after planting, a distance of 5x2 m may be adopted and alternate plants may be removed afterwards maintaining a planting distance of 5 x 4 m. The cultivar Ganesh can be planted at the distance of 3x3m and Kandhari at 4x4m apart. However, at present high density should be avoided to control diseases and pest problem. In some parts of Maharashtra, it is planted at close spacing of 4.5 x 3.0 m., 3x 2.5m., 4x2m.

Haneef *et al.* (2014) conducted a trial on four-year-old pomegranate plants of cv. BHAGWA growing under high density planting system (2 m × 2 m) with four fertigation levels, *i.e.*, 50, 75, 100 and 125% recommended dose of fertilizers and three drip irrigation levels, *i.e.*, 50, 75 and 100% on pan evaporation basis. It is concluded that 125 per cent RDF markedly enhanced vegetative growth, yield contributing characteristics, yield and leaf N, P and K contents along with minimum acidity. Similarly, drip irrigation (100%) at alternate day significantly increased vegetative characteristics, yield characteristics, quality characteristics and, leaf N, P and K. Based on statistical analysis of vegetative characteristics it is inferred that the treatment combination comprising 100 per cent recommended dose of fertilizers (RDF) and drip irrigation 100 per cent at alternate day (I2F2) resulted in higher profitable yield (net return Rs. 5,96,177 ha^{-1}) with quality fruits.

Flowering and fruiting :

In evergreen pomegranate cultivars, the flower buds of the spring flush are borne on mature wood of one year old shoot, whereas, the flowers which appear during

July –August are borne on the current year's growth between July and August. The flowers are found mostly in clusters either terminally or in axils of the leaves. The inflorescence is cyme and due to heavy drops of secondary and tertiary buds they appear to be solitary in clusters.

In western India, three flowering seasons *i.e.* Ambe Bahar (January –February), Mrig Bahar (June-July) and Hasta Bahar (September-October) have been reported. Ambe bahar is most commonly favoured by the growers because of high yield consequent to profuse flowering. In Punjab, only one flowering season is observed from April to June. In Bihar, flowering occurs twice, once during February –March and again during July-August. In Karnataka, flowering was observed in July-August, March and September. The flowering period extended for 80-87 days in first flowering and 22-30 days in second and third flowering. The flowering period of different cultivars is also quite variable. Heterostyly is common in pomegranate flowers.

The time of dehiscence of anther varied in different cultivars and no general sequence was found in the time of anthesis. The stigma was receptive one day before anthesis and remained receptive for upto 5 days. The percentage of pollen grains that germinated was over 90 in most of the cultivars. After open pollination fruit set was highest in cultivar Dholka (63.8 %), Bedana (63.0%)and Kali Shirin (62.7%). After self-pollination fruit set was appreciably lower.

Aspects of crop regulation :

Pomegranate exhibits tendency to flower throughout the year resulting in scattered fruiting, which is not preferable in commercial cultivation. Plants are, therefore, forced to flower and produce fruits in particular seasons by adopting certain techniques. This can be achieved by withholding of water for about 60 days in advance of normal flowering, root exposure and also by using chemicals like spray of urea (10%).

Although, pomegranate plant may be induced to bear fruit in any of the season, ordinarily, only one bahar should be taken from a tree. The period of withholding of irrigation depends upon the type of soil. In light rocky soils, stress of 30 days would be sufficientin medium soils it may extend to 40-45 days while in heavy /deep soils sometimes it requires stress of 60 days or even more.

Three distinct flowering seasons are preferred in this crop.

Flowering in June- July :

This is called as Mrig-Bahar coinciding with break of monsoon. This is practised in areas of water scarcity during hot weather. Watering is withheld from December to April –May leading to suppression of growth, shedding of leaves and dormant stage of plants. Manures and fertilizers are applied following light and heavy irrigations twice at weekly intervals. Within a fortnight plants will produce profuse growth subsequently leading to flower and fruit formation. Harvesting falls from October to December. As the fruiting coincides with the onset of monsoon, therefore, this bahar is not recommended for commercial fruit production in areas having clear monsoon phase. However, in areas like Bangalore, and Deccan Plateau where water is scares during hot weather, mrig-bahar crop gives good yield.

