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Effect of Spacing on Growth, Yield and Quality of Mango

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ABSTRACT

A field experiment was conducted at NARP, Ganeshkhind, during 1992 to 2013 to study high density planting of mango variety Kesar. Accordingly plant density studies in mango was laid out in the year 1992 with spacing of 5 X 5 m, 5 X 10 m and 10 X 10 m, , in randomized block design at Ganeshkhind, Pune. The growth, yield and quality parameters were recorded for three years and pooled data (2010 -2012) was analyzed statistically. The results were significant and the yield and monetary returns were 125 per cent more over conventional spacing. The recommendation of planting of mango cv Kesar at spacing of 5 X 5 m with light pruning (15 – 20 cm terminal shoot) after harvest of fruits every year is recommended for higher fruit yield and monetary returns in mango growing area of Maharashtra.

Key Words: Spacing, Growth, Yield, Quality, Mango

INTRODUCTION

Mango (*Mangifera indica* L.) is an important fruit crop in the tropical and subtropical regions of the world. High planting density is a technique that has been widely used in mango orchards worldwide to increase earliness to improve handling and cultural practices and to reduce costs (Oosthuyse, 2009). In mango orchards, some studies support the use of this technology in different countries with fruit yield reaching around 20 MT/ha/year in the third harvest (Oosthuyse, 2009). This value is almost three times higher than the world mean yield (Nath *et al*, 2007). Plant response to planting density depends on intrinsic variables related to the plants themselves such as rootstock, vigor, canopy age and extrinsic variables, including soil and climate (Yamakura *et al*, 2008). Therefore, high density planting has been standardized for the popular cultivars of Mango e.g., 2.5 x 2.5m for 'Amrapali' (Majumder *et al*, 1982) , 6 x 6m for 'Mallika' and 3.0 x 2.5m for 'Dashehari'; Ram *et al*, 1997). It was felt necessary to standardize it for most popularly grown mango cv Kesar in Maharashtra. Hence, the objective of this study was to find out suitable spacing for mango cv Kesar for optimum growth and yield per unit area under Western Maharashtra plain zone conditions.

MATERIALS AND METHODS

The present investigation was carried out at National Agriculture Research Project (Plain Zone) Ganeshkhind, Pune during the year 2010-2012. Veneer grafted plants of cv Kesar on local stalk were planted in deep black alluvial soil at three different spacing's viz. 10 X 10m, 10 X 5m and at 5 X 5m during 1992. Thirty plants of each cultivar were used for study, ten plants being a unit of a replication. The experiment was laid out in randomized block design with three replications. Observations on plant height, East West spread, Noth South spread, trunk girth at 30 cm above the ground , number of fruits/tree/year, yield/tree/year, fruit dimensions, TSS, acidity (%) and disease and pests incidence were recorded. Ten fruits were randomly harvested from each replication for recording the observations. Total soluble solids (TSS) were measured by a refractometer. Titrable acidity was determined by titrating a known quantity of blended (homogenized) pulp, diluted with distilled water, against NaOH solution (1N), using phenolphthalein as indicator and the results were expressed as percentage of citric acid (Ranganna, 1986). The data were analyzed as methods suggested by Panse and Sukhatme (1985).

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RESULTS AND DISCUSSION

The analysis of pooled data of three trials (2010-2012) have been given in Table 3. There were significant differences for all the characters under study.

Growth parameters

There was significant difference for plant height. Significantly highest plant height (7.0m) was recorded in the spacing 10 X10m which was statistically higher than other two spacing. In case of trunk girth, the maximum (98.5cm) trunk girth was attended in spacing 10 X 10m, while the plant spread (EW and NS) was significantly higher in 10 X 10m spacing. The light pruning operation was performed after fruit harvest every year.

Vegetative variables of 'Kesar' mango trees showed significant changes in response to higher planting density. In general, plants grown under traditional wide spacing (10 X10m) showed greater vegetative growth than those grown under narrow spacing (10 X 5m and 5 X 5m). As the area for each plant was decreased, there was a decrease in plant height, trunk girth, canopy spread (East – West and North - South). The reduction in vegetative variables in 'Tommy Atkins' mango trees grown under increased planting density had already been reported by Sousa *et al* (2012). Similar trends in indigenous cultivars were observed by Nath *et al* (2007). A possible explanation is the competition for water and soil nutrients (Policarpo *et al*, 2006), but mainly for light (Policarpo *et al*, 2006), since under higher planting density plant canopies overlap into the rows, reducing light incidence on leaves. Other variables, such as trunk girth, which confirmed the trend of reduced growth under high planting density, in all studies (Nath *et al*, 2007), plant height can decrease with increase in plant density as occurred with 'Dashehari' mango (Ram and Sirohi, 1991).

In higher planting densities, East - West and North – South spread showed reduction due to the restrictions of light. This probably occurred overlapping of branches. Reduced mango tree growth under high planting density was to some extent an expected result (Nath *et al*, 2007).

