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Ultra high density planting of mango in Telangana: Prospects and problems

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Abstract

Ultra high density planting (UHDP) (4 x 2 m) aims to make maximum use of land to achieve high yields in the entire life of orchard along with ease in its management. This system warrants adoption of certain important technologies like formative pruning in the initial years so as to have desirable plant architecture, proper canopy management annually to encourage vegetative growth immediate after harvest, stopping of the vegetative growth during September to favour fruit bud initiation and differentiation. Further, adoption of drip irrigation system so as to replenish the loss of moisture through evapo-transpiration and providing nutrients at required quantity at appropriate doses through fertigation technique are highly essential to get higher yield with quality fruits. Thus, it is imperative that once in Telangana UHDP is adopted; the related technologies like formative pruning to develop proper plant architecture and annual canopy management are to be followed regularly. Besides, providing optimum irrigation through drip to replenish moisture loss through evapo transpiration and proper fertigation practices to provide balanced vegetative growth and fruiting, are highly essential so as to get higher yield of mango in Telangana.

Keywords: Mango, Telangana, UHDP, canopy management, planting density, fertigation

Introduction

The area under mango in India is about 2.25 million ha with a production of about 21.8 million t. registering an average productivity of 9.7 t ha⁻¹ as against a higher productivity of 30 t ha⁻¹ in Israel. The area under mango in Telangana is about 1.15 lakh ha with a production of about 10.8 lakh t. registering an average productivity of 9.31 t ha⁻¹ as against a higher productivity of 12.05 t ha⁻¹ in Andhra Pradesh (Anon 2018). The main reason for low productivity can be attributed to poor orchard management including water and nutrient management, wider tree spacing with dense canopies, experiencing poor sunlight interception, lack of proper ventilation encouraging more pest and disease incidences. Thus, adoption of Ultra High Density Planting (UHDP) system with proper canopy management practices coupled with drip, fertigation system is highly essential to increase the productivity (Kumar 2013) ^[4]. High density planting makes maximum use of land to achieve high yields in the entire life of the orchard along with ease in its management. Although HDP in mango has been successfully demonstrated in the research institutes in India (Majumdar *et al.* 1982, Ram and Sirohi 1999, Ram *et al.* 2001) ^[7, 8, 9], Kumar, 2019 ^[5] when this technology was implemented in the field by the farmers, many problems were encountered as the farmers did not follow all the aspects related to the HDP system. In this paper, the prospects and problems in adopting the UHDP in Telangana are discussed besides the related aspects to be followed in UHDP.

Ultra High Density Planting System

Planting of fruit trees rather at a closer spacing than the recommended one using certain special techniques with the sole objective of obtaining maximum productivity per unit area without sacrificing quality is often referred as High density planting or HDP. This technique was first established in apple in Europe during sixties and now majority of the apple orchards in Europe, America, Australia and New Zealand are grown under this system. High density planting aims to achieve the twin requisites of productivity by maintaining a balance between vegetative and reproductive load without impairing the plant health.

The underlying principle of high density planting is to make best use of vertical and horizontal space per unit time and to harness maximum possible return per unit of inputs and national resources. In India during 1970s, the vitality of this technology has been proved in an array of fruit crops like Apple, plum, peaches, pineapple, banana, papaya and citrus etc.

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but not in evergreen crop like mango. However in Uttarakhand, Pantnagar and IARI, New Delhi they did some basic work but it was also not perceived in the context of maintaining the canopy system.

Mango, the King of the fruit is our Indians mostly liked seasonal fruit and its average productivity is about 6.5 tonnes/Ha, but in a country like Israel which has introduced mango from India and nearby South East Asian countries and are presently able to get 30 tonnes/Ha. There are many reasons for this productivity gap like very poor orchard management, no irrigation facilities, wider spacing like 40ft, plants are having very dense canopy, poor sun light penetration to all branches, poor ventilation, higher pests and disease incidence etc. all these causes to poor productivity. In this background only if we take up measures against above the yield and productivity will be improved.

