**Pomegranate tree**

Pomegranate (*Punica granatum* L.) is one of the oldest known edible fruits and is capable of growing in different agro-climates ranging from tropical to temperate regions of the world. However, its major cultivation is confined in tropical and sub-tropical regions. It is presumed that pomegranate was domesticated in the Middle East about 5000 years ago. Interestingly, it is considered to be one of the first five domesticated edible fruit crops along with fig, date palm, grape and olive. The scientific name is derived from the name (apple) (grainy) or seeded apple. Pomegranate belongs to Punicaceae family. Despite this, its cultivation was limited and considered as a minor fruit crop in several countries including India.

Evidences are available that pomegranate originated in Iran and its surrounding areas. Long back, it was cultivated in ancient Egypt, in early Greece and Italy, and Iraq. Over time, it spread to Asia (Turkmenistan, Afghanistan, India, China etc.), North Africa and Mediterranean Europe. Domestication process of pomegranate might have started independently in various regions during different periods. Ancient sailors and traders introduced it in Greece and the areas surrounding the Mediterranean Sea, as far west as Spain and Portugal and then to the New World. According to an estimate pomegranate was introduced into India and China over the Silk Route.

Pomegranate is cultivated throughout the world in different micro-climatic zones of sub-tropical and tropical regions. However, the best soils for pomegranate cultivation are considered to be fertile, rich with humus, deep, medium density having good drainage, especially alluvial (silty or grainy) soils can produce the best quality fruits with good color development. Pomegranate is a light loving plant and reacts negatively to excessive shading. But direct sunlight and considerable heating often causes harmful effect on fruits leading to sun-burns. The optimal conditions for pomegranate cultivation include high insolation. However, best quality fruits are produced in arid regions having a long, hot and dry summer. It can easily withstand temperatures up to 45-48°C in combination with dry hot winds.

**Orchard establishment**

1. **Planning :** Establishment of an orchard is long term investment and hence needs thorough planning. Well drained land with moderate slope (3-5%) should be selected for establishment of an orchard. There should be no water stagnation in the orchard. A well laid out internal network of main, cross roads and paths is essential for efficient movement of workers and machinery. The farm should have adequate electricity supply with assured irrigation facility. Required numbers of buildings including office, implement shed, go down-cum-store, packing shed, pump houses etc. should be constructed at convenient locations preferably in the center to ensure sufficient supervision and watch and ward.
2. **2- Planting system, spacing, pit-digging and time of planting**:

As f a r a s p l a n t i n g s y s t e m i s concerned square or rectangular planting system can be followed. Planting distance should be decided depending upon soil type, soil depth, climatic condition and variety Pits of 1 m x 1 m x 1 m or 0.75 m x 0.75 m x 0.75 m are dug at a spacing of 4.5 m x 3.0 m, especially for cv. Bhagawa depending upon soil type and depth. This can accommodate about 740 trees/ha

**3.Staking:**

just after planting some support is required to keep the plant straight and to bear the load of growing shoots as the branches and stem tend to break due to strong wind. 75 cm to 1 m long bamboo or wooden sticks should be used for staking. And tie the plant at one or two places with coconut or jute strings to avoid bending and breaking of the plant.

Pomegranate is a shrub or small tree that tends to develop multiple trunks and has a bushy appearance. Depending upon variety and agro-climatic conditions, it can grow up to 5 m. However, in natural condition it grows up to 7 m. Even dwarf and semi-dwarf varieties of pomegranate. Most of the varieties are deciduous and in Deccan Plateau, the trees are evergreen or partially deciduous. Though, some evergreen varieties shed their leaves in higher elevations and colder climate. The young branches from the vegetative growth of the recent years are numerous and thin.

**Flowering and fruiting behavior:**

The flowers may be solitary (single) or grouped in twos and threes at the ends of the branches. Generally, cross-pollination occurs by insects that increases the fruit set. However, wind pollination has insignificant role. Flowering time varies according to geographical situation and cultivars. In tropical climate, pomegranate flowers almost throughout the year whereas in subtropics, it flowers once a year. Under tropical condition, flower bud differentiation takes place at varied times. Time span between the start of the flower bud elongation and anthesis varies between 14 to 28 days depending on the variety and climatic conditions. But, in subtropical climates of the northern hemisphere, flowering occurs from the last week of March till the second week of May. In subtropical central and western India, there are 3 distinct seasons of flowering.

**Application of manure and fertilizer in nonbearing trees**: Recommended dose of manure and fertilizer should be applied to nonbearing trees (1-3 years) in three split doses coinciding with growth flushes during January, June and September. The manure and fertilizer s h o u l d b e a p p l i e d i n s h a l l o w trenches/small pits at 30-45 cm away from the main stems below the tree canopy at 8-10 cm depth and it should be covered immediately after application.