Flowering in February-March :

In areas with enough water availability during hot weather, harvesting during June- July can be planned called as Ambe – bahar. Here plants shed leaves in October – November. Manuring is done in December-January followed by irrigation and in February flowers appear and in June- July fruits become ready for harvest. As the fruiting coincides with hot and dry summers, therefore, this crop is not economical in North India. In Southern India, however, the areas having assured irrigation, ambe bahar crop produces good yield.

Flowering in September-October :

Hast - bahar is the third type of flowering pattern in pomegranate in which plants stay dormant during August –September, flower in September – October and harvest coincides with January –February.

Mrig-bahar is the most advisable pattern to be induced in arid and semi-arid regions with limited resources. Plants start bearing in about four years after planting and by tenth year onwards a stabilised yield can be expected. Economic life of tree extends for about 25-30 years under good management conditions.

Pomegranate is a non- climacteric fruit and should be harvested when fully ripe. Fruits become ready for harvest in about 4 to 41/2 months after fruit set. Maturity indices are colour change to yellowish red, suppression of fruits on sides, distinct sounds of grains cracking inside

when slightly pressed and closing of calyx at distal end of fruit. Harvesting is usually done by hand plucking of individual fruits.

Supe *et al*. (2015) investigated effect of different chemicals on leaf shedding of pomegranate 'Bhagwa' with four treatments *i.e.*, ethrel at 2.0 ml/l, thiourea + di-ammonium phosphate at 10 g/l, propenophos at 5 ml/l and control (water spray). The data revealed that early leaf shedding (6.60 days) was observed due to spraying of ethrel at 2 ml/l and was statistically at par with spray of thiourea + di-ammonium phosphate (10 g/l of water each) and propenophos (5 ml/l) 6.80 and 7.00 days, respectively. Maximum number of female flowers was observed in ethrel treatment (95.40). Maximum fruit set was observed in ethrel spraying treatment (71.00%). The number of fruits/tree (94.95), average weight of fruit (263.74 g) and yield (25.05 kg/tree) were found highest due to spraying of ethrel (2 ml/l). The fruit sample of ethrel at 2 ml/l and propenophos at 5 ml/l treatments analysed from pesticide residue point of view revealed that the treatment ethrel at 2ml did not show any detectable level of residue in harvested fruits, whereas, the treatment of propenophos at the time of leaf shedding showed detectable level which is below maximum residue level.

Training and pruning :

Training:

Pomegranate may be trained as multistemmed tree or single stemmed tree

Multistemmed tree :

Pomegranate is bushy in growth habits and thus produces considerable number of shoots from the base,which create crowding and may lead to infection by insects such as shoot borers. In this method, 3 to 4 stems are retained at hill and remaining shoots are removed, this will give a bush form look to the tree.

In Maharashtra the growers prefer multistemmed training by retaining all stems. But yield has not been found to be affected by number of stems per plant. If one stem is affected by shoot borer, by removing that shoot, the plant can be saved.

Single stemmed tree :

The single stem upto 30 cm is left by removing all the side shoots at the time of planting. The main stem is headed back at a height of about 1 meter results in the formation of branches. Four or five well distributed branches on all sides above 60-70cm from the ground level are allowed to grow. In the third year of planting, one can maintain desired shape of pomegranate.

Single stemmed tree has tendency to produce less number of shoots. Also, when trained on single stem, the fruiting area goes too high making it difficult to spray the trees, harvest fruits and protect from bird damage.

Pruning :

Pomegranate does not usually require pruning except for removal of suckers, dead and diseased branches and developing a sound framework of the tree. It is essential to remove the suckers as soon as they arise. The fruits are borne terminally on short spurs produced all along the slow growing mature wood. These bear fruits for three to four years therefore only a limited pruning of bearing tree is required. Annul pruning in winter during dormant period should be confined to shortening of the previous season's growth to encourage fruiting.