Strategies to enhance productivity

Poor orchard management practices particularly water and nutrient management can be altered by Drip and fertigation system. Similarly wider spread, senile orchard with dense canopies can be managed by High Density Planting with proper canopy management practices.

Mango growth pattern

In Mango under North Indian conditions due to subtropical, temperate climate and winter checks the mango growth will results limited growth that's why canopy management not very much required. But under South Indian conditions due to tropical climate, we observe continuous growth and put forth 2-3 flushes in a year hence very much canopy management is essential under UHDP. If we go for UHDP, drip fertigation and canopy management are essential and are interrelated.

Planting material

For UHDP, only soft wood grafted planting material is suitable and formative pruning and annual canopy management as well as drip fertigation essential. In UHDP system >10times increased number of plants per unit area than conventional or normal mango planting. Soft wood grafted mango with at least 3 flushes is ideal for planting for UHDP system. If we go for planting of too young (i.e before 3 flushes) or too old (i.e 1-2 year old) will results failure of UHDP because they may not give good response to early pruning and training.

Planting

Field experiments conducted at TNAU to study the different systems of planting in mango cv. Kalepad revealed that the double hedge row system of planting with a spacing of 10 m between double hedges, 5 m within double hedge and 5 m between plants in double hedge (200 plants ha⁻¹) is the best planting system for obtaining maximum number of fruits and the highest yield per unit area. (Jasmine *et al.*, 2009). In South India, under tropical condition, several researchers tried different UHDP methods with different spacing like 3X1m with 1349 plants/acre, 3X2m with 674 plants/are and 4X2 m with 500 plants and all methods are good in terms of yield but for in the sake of maintenance like weeding, use of implements, inter cultivation with small tractor i.e partial mechanization allows only in 4X2m spacing with 500 plants/acre, hence recommended for commercial cultivation. Even in Telangana also State Horticulture Department and Centre of Excellence, Mulugu has started recommending HDP with 4 x

2 m spacing for all commercial varieties.

Varieties recommended for Telangana under UHDP

In India more than 1000 mango varieties are there, however among these Baneshan, Imam Pasand, Alphanso, Dasherri and bangalora are recommended for South India under UHDP because these varieties can responded to repeated prunings and also while pruning there should not attack of any pests and diseases. Ratna, Kesar, Mallika, Amrapali varieties are also recommended for UHDP of Northern Telangana area. As the Cultivation Practices are very intensive, high value varieties are recommended.

Land preparation and planting method

Normally for mango planting we recommended 1m X 1m X 1m size pits at recommended spacing. But in case of UHDP, to make it very easier, better go for trench method i.e alternatively one meter deep and one meter wide trench can be prepared at every four meter, with the help of JCB, as it is more convenient, good for establishment and growth. The pits should be allowed to wither for some weeks before filling with mixture of planting media. The media consists of 40-50 kg native soil, 0.5- 1.0 kg Single Super Phosphate (SSP), 0.25 kg Neem cake, 20 kg compost or 10 kg vermicompost and 50g Carbofuran granules. Even we can use black polythene mulch over the raised bed before planting.

Training and Pruning

Canopy management is essential in ultra high density planting system to control size of the tree and also to strike a balance between vigour and productivity. It starts from early months from planting

1st training

When the plant height reaches 45-60 cm, the terminal bud should be pinched at 5-6 cm below the apex to encourage growth of auxiliary buds and is done usually 4 months after planting. After the growth from auxiliary buds 3-4 healthy, vigorous shoots are to be retained in different directions at 15-20cm interval which will develop as primary branches.

2nd training

After 3 months of 1st pruning the primary branches grows to a height of 60-70cm. At these stages go for cutting of primary branches at a length of 35-40cm from the base below the whorl. After cutting, from that heights each primary branch may produced many number of new shoots/ branches but remove all and retain only 2 healthy branches. These newly retained 2 healthy branches called secondary branches.

Number of secondary branches = 3 primary branches X 2 = 6 Secondary branches/plant. Or if we retain 4 primary branches then = 4 primary branches X 2 = 8 Secondary branches/ plant.

