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Problem and Prospects of Temperate Fruit Crops Cultivation in Pulney Hills of Tamil Nadu

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Abstract: India is the second largest producer of fruits next to China and productivity is significantly low as compared to otherdeveloped countries. The majority of the temperate fruit crops and nuts are being cultivated in the north-western Himalayan, north eastern and small areas are lies in upper pulney hills in Tamil Nadu. High altitude and temperate regions are capable to produce high yield and good quality fruits. But the foothill where the chilling is insufficient adversely affects the yield and quality. In India, majority of the temperate fruits were introduced from other parts of the world and some are indigenous to India like walnuts and wild apple species. Therefore, the improvement of the temperate fruits and nuts were taken place mainly through introduction of promising varieties. The exotic species and cultivars are still the backbone of fruit production in India particularly for apple, pear, peach, plum and cherry. Recently, several varieties have been developed in India in apple, peach, plum, apricot, cherry and walnut from varies institute like CITH, Srinagar, SKUAST-K, SKUAST-J in Union territory of Jammu and Kashmir, PAU, Ludhiana, GB Pant University, Pant Nagar, UP and TNAU, Tamil Nadu. The potential of these cultivars are immense for commercial exploitation.

Keywords: low chilling cultivar, pollinizer, pollinators, spur, fruitfulness, alternate bearing

INTRODUCTION

India is the second largest producer of fruits (81.29 million tonnes)and cultivating in an area of 6.99 million hectares (Anon. 2017). Apple and walnut represent major crops of temperate fruits covering about 52% and 23% of the total area and accounting for 79% and 5.44% of temperate fruit production respectively; while rest came from other fruits like pear, peach, plum, almond, apricot, etc. According to the FAO (2017) the productivity scenario in India is very low among temperate fruits including apple (7.42 t/ha), pear (7.86 t/ha), peach (7.13 t/ha), plum (8.40 t/ha), apricot (2.80 t/ha), almond (0.58 t/ha) and walnut (1.01 t/ha). The cause of low productivity is mainly associated with monoculture, old and traditional varieties, senile /sick orchards, non-availability of high quality cultivar spectrum (narrow varietal base), non-availability of quality planting material of elite varieties on clonal and standard seedling roots stocks, poor diversification with new emerging early, mid and late cultivars, low rejuvenation and phased replacement of senile orchards, incidence of biotic and abiotic stress, rainfed cultivation etc.

Kodaikanal is a town in the hills of Dindigul district in the state of Tamil Nadu. The Kodaikanal is 7200 feet above sea leveI. It is situated on a plateau above the southern escarpment of the upper Palani Hills at 2,133 metres between Parappar and Gundar valleys. The study area namely Kodaikanal region covering the whole of Kodaikanaltaluk is located between 10°7′56″ N latitude and 10°26′ and 77°15′ East and

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77°42' East longitude. Kodaikanaltaluk falls in the jurisdiction of Dindigul district. The taluks that bound Kodaikanaltaluk are Palani (North) Dindigul, Nilakottai (East), Periyakulam (South) and Kerala state (West).

These Research and Development institutions attempted several improvement work involving programmes like introduction of new varieties, clonal selection, bud mutation, hybridization and biotechnological tools. Keeping in view the strength and the weaknesses of the horticulture sector in the temperate region and to overcome the bottlenecks of low productivity, the following crop improvement programs played a significant role in the transformation of horticulture leading to livelihood security. Several strategic attempts have been made in the improvement of temperate fruit and nut crops.

In this regards, efforts have been made for temperate fruit crop improvement in India and abroad taking in account important objectives. The broad objectives for improvement of temperate fruit and nut crop is relatedto higher yield; good appearance and eating quality; resistance to important diseases and pests; good storage and shelf life; climatic adaptation and frost resistance; fruit quality (fresh and drying purpose); late blooming (almonds); increased fruit size; increased flesh-to-pit ratio (stone fruits); low chilling requirement for subtropical areas; control of tree size and vigor; extending seasonality; resistance to cracking in cherry (Janick and Moore, 1996; Ghosh *et al*., 2015a; 2015b). Fruit crop improvement is a complex process and need several systematic approaches to achieve the goals. Therefore, it is being carried out through various strategic methodologies.

