

EFFECT OF DIFFERENT SPACING AND FOLIAR SPRAY OF NUTRIENTS ON FLOWERING AND YIELD IN CASHEW UNDER ULTRA HIGH DENSITY PLANTING SYSTEM

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ABSTRACT

An experiment was conducted during 2013-2014 at Regional Research Station, TNAU, Vriddhachalam. The experiment was laid out in split plot design with main plot consisted of spraying of nutrients (M_1) and without spraying (M_2). The sub plot consisted of three different spacing 3 x 2 m (1666 plants ha^{-1}), 4 x 2 m (1250 plants ha^{-1}) and 5 x 4 m (500 plants ha^{-1}). The results also revealed that the treatment (M_1S_2) consisting of foliar spray of nutrients along with spacing (4 x 2 m) was found to be the best in increasing number of current season's shoot (11.4 and 8.73 Numbers), number of panicles (35.5 and 118.5 numbers per m^2) and nuts yield (1.10 and 5.15 kg per tree) in cashew grown under ultra high density planting system.

INTRODUCTION

Cashew, *Anacardium occidentale* L. (Anacardiaceae), is a nut crop of world importance. It is a predominantly cross pollinated tree with entomophilous pollination (Nambiar and Pillai, 1985). In India, Kerala, Karnataka, Goa, Maharashtra on West Coast and Tamil Nadu, Andhra Pradesh, Orissa, West Bengal on East coast are the major cashew growing states. Maharashtra leads in area, production and productivity with 1.64 lakh hectares, 1.97 lakh MT and 1.5 MT ha^{-1} respectively.

Tamil Nadu records a poor productivity of (700 kg ha^{-1}) despite its large area under cashew (1.23 lakh ha^{-1}). Large area of old senile seedling orchards, low plant population, poor canopy management and non-adoption of improved package of practices are considered as the major limiting factors in cashew production (Kumar *et al.*, 2012). Development, popularization and area increase under improved varieties / hybrids, development of high density planting system and good agricultural practices to double the yield per unit area are the ways to improve the cashew productivity and income of the farmers in the state.

Ultra high density planting (UHDP), a system of planting 10 times more plants per acre than conventional methods. High density planting or ultra high density planting aims to make maximum use of land to achieve high yields in the early periods of orchard along with ease in its management Kumar (2019). Recently, in Tamil Nadu an ultra high density planting (UHDP) of 3x2 m accommodating 1666 plants / ha is recommended to get a higher yield of 15t/ha in mango. Cashew ultra high

density planting system with spacing of 4 x 2 m (1250 plants ha^{-1}), 3 x 2 m (1666 plants ha^{-1}) have been established at Vriddhachalam. However, it becomes necessary to study the effect of such spacing combined with various nutrient foliar spray schedules for canopy management and to double the nut yield per unit area under ultra high density planting system.

Keeping this in view, this study was proposed to standardize a spacing combined with and foliar spray schedule to get higher nut yield under ultra high density planting system. Therefore, the present study was taken up in cashew with an objective of effect of different spacing and foliar spray of nutrients on flowering and yield in cashew under ultra high density planting system.

MATERIALS AND METHODS

A field experiment was conducted during 2013-14 at Regional Research Station, TNAU, Vriddhachalam. The experiment was laid out in a split plot design with 2 main plot and 3 sub plot treatments with 2 replications. The variety used for the study was VRI 3 with hundred uniform sized trees. Trees were about 2 years old. Tertiary shoot pruning was done on July. First foliar spray of NPK 19:19:19 was given on August (New flush stage). Second foliar spray (Boron 0.1% and MAP 1%) was given on December (Flowering stage) (Murali *et al.*, 2015). Observation on plant morphological characteristics was taken 30 days after foliar spray of NPK 19:19:19 given as per the treatments.

Treatment details

Main plot

M₁ – With spray (NPK 19:19:19 1% (New flush stage) + Boron 0.1% and MAP 1%

(Flowering stage)

M₂ – No spray

Sub plots:

S – Different spacing

S₁ – 3 x 2 mS₂ – 4 x 2 mS₃ – 5 x 4 m**RESULTS AND DISCUSSION****Effect of different spacing and foliar spray on plant height**

The maintenance of optimum tree height in any crop is highly essential to make harvest and other cultural operations easier. M₁ with spray recorded the highest plant height (3.02 and 3.44 m), when compared to M₂ without spray (2.80 and 3.03 m) during second and third year respectively. Tomar and Navdeep (2007) reported that foliar spray of urea 0.5 % in

Table 1. Effect of spacing and foliar spray on plant height in cashew Main plot mean

Plant height (m)				
Treatment	2013		2014	
M ₁	3.02		3.44	
M ₂	2.8		3.03	
Mean	2.91		3.23	
	SEd	CD(0.05)	SEd	CD(0.05)
M	0.02	0.19**	0.03	0.42**