3rd training

After 3-4 months of 2nd training the secondary branches grows to a height of 60-70 cm. At these stages go for cutting of secondary branches at a length of 35-40cm from the base below the whorl. After cutting, from that height each secondary branch may produce many numbers of new shoots/ branches but remove all and retain only 2 healthy branches. These newly retained 2 healthy branches called tertiary branches.

Number of tertiary branches = 6 secondary branches X 2 = 12 tertiary branches / plant. Or if we retain 4 primary branches

then = 8 Secondary branches X 2 = 16 Tertiary branches / plant.

By this training plant which has got minimum 12 branches or maximum of 16 branches which may be act as framework of entire plant and from these subsequent branches will be produced that we have to maintain periodically. The point from which mango leaves aroused called whorl. Always pruning should be done below whorl not above the whorl.

Ultimately the tree row will form a dome shaped hedge. In many orchards, improper training especially the formative pruning resulted in overcrowding of branches resulting in more incidences of hopper, powdery mildew and anthracnose disease etc.

Pruning

Pruning is very essential and critical operation of HDP or UHDP to maintain fruiting shoots and contain the canopy. Once the tertiary branches produced we have to start pruning for fruiting i.e 2-3 months after 3rd training by cutting of tertiary branches at the length of 35-40cm for the multiplication of shoots. If we are not done this tertiary branches will produce only 2-3 shoots which will end with panicle/inflorescences. By this pruning each tertiary branch will produce many number of shoots with panicle/inflorescences will results more panicle/inflorescences / unit area.

All the 3 trainings and pruning also facilitate to entry of sun light in to the centre of the tree otherwise harbor many pests and diseases. Within 2-3 years plants reach to a height of 5-6 feet with full of flowers. All fruits are produced at reachable height hence harvesting is very easy, labour can pluck the fruits compare to conventional method where labour can climb and harvest the fruit and drop on the ground results mechanical damage. Colour, size and quality of fruit is very good because of proper exposure to sun light. Spraying and other intercultural operations are very easy.

Under the UHDP system it will start bearing by third year onwards and depending up on variety we can allow 35-40 fruits / tree, if more fruits are there go for fruit thinning. If we follow this method a fruit yield of 2.5tonnes/ acre at 4th year, 6 tonnes/ acre in 5th year, 7.2 tonnes/ acre in 6th year, 8 tonnes/ acre in 7th year and 10 tonnes/ acre in 8th year and average yield of India is 2.4 tonnes/acre so there is a possibility of quantum jump of 3-4 times higher yield in this system.

Pruning techniques

Pruning must be completed as soon as possible after harvest preferably before 15th June in Telangana. Tertiary branches have to be headed back in such a way that the plant height can be maintained at 1.5 m and having 10-15 tertiary shoots. Excess tertiary shoots have to be thinned out to avoid overcrowding. About one month after pruning, thinning of newly emerged shoots is essential to avoid excess shoots and overcrowding. On each tertiary shoots 3-4 new shoots are to be maintained. Dried panicle along with 2-3 leaves and dried shoots / branches must be removed at the time of pruning. All these new shoots will end with panicles in the subsequent year. After 5 years need not go for typical pruning of individual shoot which was very difficult and so just use pruning saw go for pruning to level of 5 feet only i.e 50 percent of shoots receive normal pruning and immediately after pruning Cut ends to be pasted with Bordeaux paste or 2% Copper Oxychloride (COC) suspension to all pruned shoots against fungal diseases. As manual method of heading

back of the shoots is a laborious one under large scale, mechanical means to prune the mango tree is to be developed (Kumar *et al.* 2013)^[4].

Level of pruning: Removal of 30 percent growth of the past season (brown colour) is called as light pruning. Removal of 50 percent past year growth is called annual back pruning. These two may be done in alternate years we can easily maintain canopy in UHDP.

Nutrient and water management

The success of mango production under HDP or UHDP also depends upon proper Nutrient and water management.