Yield parameters

Significantly the highest (347.1) number of fruits per tree was recorded in spacing 10 X 10m, while the maximum fruit weight (271.1 g) was observed in the same spacing. The yield per tree was highest in the spacing 10 X 10m but the yield per hectare was higher (216 MT) in the spacing 5 X 5m. As with vegetative variables, reproductive variables were also negatively affected by planting density. The smaller the area available to plants, the higher the tendency to decrease the number and percentage of flower shoots, and the number and yield of fruit per plant.

As a consequence of the higher planting densities was the reduction of the number and percentage of flowering shoots. Plants grown under lower planting density may produced flowers in all quadrants of the canopy, while those grown under increasing planting density (5 X5 m) might produced flowers only in the two quadrants of the canopy.

Fruit weight was negatively co-related with plant density, it is among the variables that changed more often due to high planting density (Souza *et al*, 2012). Consequently, there were reductions in the number and yield of fruits/plant. In the planting densities of 100 (10 X10m) and 400 (5 X5m) plants/ha, the number of fruits produced represented only about 76 per cent of those produced in the lowest planting density, with 100 plants/ha.

However, planting density of 400 plants/ha (5 X 5 m) showed estimated fruit yield of 21.36 MT/ha/year, representing an increase of approximately 125 per cent over the yield obtained at the planting density of 100 plants (10 X 10m)/ha, which was 9.46 MT/ha/year. These results were in accordance with Joglekar *et al* (2013) for indigenous cultivars and Sousa *et al* (2012) with respect to Tommy Atkins.

Quality parameters

The significant differences were noticed for the fruit length and breadth. In the spacing 10X10m recorded highest fruit length, breadth, TSS and acidity (10.72 cm, 7.42 cm, 19.62 oBrix and 0.18 %

respectively). The pulp per cent was significantly higher (63.2%) in the spacing 10 X 10m but it was at par with the spacing 10 X 5m. According to Policarpo *et al* (2006), under high planting density, besides the changes in the quantity and quality of intercepted light, the partitioning of assimilates between vegetative and reproductive shoots may be responsible for the effects on fruit quality. Decrease in fruit diameter with increase in plant density is reported by Sousa *et al* (2012).

Pest and disease reaction

The data (Table 1) show that incidence of mango hoppers/inflorescence and powdery mildew/ inflorescence was maximum (23.4 and 16.4 as PDI, respectively) in 5 x 5m planting. It was obvious to have more incidence of insect and pest attack in dense planting.

Table 1. Effect of different spacings on pest and disease incidence of mango cv Kesar (Pooled 2010-12).

Sr. No.	Spacing (m)	Mango hopper incidence per inflorescence	Powdery mildew per inflorescence (PDI)
1.	5 X 5	23.4	16.4
2.	10 X 5	20.4	16.3
3.	10 X 10	15.8	16.3

Economics

The data (Table 2) reveal that, per hectare economics for all the spacing were worked out and it was observed that, the highest monetary returns (Rs. 3,72,312/- ha) and the highest (3.3) B:C ratio was recorded in the spacing 5 x 5m and it was followed by the spacing 5x10 m (2.5). These results were in confirmation with findings of Ram *et al* (1997).

CONCLUSION

In the density studies in mango cv kesar, on hectare basis the highest fruit yield (21.4 MT) was produced in closer spacing of 5 X 5m. However the highest fruit yield per tree was recorded in the wider spacing of 10 X 10m.

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Table 2. Effect of plant spacing on economics of mango cv Kesar (Pooled 2010-12)

Sr. No.	Spacing (m)	Yield MT/ha	Production cost/ha (Rs.)	Gross returns Rs./ha	Net profit Rs/ ha	B:C ratio
1.	5 x 5	21.4	1,61,687	5,34,000	3,72,312	3.30
2.	10 x 5	14.8	1,46,437	3,69,500	2,23,062	2.52
3.	10 x 10	9.4	1,32,911	2,35,750	1,02,838	1.77

Sale rate: Rs. 25,000/MT

Table 3. Effect of plant spacing on growth, yield and quality of mango cv Kesar (Pooled 2010-12).

Sr. No.	Spacing (m) (plants/ha)	Plant height (m)	Trunk girth (cm)	Plant spread (EW)	Plant spread (NS)	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	No. of fruits/ tree	Yield (kg/tree)	Yield (MT/ ha)	Pulp (%)	TSS (O B)	Acidity (%)
1	5 x 5 (400)	6.24	80.8	6.20	6.30	9.5	6.20	201.30	264.80	53.40	21.40	60.80	18.90	0.17
2	10 x 5(200)	6.45	87.9	6.80	6.50	10.5	6.80	234.90	312.90	73.90	14.80	62.20	19.20	0.18
3	10 x10(100)	7.02	98.5	8.90	8.70	10.7	7.40	271.67	347.10	94.30	9.40	63.20	19.60	0.18
	SE +	0.09	1.49	0.18	0.15	0.11	0.10	2.49	9.94	2.53	0.57	0.49	0.16	0.002
	C.D.at 5 %	0.27	4.28	0.52	0.44	0.32	0.28	7.14	28.52	7.27	1.65	1.41	0.46	0.005

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