Breeding objectives of temperate fruit crops

Purposeful genetic improvement of fruit crops through various techniques through including introduction, selection, hybridization, mutation and molecular techniques. (Janick, J. 2011a) Its origin trace to the domestication process in prehistory and antiquity, where useful species were chosen and cultivated and improved by continuous selection. Early beginning of fruit breeding technology can be demonstrated in strawberry and pear. The following points to be considered while doing temperate fruit crop breeding

Higher yield

Good appearance and eating quality

Resistance to important disease and pests

Good storage and shelf life

Climatic adoption and frost resistance

Fruit quality (Fresh and drying purpose)

Late blooming

Rootstock for Temperate Crop Production

Apple trees can be propagated either from seeds or from clonal rootstocks.Apple trees can be easily grown from seeds and such trees are called seedling trees. The apple seeds is formed by a cross pollination of the flowers of two different compatible varieties. The fertilized seed inherits the genes of its parents. There can be many gene combinations and the resultant characteristics of the tree from these seeds can be highly variable. Thus the fully grown tree may have all the good qualities or all the bad qualities or a combination of both, of its parents. Therefore, such a tree can be highly productive or a poor yielder. Even the fruit of such trees is not true to type and may show a wide variation, even from year to year. Fruit of such trees may have no resemblance to their parents and it is possible that a tree grown from the seed of a red apple may produce a yellow or a green apple. Such fruit are called seedling fruit.

To ensure that an apple trees produces fruit of a particular variety, it is necessary to graft the one year old seedling with the wood of the desired variety. This grafting wood known as scion is grafted about 15-30 cm above the ground and the part below grafting point usually inherits the characteristics of the tree on which the seed is obtained. Over the centuries, apple tree have been grown by propagating its seed and grafting or budding the seedling. To facilitate further propagation, new methods of growing tress vegetatively, rather than from the seed, were evolved. The rootstocks which are multiplied from the vegetative parts of the trees, are called clonal rootstocks. Since they are produced from a part of the parent plant, they inherit all

the characteristics and traits of the parent and hence do not show any marked variations. These rootstocks also need to be grafted or budded with the scion wood of the desired variety. Most of the available research on rootstocks is generally based on European agro-climatic conditions. These trees may not behave in the same manner when grown in India, where the agro-climatic conditions are different. However, some of the these stocks have been tried in India and a very limited amount of data is available. But since this is very inadequate, an urgent need for rootstocks research remains.

Description of Rootstocks : A good rootstock must have a good anchorage, be easy to propagate, should not sucker, be resistant to crown rot, and other pest and diseases. It should be able to take up micro-nutrients from the soil easily. It should fruit early, and produce consistently heavy crops. The tree should not be very large and should have well spread out branches. Last, but not the least, it should be tolerant of prevailing weather conditions. All these qualities cannot yet be found in any one rootstock. Table 1. Shows the comparative performance of different rootstocks

Advantage of seedlings: The root system of seedling trees is well spread out. It is capable of going deep into the soil and spreading over the vast area. This tree has excellent anchorage and is likely to withstand both strong winds and a heavy load of crop or snow. It is also capable of drawing moisture and nutrients from much wider and deeper layer of the soil, and hence can withstand drought better than clonal rootstocks, particularly those which have restrictive rooting. The tree is hardier and requires less care than the trees on not so vigorous clonal rootstock. There is also the added advantage that tree on seedling rootstocks require less attention,

Comparative advantages of clonal rootstocks

Size of tree: Seedling trees show a great variation in size as the seeds have been taken from apple whose parentage is not known. Since the seeds may be from different trees, the trees planted on seedling rootstock have different sizes. This often leads to either large of empty spaces in the orchard or trees which crowd into one another; neither of which condition is desirable. The clonal rootstocks, on the other hand, will be generally of a standard size as they have inherited all the characteristics of the mother plant. This can enable the farmer to plan its orchard properly and ensure that there is no overcrowding or unnecessary wastage of space.

Tree behaviour: The productivity and bearing age of the tree on a seedling rootstocks cannot be adapted. One tree on a seedling may give consistently excellent crops with very good fruit quality, whereas another tree on a similar seedling plant may crop pooly. On the other hand, the characteristics of the clonal rootstocks are known and these characteristics remain true to type. Table 1. Compares the horticultural characteristics of some rootstocks with reference to the age of bearing (Prococity index), productivity with reference to consistency and quantity of production (Production index), root anchorage, the propensity to produce suckers, the ease or difficulty in propagation, their compatibility with the scion wood grafted on them and the quality of wood, that is, whether it is weak or brittle and break easily or is strong. Seedling rootstock is known to have good anchorage, not brittle and easy to propagate.