Irrigation management

The critical component of UHDP technology is the management of inputs: irrigation water and fertilizer. These two are provided through drip irrigation system i.e fertigation. In Telangana, mango is not considered as an irrigated crop. In the event that UHDP gets acceptance from Telangana mango growers in order to enhance productivity and income it is imperative that they should adopt drip irrigation, wholly and not in parts. The quantity of water per tree also varies with age and season.

Through this exact volume of water needed by the plant is delivered at regular intervals to the root zone. Only the root zone is wetted and rest of the field will remain dry. Plant nutrients are supplies with irrigation water to the root zone. In case of mango through drip fertigation we can save water up to 50 percent, fertilizer upto 30 percent and even saving of power and labour too. For mango water requirement is standardized to all ages of mango plants, approximately 1st year 1 litre of water, 2nd year 2-3 litre of water, 3rd year 8-9 litre of water and during bearing period around 15 litre of water /day/plant (Table.1). Water is also very important for mango under UHDP system. For the bearing trees (3rd year onwards) irrigation to be given during September 3rd week to October to induce flowering. The rainfall events are very erratic and therefore not adjusted on a daily basis. The general recommendation is that if rainfall exceeds 10 mm in any one day, suspend drip irrigation for the next 2 to 3 days. The online drip system is found to be more suitable for Mango. The drip laterals are spaced at the relevant row spacing. Each tree is provided with one dripper of 4 L h⁻¹ during initial two years and 2 drippers of 4 L h⁻¹ from 3rd year. When 2 drippers are installed they should be placed 45 cm away from the trunk (Anon 2015)^[1].

Table 1: Irrigation Requirement for UHDP Mangoes

Month	Evaporation (mm)	Litres/Day/Plant			
		1 st Yr	2 nd Yr	3 rd Yr	4 th Yr onwards
January	4.60	0.63	2.53	5.69	10.12
February	5.90	0.80	3.21	7.21	12.82
March	7.29	1.00	4.00	8.99	15.98
April	6.69	0.89	3.55	7.99	14.21
May	7.54	0.94	3.76	8.45	15.03
June	7.45	1.01	4.05	9.12	16.21
July	7.47	1.03	4.11	9.24	16.43
August	7.84	1.09	4.35	9.78	17.39
September	7.78	0.96	3.84	8.64	15.35
October	4.74	0.55	2.21	4.97	8.83
November	3.84	0.59	2.35	5.28	9.39
December	3.90	0.58	2.33	5.25	9.33
Average	6.02	0.93	3.73	8.39	14.92

Fertiliser requirement

In conventional method of mango cultivation, fertilisers applied in two split doses i.e June –July and October – November. But under UHDP fertilisers are rationalized over the entire growing season. Fertiligation schedule is in such a way that fertilisers are applied almost 9-10 months per annum which results high fertiliser use efficiency and very good yields. For UHDP plants we recommended each plant should receive 120g N, 75g P, 100 g K along with 15 Kg FYM/year/plant at the age of 5th year onwards (Table.2). These fertilizers are spread across different seasons for a mature mango tree in June to August we have to give 12 weeks, in September 4 weeks and in January to March 12 times and just

before harvest we will stop fertigation i.e April –May months (Table.3). Based on this, Jain Irrigation Systems Limited recommends the following fertigation schedule for UHDP mangoes (Soman 2009) ^[10].

Table 2. Fertiliser recommendation for UHDP mango

Age	g/tree			FYM Kg/ Tree
	N	P	K	
1 st Yr	35	15	25	5
2 nd Yr	45	25	50	5
3 rd Yr	75	50	75	10
4 th Yr onwards	120	75	100	15

Table 3: Fertigation schedule and quantity (Kg/dose/acre) for mango

Age	Month	No. of doses (Weekly once)	Urea	H ₃ PO ₄	MOP	MgSO ₄
1 st Yr	July-Sept	12	1.4	0.5	0.8	0.000
	Jan-May	20	1.7	0.6	0.9	0.000
2 nd Yr	July-Sept	12	2.7	1.5	2.3	0.278
	Jan-May	20	1.6	0.7	1.4	0.167
3 rd Yr	15 June-Aug	12	4.5	2.3	3.5	0.555
	September	4	1.4	1.2	3.1	0.000
	Jan-May	20	3.2	1.2	1.5	0.333
4 th Yr onwards	15 June-Aug	12	7.2	3.5	4.6	0.833
	September	4	2.2	1.7	4.2	0.000
	Jan-March	12	5.1	1.7	3.2	0.833