Chakma (2014) carried out investigation on the effect of different orchard management practices on the growth, productivity and rejuvenation of declining trees of pomegranate (*Punica granatum* L.) cv. KANDHARI KABULI". The results of the present investigation revealed that among different pruning intensities in the first experiment, the best results in terms of shoot extension, fruit retention, fruit size, fruit weight and fruit physico-chemical qualities were in fruits from shoots with 15 cm fruiting shoot length retained. However, maximum fruit set was recorded in control and it decreased with increasing pruning intensity. The pruning treatments also proved beneficial in controlling bacterial blight on fruit and leaf surface upto some extent.

Stress factors and their management :

Fruit cracking :

It can be observed at any stage of development. Fruit cracking is a serious problem of pomegranate. The malady is thought to be due to boron deficiency in young fruits while in developed fruits it is caused due to variation in soil moisture content and atmospheric humidity. At the time of ripening, if the soil becomes too dry and then irrigate heavily or there is unexpected rains, cracking may occur.

Cracking is correlated with rind thickness. Some

cultivars like Gule Shah, Bedana, Khog and Jallor seedless are comparatively tolerant to fruit cracking. For checking fruit splitting in pomegranate regular irrigation to maintain soil moisture a desired level planting windbreak around the pomegranate plantation, spraying of calcium compounds or 0.2 % borax or 250 ppm GA3 on young fruits are reported to minimize fruit cracking.

Mulching with organic materials like sawdust, paddy husk or with black polythene sheet is found useful. Spraying anti transpirants like kaolin (10%), power oil (1.5%) and liquid paraffin (1%) are found beneficial for better productivity.

Khadivi-Khub (2015) in his work reviewed genetic, morphological, environmental and physiological aspects of fruit cracking. He observed that under the same environmental conditions, fruits from different cultivars show differences in cracking susceptibility. Some correlations have been observed between susceptibility of fruit cracking and some fruit traits (fruit shape, fruit size, fruit firmness; anatomy and strength of the fruit skin, stomata in fruit skin, cuticular properties, osmotic concentration, water capacity of the fruit pulp and growth stage of the fruit). Also, orchard management (such as irrigation and nutrition) and environmental condition (such as temperature, wind and light) can influence fruit cracking. Besides, fruit cracking is quantitative trait and is controlled by several genes. The best way to reduce fruit cracking at present would be a suitable orchard management that takes into account and try to minimize stress of the water, nutrition and physiological factors that contribute to fruit cracking. Also, the most resistant cultivars to fruit cracking that have desirable fruit quality can be selected for cultivation.

Blackening of arils :

Apparently the mature fruit looks good and intact, but after opening some arils in particular segment or hole of root is found brown or black and giving foul smell in advanced stage. Initially there is a loss of pigment from aril, arils become soft and shrivelled and turn brown and finally black.It is a complex caused by genotypes, season of fruiting, soil fertility, imbalance of nutrients and stage of maturity. The incidence is more in ambe bahar. Incidence occurs 90 days after anthesis and intensity increases if fruits are retained after 140 days. Hence, harvesting between 120 to 135 days after fruit set is recommended. The exact cause for this malady is unknown even now.

Bacterial leaf and fruit spot :

It is caused by *Xanthamonas campestris var. punicae.* It occurs in comparatively humid areas. Typical irregular water soaked spots of light brown to dark brown color appear on leaves and fruits. Affected fruits become unmarketable due to their poor appearance. Collection and destruction of fallenleaves and fruits and three sprays with 500ppm pausha mycin +2 % copper oxychloride at 15 days interval starting from the initiation of the disease significantly reduce the incidence.