Response to climatic factors: Every rootstock responds differently to various agro-climatic conditions in the region. It is essential for the grower to know the resistance or susceptibility of the rootstocks to the local climatic and soil condition to enable him to take the correct investment decision. Rootstocks susceptible to water logging or wet feet, should not be planted in region experiencing heavy monsoon rains. Table 2.Compares the response of different rootstocks to climatic factors. Seedlings are generally, moderately resistant to winter injury and drought.

Resistance to disease: Seedling rootstock may or not be resistant to certain diseases and insects. The resistance or susceptibility of clonal stock is known and therefore, only those rootstocks are planted in a given region which are likely to succeed. Table 3.Gives the resistance or susceptibility to some disease and insects. The clonal rootstocks have the greatest advantage in that they are tailored to the needs of an individual orchardist.

Interstocks

The use of double grafted trees or interstock is being tried in many apple growing areas of the world. Interstocks is a means of dwarfing a tree without relying solely on rootstock. The normal technique is to graft a vigorous, very vigorous or seedling rootstock with the wood of a dwarfing stock during the first year. During the following year, the scion wood of the desired variety is grafted on to the first graft, thereby getting a double-worked tree. A typical example would be the grafting of an interstock of M9 on seedling rootstock in the first year, followed by a graft of Red Delicious during the second year. This will produce a double grafted tree.

Table 1: Temperate fruit and nut crop rootstock

Crop	*Rootstocks*	*Salient features*
Apple	EMLA 111/ MM 111	Suit to drought prone areas
	EMLA.7/ M-7	Suit to sloppy, virgin lands, semi vigorous
	EMLA.106/ MM.106	Suit to sloppy, and less clay soils, semi vigorous
	EMLA 9/M9	For high density planting with assured irrigation and deep fertile soils, very dwarf
	M 779	For hilly areas of Uttarakhand and H.P.
Pear	Quince-A	Standard rootstocks ,semi vigorous
	BA .29C	Standard rootstocks ,semi vigorous
	Quince - C	Very dwarf
	Quince - B	Semi vigorous
Apricot	Apricot seedling	Vigorous, drought tolerant and compatible
	Peach seedling	Suitable for dry and light soils
Peach	Peach seedling	Vigorous and compatible
	GF-557 &GF-677	Drought tolerance
	Siberarian-C* Rubia	Dwarf
Plum	Wild peach × Apricot seedling	Seedling are vigorous
	Myrobalan-B, Myrobalan-29C, Myrobalan-GF-31, Marigona-2621, GF-8/1	Clonal and semi vigorous, compatible rootstocks
	Pixy × St. Julian. K	Dwarfing rootstocks
	Peach ×Apricot seedlings	Semi vigorous
Cherry	Colt	Semi dwarf
	F-12/1	Vigorous
	Mazzard and Mahaleb	Vigorous
Almond	Apricot, peach and almond seedlings	Vigorous
	Peach and almond hybrids GF-557 × GF-677	Semi dwarfing, good for high density
Walnut	Walnut seedlings	Vigorous

Unfruitfulness in Apple Production

Trees in a particular orchard do not bear any fruit even though they are old enough to do so. In such circumstances, it is necessary for the grower to identify the cause of their unfruitfulness and then take corrective measure. The reason for unfruitfulness may be any one or more of the following:

1. Sufficient pollinizers are not available close to these trees. Consequently effective cross pollination cannot take place.
2. The trees are getting excessive nitrogen resulting in a very vigorous growth. This prevents them from setting down to bearing fruit.
3. The trees may be starved of nitrogen. This may promote heavy flowering but the trees will not have the energy or nutrients to set the crop.
4. The trees have been trained or pruned to an upright shape, with the branches growing vertically. Consequent low carbohydrate accumulation in the branches prevents the formation of fruit buds.
5. The pruning system adopted by the grower is defective. He may be pruning large quantities of old wood on which fruit buds are formed. He may also be retaining water shoots or vertical branches instead of horizontal branches.
6. The pruning may be heavy, prompting the tress towards vegetative growth and consequent failure to bear fruit.
7. The trees may be growing in a shady area or may be overshadowed by tall wild

trees. This continuous shade hinders the formation of fruit buds.

Once the grower has indentified the reasons for the trees failure to set fruit, he can remedy it by increasing or with-holding nitrogen, correcting the pruning techniques, ringing the tree or by providing pollinizers.