Sub plot mean

S ₁	2.25		2.58	
S ₂	2.7		2.88	
S ₃	3.78		4.25	
Mean	2.91		3.23	
	SEd	CD(0.05)	SEd	CD(0.05)
S	0.07	0.20**	0.16	0.43**

Interaction effect

M ₁ S ₁	2.35		2.64	
M ₁ S ₂	2.75		2.88	
M ₁ S ₃	3.95		4.8	
M ₂ S ₁	2.16		2.51	
M ₂ S ₂	2.65		2.88	
M ₂ S ₃	3.6		3.69	
Mean	2.91		3.23	
	SEd	CD(0.05)	SEd	CD(0.05)
M AT S	0.08	0.26*	0.18	0.57*
S AT M	0.1	0.28*	0.22	0.61*

walnut increased the tree height which is in accordance with the present study where in, foliar spray in pruned plants had increased the plant height.

Among the sub plot, 5 x 4 metre recorded higher value for plant height (3.78 and 4.25 m) followed the lowest plant height 3 x 2 metre with 2.25 and 2.58 m during second and third year respectively. Maintenance of optimum canopy shape and canopy architecture in cocoa particularly the plants with

Table 2: Effect of spacing and foliar spray on current season shoot in cashew**Main plot mean**

Current season shoot				
Treatment	2013		2014	
M ₁	6.55		10.36	
M ₂	5.17		8.96	
Mean	5.86		9.66	
	SEd	CD(0.05)	SEd	CD(0.05)
M	0.34	NS	0.27	NS

Sub plot mean

S ₁	5.86		9.47	
S ₂	6.99		10.5	
S ₃	4.73		8.84	
Mean	5.86		9.66	
	SEd	CD(0.05)	SEd	CD(0.05)
S	0.28	0.78**	0.38	1.05*

Interaction effect

M ₁ S ₁	9.94		6.06	
M ₁ S ₂	11.4		8.73	
M ₁ S ₃	9.48		4.84	
M ₂ S ₁	8.99		4.61	
M ₂ S ₂	9.67		5.66	
M ₂ S ₃	8.21		5.25	
Mean	5.86		9.66	
	SEd	CD(0.05)	SEd	CD(0.05)
M AT S	0.47	NS	0.52	3.77**
S AT M	0.39	NS	0.54	1.09**

big canopies, big spreading nature are found to be ideal (Thomas and Balasimha, 1992). Spacing 5 x 4 metre with foliar spray showed the highest plant height 3.95 and 4.80 m followed by foliar spray with Spacing of 4 x 2 metre recorded 2.75 and 2.88 m of panicles during second and third year respectively (Table.1). Currently, there is a worldwide trend to plant fruit trees at higher density or meadow orcharding to control tree size and maintain desired architecture for better light interception and ease in operations such as pruning, pest control and harvesting (Singh, 2010). Maximum yield of a particular crop in a given environment can be obtained at row spacing where competition among the plants is minimum. This can be achieved with optimum plant spacing which not only utilize soil moisture and nutrients more effectively but also avoids excessive competition among the plants.

Effect of different spacing and foliar spray on number of current season's shoot

The major disadvantage in high density planting is the control of canopy size which is possible only by way of systematic annual pruning. Consequent to pruning of branches, new shoots are expected to grow as a result of removal of apical dominance. Ram (1999) also opined that shoot decapitation in the last week of June and first week of July followed by 1% urea spray after harvesting increased new shoot production. There was no significant difference among the main plot treatments with respect to current season shoot. Among the sub plot, spacing 4 x 2 metre recorded the highest mean value for current season's shoot (6.99 and 10.5 numbers) followed the lowest number of current season's shoot in 5 x 4 metre

Table 3: Effect of spacing and foliar spray on number of panicles in cashew
Main plot mean

Treatment	Number of panicles			
	2013		2014	
M ₁	29.2		101.7	
M ₂	18.5		81	
Mean	23.9		91.4	
	SEd	CD(0.05)	SEd	CD(0.05)
M	1.21	15.4*	1.8	22.8**

Sub plot mean

S ₁	18.9		79.2	
S ₂	28.1		105.5	
S ₃	24.4		89.5	
Mean	23.9		91.4	
	SEd	CD(0.05)	SEd	CD(0.05)
S	0.59	1.64**	1.65	4.59**

Interaction effect

M ₁ S ₁	22.5		86.3	
M ₁ S ₂	35.5		118.5	
M ₁ S ₃	29.5		100.5	
M ₂ S ₁	19.4		72.1	
M ₂ S ₂	20.8		92.5	
M ₂ S ₃	15.3		78.5	
Mean	23.9		91.4	
	SEd	CD(0.05)	SEd	CD(0.05)
M AT S	1.39	14.4**	2.62	19.5*
S AT M	0.84	2.32**	2.34	6.49*

with 4.73 and 8.84 numbers during second and third year respectively. Foliar spray with 4 x 2 metre spacing showed the highest value of 11.4 and 8.73 numbers followed by foliar spray with spacing 3 x 2 metre with 5.87 and 9.94 numbers during second and third year respectively (Table.2). In this study spacing and foliar spray produced higher number of current season shoot compared to without spray. Optimum spacing provides favourable conditions to crop for flourishing, absorption of nutrients and tapping of solar energy from the atmosphere, which ultimately results in higher production of photosynthates. Cashew is a current season shoot bearer and hence reduction in canopy size could no way have deleterious effect on current season's shoot production. This is highly beneficial in increasing the number of flowering shoots and thus nut yield.