Water and nutrient management :

Irrigation :

The newly set plants require regular irrigation so that the roots become well established and the plants can start the growth. After the plants are well established ,in about six months, they can stand considerable amount of drought and irrigation may be given at intervals of 2-4 weeks depending upon the soil, climate, weather conditions and intercrops grown. However, during summer, irrigate the plants at an interval of 10-15 days. Regular irrigation is essential from flowering to ripening of fruits as irregular moisture conditions results in dropping of flowers and small fruits and may cause cracking in mature fruits.

Drip irrigation is the preferred method. Overhead irrigation is not advisable as it will increase the spread of field pathogens and may also result in reduced fruit set because the flowers are highly sensitive to humidity and

Table 1 : Fertilizer schedule recommended by MPKV, Rahuri

Age of the tree	Fertilizer dose (g/plant)		
	Nitrogen	Phosphorus	Potassium
1yr.	125	50	50
1and half yr. -2 yrs.	250	125	125
2 and half yr. -3yrs.	500	125	125
3 and half yr. - 4 yrs.	500	125	250
4 and above	625	250	250

moisture. Excessive soil moisture in the summer can lead to an abundance of vegetative growth, but the fruit produced will tend to be softer, resulting in poor postharvest quality.

Parvizi and Spaskhah (2015) investigated the effect of different drip irrigation strategies including irrigating one side of trees with 50% and 75% of ETC (DI50, DI75); irrigating alternate sides of trees with 50% and 75% of ETC (PRD50, PRD75), and full irrigation (FI) that received 100% ETC and three prevalent fertilizers type including manure (M), chemical (CF) and foliar (FF) fertilizers on quality of pomegranate fruit in a semi-arid area. Results showed that the values of measured attributes varied from 64.4 to 71.2% in aril, 28.8 to 35.6% in peel, 49.0 to 55.7% in juice percentage, 1.055–1.064 g cm^{-3} in juice density, 12.4 to 15.7 in maturity index (MI), 1.14 to 1.53% citric acid in titratable acidity (TA), 17.5 to 19.2 °Brix in total soluble solids (TSS), 10.8 to 12.3 mg per 100 ml of juice in vitamin C and 3.12 to 3.26 in pH. On average, PRD strategies increased the juice percentage, MI and decreased the TA in comparison with FI while the results of DI strategies were in contrast to PRD. Furthermore, higher level of water stress (PRD50 and DI50) increased the TSS and decreased the vitamin C in comparison with other irrigation strategies. Among the irrigation strategies, PRD50, PRD75 and DI75 strategies is recommend due to the positive impact on fruit quality attributes; however, it is important to consider the negative effect of PRD50 on fruit yields. For fertilizer types, the fertilizers including microelements (M and FF) are preferred in comparison with CF (including NPK). Based on the results, correct harvest maturity and ripening for pomegranate fruit can be determined when TA is reached lower than 1.32% citric acid, MI is increased to higher than 13.95 and TSS is greater than 18.25°Brix.

Manuring :

In case of young plants, manuring should be done just before the start of monsoon. The one year old tree should be manured with 10 kg FYM, 125 g nitrogen, 50 g phosphorus and 50 g potash. The dose is increased every year by the same rate so that after 5 years, a yearly dose of 625 g nitrogen, 250 g phosphorus, and 250 g potash is applied to each tree besides the basal dose of 50 kg organic manure (Table 1).

Nitrogen is applied in two split doses one at the time of first irrigation in spring and the second after three weeks of the first application whereas full dose of phosphorus and potash are applied once along with the first dose of nitrogen. Organic manure should be applied 20-30 days before the first irrigation.

Micronutrition is also important in pomegranate. The micronutrient deficiencies of zinc, iron and boron can be overcome by two foliar sprays of zinc sulphate (0.06%), ferroussulphate (0.4%) and borax (0.2%), respectively. These can be applied separately or in combination during flowering and fruit set.

Conclusion :

The pomegranate is thought to have been first cultivated in Iran about five to six thousand years ago. India is the world's largest producer of pomegranates. Moreover, India produces finest edible quality pomegranates which are available almost throughout the year. In India, pomegranate is commercially cultivated in Maharashtra and accounts for 54.8 % of total production of the country.