Management practices to ensure regular bearing in mango

Normally after harvest, in the first week of June we have to prune the tree and then in July to part of September (nearly 3 months) encourage vegetative growth. In the second fortnight we have to arrest the vegetative growth, converted to reproductive shoots, flower bud by applying Paclobutrazole (PBZ). This PBZ arrests synthesis of Gibberelic Acid (GA). If GA production is there in growing shoots, automatically vegetative growth will continued. This can be stopped by applying PBZ. Due to this treatment, the shoots which having 3-4 months old are start to flower bud initiation and differentiation in the month of October-November and it is ready for flowering. After the end of NE monsoon stop the drip fertigation for one month will results profuse flowering in December –January followed by fruiting in April –May and

are ready for harvesting within 3-4 months.

Application of Paclobutrazole (PBZ)

To get assured flowering, uniformity in flowering, earliness in flowering, to manage alternate bearing, to get higher yield we should apply PBZ. Under UHDP we will recommend 2ml/1m canopy of plant and mix in 2 Litre of water. At the age of 3 year old plant should receive 3ml/2.5m canopy of plant and mix in 2 Litre of water and applied in the basin. This will be followed by continuous drip irrigation for a period of 15 days.

Benefits of UHDP

Increases productivity up to 2-3 times, 10 year old UHDP yielded up to 18-20 MT ha⁻¹. It reduces orchard gestation period to three years as compared to conventional orchards (Table 4).

Table 4: A Comparison of UHDP with traditional planting system (Soman 2009) ^[10]

S. No.	Particulars	Planting method	
		Traditional	UHDP
1	Pre bearing period	7-8 years	4 years
2	Duration to reach full yield potential	15 years	5 years
3	Yield potential	Medium	Very high
4	Pruning	Very difficult	Easy
5	Spray operation	Difficult	Easy
6	Spray efficiency	Very poor	Good
7	Harvest	Very difficult	Very easy
8	Control of fruit quality	Impossible	Easy
9	Expected yield /Ha		
	a. High volume varieties	12	20-25tonnes/Ha
	b. Low volume varieties	6	10-12
10	Incidence of Pests and diseases	Very high	Low/No
12	Commercial orchard life	Up to 50 years	20-25 years

Get maximum yield in shortest span of life and switch over to another crop or replanting. In case of Bangalora we can also go for offseason production by pruning technology under

UHDP. Table 4 indicates that UHDP is generally good to get higher yield and quality fruits.

Problems to be faced in UHDP mango orchards of Telangana

Once HDP is adopted, all the recommended practices are to be followed scrupulously, otherwise, it would result in several problems included vigorous, more crowded, upright growth, no sunlight penetration, very poor yield, (1.5-2.0 MT ha⁻¹) harvesting problem because of higher growth, severe incidence of powdery mildew, white scale and anthracnose. Hence UHDP is adopted; the related technologies like formative pruning to develop proper plant architecture and annual canopy management are to be followed regularly.

Conclusion

UHDP system can be used for commercial cultivation of Mango. Yields are 2-3 times higher than the conventional planting. UHDP can be used for shy bearing and prolific bearing cultivars. Timely pruning, drip fertigation and paclobutrazole application ensures regular yields. UHDP makes mango crop as profitable as other cash crops. Because yields start in 3rd year and get stabilized by 5th year, bank financing is possible for projects. Thus, it is imperative that once in Telangana UHDP is adopted; the related technologies like formative pruning to develop proper plant architecture and annual canopy management are to be followed regularly. Besides, providing optimum irrigation through drip to replenish moisture loss through evapo transpiration and proper fertigation practices to provide balanced vegetative growth and fruiting, are highly essential so as to get higher yield. If these practices are followed, the management of pests and diseases would be very effective.

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