Effect of different spacing and foliar spray on number of panicle

In an evergreen tree like cashew, proper canopy management is essential to encourage sufficient number of panicles per square meter and number of panicles per tree so that the higher productivity could be achieved. Results of pruning on 28 year old trees revealed that trees with three branches pruned recorded the highest number of panicles / sq. m. in cashew (Panda, 1990). There was significant difference among the main plot treatments with respect to number of panicles. Foliar spray recorded the highest value of (29.2 and 101.7 numbers), when compared to without spray (18.5 and 81.0 numbers) during second and third year respectively (Table.3). The enhanced number of panicle production is attributed to nitrogen, phosphorous, potash in foliar sprayed treatments in

mango by Kanwar *et al.* (1987). Aneesa rani *et al.* (2011) reported that foliar spray of NPK 19:19:19 (1%) and MAP (1%) at flushing and flowering stage respectively enhanced the number of panicles in VRI 3 cashew.

Among the sub plot, spacing 4 x 2 metre recorded higher value for number of panicles (28.1 and 105.5 numbers) followed the lowest number of panicles in 3 x 2 metre spacing with 18.9 and 79.2 numbers during second and third year respectively. Foliar spray with 4 x 2 metre spacing showed the highest value of 35.5 and 118.5 numbers followed by spray with 5 x 4 metre with 29.5 and 100.5 number of panicles during second and third year respectively.

Effect of different spacing and foliar spray on nut yield

Nut yield in cashew is mainly influenced by number of current season's shoot, flowering clusters and fruit set percentage (Murali *et al.*, 2015). The rise in nut production might be ascribed to the increase in fruit setting. Foliar spray with nutrients, recorded the highest nut yield per tree (0.87 and 3.55 kg per tree), when compared to without spray (0.43 and 2.48 kg per tree) during second and third year respectively. Foliar spray of boron and MAP at different concentration increased the yield. Similar results obtained by boron in hazel nut (Silva *et al.*, 2003; MAP in apple (Wojcik and Klamkowski, 2005).

Among the sub plot, spacing with 4 x 2 metre recorded higher value for nuts yield (0.86 and 4.40 kg per tree) followed the lowest nut yield in 3 x 2 metre spacing with 0.45 and 1.83 kg per tree during second and third year respectively. In any perennial crop, the ideal canopy is one which harnesses the

Table 4: Effect of spacing and foliar spray on nut yield in cashew
Main plot mean

Treatment	Nut yield kg per tree			
	2013		2014	
M ₁	0.87		3.55	
M ₂	0.53		2.48	
Mean	0.7		3.02	
	SEd	CD(0.05)	SEd	CD(0.05)
M	0.01	0.08**	0.01	0.08**

Sub plot mean

S ₁	0.45		1.83	
S ₂	0.86		2.83	
S ₃	0.79		4.4	
Mean	0.7		3.02	
	SEd	CD(0.05)	SEd	CD(0.05)
S	0.05	0.15**	0.05	0.15**

Interaction effect

M ₁ S ₁	0.55		2.1	
M ₁ S ₂	1.1		5.15	
M ₁ S ₃	0.95		3.4	
M ₂ S ₁	0.35		1.55	
M ₂ S ₂	0.61		2.25	
M ₂ S ₃	0.65		3.65	
Mean	0.7		3.02	
	SEd	CD(0.05)	SEd	CD(0.05)
M AT S	0.06	0.18**	0.18	0.57**
S AT M	0.08	0.21**	0.22	0.61**

maximum light interception there by increasing the photosynthesis rate leading to higher productivity in the perennial trees. Mishra and Adak (2009) reported that the incoming light is critical for physiological and morphological aspects of tree and fruit growth and development, spraying of nutrients combined with 4 x 2 metre spacing showed the highest nut value of 1.10 and 5.15 followed by spraying with 5 x 4 metre spacing with 0.95 and 3.40kg per tree during second and third year respectively (Table.4). In the present study, the fruit yield per tree during the period of experiment was generally higher in spacing combined with foliar spray treatments. The present study clearly revealed that increased production of nut yield kg per tree by spacing followed by two sprays one at new flush stage and another at flowering stage had significant effect on cashew nut yield under Ultra high density planting system. This technology can bring revolution in cashew cultivation and production and the targeted requirement of raw nuts in the country can be made available in short span of 4-5 years.

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