In this paper different concepts related to technologies followed for advances in the production of pomegranate fruit crop, various concepts and techniques of growing the pomegranate fruit crop *i.e.* propagation methods, planting systems, flowering and fruiting aspects of crop regulation, training and pruning, stress factors and their management, water and nutrient management, total quality management etc are discussed.

It can be concluded that for best quality production of pomegranate, various recent advances should be taken into consideration. High planting density planting may be adopted with proper canopy management, integrated nutrient and water management, Keeping proper load of fruits on the tree, using disease free and quality plant material of improved cultivars along with timely control of pests and diseases by adopting IPM practices

REFERENCES

Chakma, J. (2014). Effect of different orchard management practices on the growth, productivity and rejuvenation of declining trees of pomegranate (*Punica granatum* L.) cv. KANDHARI KABULI. M.Sc. Thesis, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.) India

Damar, D. (2013). Effect of growth regulators and biofertilizers on survival of pomegranate (*Punica granatum* L.) stem cuttings. M.Sc. Thesis, Rajmata Vijayaraje Scindia Krishi Vishwa

Vidyalaya, Gwalior (M.P.) India.

Haneef, M., Kaushik, R.A., Sarolia, D.K., Mordia, A. and Dhakar, M. (2014). Irrigation scheduling and fertigation in pomegranate cv. BHAGWA under high density planting system. *Indian J. Hort.*, **71**(1): 45-48.

Khadivi-Khub, A. (2015). Physiological and genetic factors influencing fruit cracking. *Acta Physiologiae Plantarum*, **37**(1): 1

Murkute, A.A., Patil, S. and Singh, S.K. (2004). *In vitro* regeneration in pomegranate cv. GANESH from mature trees. *Indian J. Hort.*, **61**(3): 206-208.

NHB (2013). Indian Horticulture Database - 2012. National Horticulture Board, Ministry of Agriculture, Govt. of India. pp. 8. http:// www.nhb.gov.in

Naik, S.K., Pattnaik, S. and Chand, P.K. (1999). *In vitro* propagation of pomegranate (*Punica granatum* L. cv. Ganesh) through axillary shoot proliferation from nodal segments of mature tree. *Sci. Hort.*, **79**(3–4): 175-183.

Parvizi, H. and Sepaskhah, A.R. (2015). Effect of drip irrigation and fertilizer regimes on fruit quality of a pomegranate (*Punica granatum* (L.) cv. Rabab) orchard. *Agric. Water Manage.*, **156** : 70-78.

Saroj, P.L., Awasthi, O.P., Bhargava, R. and Singh, U.V. (2008). Standardization of pomegranate propagation by cutting under mist system in hot arid region. *Indian J. Hort.*, **65**(1):25-30.

Singh, B., Singh, S. and Singh, G. (2009). Influence of planting time and IBA on rooting and growth of pomegranate (*Punica granatum* L.) 'Ganesh' cuttings. *ISHS Acta Hort.*, **890**: II International Symposium on Pomegranate and Minor – including Mediterranean - Fruits: ISPMMF2009. DOI:10.17660/ ActaHortic.2011.890.24

Singh, P., Patel, R.M. and Kadam, S. (2013). *In vitro* mass multiplication of pomegranate from cotyledonary nodal explants cv. GANESH. *African J. Biotechnol.*, **12**(20): 2863-2868.

Supe, V.S., Joshi, V.R., Patil, S.D. and Attar, A.V. (2015). Effect of different chemicals on leaf shedding of pomegranate 'Bhagwa'. III International Symposium on Pomegranate and Minor Mediterranean Fruits. DOI:10.17660/Acta Hortic., 2015.1089.61

Tomar, K.S. (2011). Effect of different concentrations of growth regulators on rooting and survival percentage of pomegranate air layers. *Prog. Agric.*, **11**(2): 431-433.

Vision (2050, 2015). Indian Council of Agricultural Research, New Delh.