Biennial or alternate bearing:

Alternate bearing is a condition with which the Indian apple grower is well conversant. The apple trees bear a very heavy or bumper crop one year, and a poor crop the following year. The years are generally referred to as the On year and the Off year. In a year of heavy crop, the production is high, yet the size of the apples is small and the prices low, giving low net returns to the farmer. On the other hand, in an off year, the prices are high but the production, at times, is so low that the farmer cannot even recover the orchard management expenses or satisfy his personal needs. It is a vicious circle which confronts a large number of growers in India. It is, therefore, essential to correct biennial bearing whenever it occurs.

In some apple varieties, biennial bearing is a basic characteristic. These varieties, like Pippins, Golden Delicious etc., have an inherent tendency to bear fruit in alternate years. This habit can be slightly changed but not fully cured. On the other hand, varieties like Red Delicious do not have the basic characteristic of bearing in alternate years, but can become alternate bearers by force of circumstances. In the latter case, it is comparatively easy to correct this condition.

The apple trees go into an alternate bearing habit due to crop failure during any year because of unfavourable weather conditions. The low crop leaves the tree with adequate energy and nutrition to form a large number of healthy fruit buds for the following year. During the second year, with a very large number of fruit buds, the tree is likely to set a very high crop. This high crop consumes all the energy and the nutrients, leaving little for fruit bud formation and consequent flowering for the third year. Secondly, the high concentrations of gibberellins produced by apple seeds inhibit flower bud formation. This cycle goes on repeating endlessly.

This condition in apple trees can be corrected by the following methods

1. By applying a heavier dose of nitrogen in the 'on' year.
2. By heavier pruning during the winter prior to the 'on' year. This will reduce the number of lower buds and growing points and decrease the nutrients requirement. The lower nutrient requirement for the remaining flowers and fruit will leave the tree with some surplus to initiate flower bud formation for the following year.
3. By thinning the crop to a reasonable level either by chemical thinning or by manual removal of fruits. The reduced crop will require lesser nutrients and enable the formation of reasonable number of fruit bus.
4. By ensuring good cross-pollination in an off year, by placing more bees in the orchard, by hanging bouquets of pollinizer blossoms, or by hand pollination

By following the above methods, it is possible to reduce the incidence of alternate bearing. The growers must be careful to avoid alternate bearing on pollinizer varieties because the lack of sufficient pollinizing blossoms will necessarily make the year an 'off' year for the entire crop.

Fruit drops

Fruit drops are a common phenomenon with which the fruit growers are as familiar in India as anywhere else. In apple there are generally four drops combined into two drop periods. The first periods starts shortly after petal-fall and continue for two or three weeks. The second drops, commonly known as June drop, starts in late May or early June and completed by the end of June. These drops have a set pattern and are generally uniform from year to year, even under different weather conditions. It is considered to be a hereditary characteristic of the variety. In some varieties, the first drop is heavier than the others, whereas in other varieties, the opposite is true. The Red Delicious group of apples tend to

drop more fruit during the first drop than during the seconds or June drop. June drop, however, seems heavier as the fruit size is bigger and more apparent to the grower.

Factor affecting fruit drops

A number of factors, in addition to hereditary characters, influence the fruit drops. Most of the fruit that falls soon after fruit set is that in which adequate number of seeds have not been formed because of poor cross-fertilization of the flowers. Effective cross pollination, therefore, can reduce the extent of the drop.

Reason for fruit drop may be the flower may have not developed properly; pollen in the anther did not develop completely or anther failed to dehisce; the flower may have been missed by a bee; the stigma were not receptive; the stigma surface may have been saturated with the wrong kind of pollen; the pollen may have failed to germinate; the pollen germinated, but the pollen tube was defective or only grew part way down the style; the embryo sac was not entered; the nuclei of the embryo sac were not at the right developmental stage to be fertilized.

Defoliation of, or heavy damage to, the basal leaves, which feed the fruitlets can also increase the drop. The reduced leaf surface cannot manufacture the food for the full requirement of the fruits. Sudden drops in temperature, or very low temperatures, soon after fruit set, can kill the fruitlets which are very tender, and cause heavier drops.

June drop, or the late shedding of apples, probably occurs because of the competition for nutrients among the fruitlets on the tree. This causes the weaker fruit to fall down. If weather conditions are ideal for the growth of the fruit, it increase the competition between the fruits. In such a case the June drop can be quite heavy. It is, perhaps, possible to reduce the extent of June drop by judicious fertilization and pruning and meeting the nutrients requirements of the trees. These practices may only reduce the extent of June drop but cannot control it fully.

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