**Application of manure and fertilizer after fruit harvest:** The plants are exhausted to a considerable extent after fruit harvesting. Then it becomes necessary to promote vegetative growth by proper pruning and nutrition. Hence, after harvesting of the crop, pruning and nutrient application should be done with the aim to encourage vegetative growth that will help accumulation of sufficient reserve material in the plant system for better flowering, fruiting and development of the fruit in the next season. Thus, 1/3 recommended dose of manure and fertilizer along with neem cake 0.5 kg,vermi-compost 1 kg and calcium ammonium nitrate 50 g/tree should be applied just after pruning in shallow circular trenches (8-10 cm depth) at 45-60 cm (depending upon the age of the tree) away from the main stems; cover with top soil and provide irrigation.

**Water management**

Although pomegranate enjoys heat and thrives well in arid and semi-arid areas, it still needs regular irrigation throughout the dry season to get optimal yield and fruit quality. However, at the same time it is sensitive to even slight water deficit or excess water that affects tree growth adversely. In fact, from commercial point of view, it should not be considered as a drought tolerant plant and irrigation should be scheduled so as not to stress the plant. The most sensitive phase of a plant growth cycle occurs during pollination and fertilization; it is critically important not to incur water deficits in these phases. Further water deficits, at fruit maturity and ripening stages, will likely result in splitting of fruits and such fruits will be unsuitable for the fresh market. Therefore, irrigation management is highly essential in pomegranate in order to get higher yield and better fruit quality.

Physiological disorders and their management Among the abiotic disorders, fruit cracking, sun scald/sunburn and internal breakdown or blackening of arils are very common in pomegranate. These disorders are associated with several factors like environmental, edaphic, nutritional, hormonal, varietal, cultural etc.

1. **Fruit cracking and splitting**: This is a general phenomenon in fruit crops that fruits are splitted or cracked. However, cracking is a general term applied to certain physical disorders of fruits that are expressed as fractures in cuticle or skin. These fractures may be microscopic or easily seen, sometimes extending deep into inner flesh as well defined cavities. Splitting is an extreme form of cracking in which the cracks penetrate deep into the flesh. As high losses as 75 % have been reported in pomegranate. Cracks or splits provide open wounds that facilitate rapid moisture loss and excessive shriveling, which lowers fruit quality and storage life. Fruit cracking occurs in practically all pomegranate growing areas but degree of crop loss varies in different regions. As high as 63 % cracking has been reported in pomegranate in the spring crop (January-June), 34 % in the winter crop (October-March). Apart from biotic fruit cracking caused by bacterial blight, it is also associated with improper irrigation, environmental factors and nutritional deficiency, especially boron, calcium and potash. Besides, high temperature during the drought period causes desiccation of the plants and consequently the fruit skin become hard and less elastic. The cracking is more evident when the fruits are at maturity stage.
2. **Sun scald**: pomegranate fruits are damaged owing to high solar radiation. In case of sun scald (sunburn), the fruit skin turns brown or bronze color. Generally, the fruits facing sunlight are more affected during April to June by solar radiation. And fruit surface temperatures that causes sunburn are reported to vary between 41°C and 47.5°C. However, in Israel early cultivars such as Akko and Shani-Yonay are noted to be less susceptible to sun burn. Usually, high temperature along with excessive light, drought, and low relative humidity are responsible for sun scald injuries. However, sun scald damage on fruits can be reduced by proper training and pruning.
3. **Internal breakdown:** Aril browning or blackening (internal breakdown) is a common phenomenon in pomegranate varieties. The arils become brown and somewhat flattened rather than plumb. Even, the aril color development is arrested and flavor is abnormal. The fruit is apparently healthy but after cut open its arils look abnormal (brown or blackish). It originates commonly during growth in some seasons. The incidence of browning increases with increase in weight of fruit from 150 to 200 g (26.60%) to more than 350 g (60%). Chemical analysis of pomegranate fruit revealed that TSS, acidity, ascorbic acid, total sugars, reducing sugars, calcium, phosphorus and the enzyme catalase were low whereas non reducing sugars, starch, tannins, nitrogen, potassium, magnesium, boron, polyphenoloxidase and peroxidase enzymes were high in affected arils than in healthy ones.

**Fruit maturity and harvesting**

In general, the fruit ripens 5-8 months after fruit set, depending on the variety. Most of the pomegranate varieties reach full ripeness between 125 and 180 days after flower opening in different agro-climatic conditions. Pomegranate fruit has a typical characteristic of non-climacteric fruits. Thus, in order to ensure the best eating quality, the fruit should be picked at the fully ripened stage. The major maturity indices in pomegranate are TSS, acidity and fruit color. Generally, sweet varieties contain acidity below 1 % while sweet-sour ones 1-2 %. Thus, based on these maturity indices fruits can be harvested. Time of harvesting influences the storage life of fruits. In order to have better fruit quality and prolonging shelf life, the fruits should be harvested either early in the morning or in the evening hours with the help of clippers from the base of the fruit.