Short Scientific Report

Journal of Plantation Crops, 2014, 42(1): 113-116

Influence of growth regulators on certain reproductive parameters of cashew *(Anacardium occidentale* L.*)* variety Bhaskara

Lakshmipathi*, J. Dinakara Adiga and D. Kalaivanan

Directorate of Cashew Research, Darbe Post, Puttur- 574 202, Dakshina Kannada District, Karnataka, India

(Manuscript Received: 12-07-13, Revised: 06-08-13, Accepted: 05-10-13)

Keywords: Cashew, flowering, growth regulators, reproductive growth, yield.

Cashew (*Anacardium occidentale* L.) is a polygamous tree and produces male and hermaphrodite flowers in different phases during flowering. Some of the factors for low yield of cashew are the production of low percentage of hermaphrodite flowers, poor fruit set, immature fruit drop and low fruit retention (Haribabu, 1982).

Flowering in cashew is seasonal, producing flower bud in varying phases starting from September to March depending upon the cultivars and climatic conditions. Though, cashew produces innumerable flowers, only 1-2 per cent of the flowers set fruit and reach maturity. Production of more number of pistillate flowers and reduction in nut drop can be accomplished by the use of plant hormones. Fruit set and their retention are the major limiting factors for low yield in cashew which needs due attention. The nuts those develop after pollination start drying followed by dropping, leading to very low percentage of matured nuts. Use of growth regulators like auxins, gibberellins, and ethylene has resulted in improving the vegetative and reproductive parameters which are associated with high yield in many fruit crops (Lafer, 2008; Chacko *et al*., 1974; Rawash *et al*., 1983; Singh *et al*., 1986).

Preliminary studies carried out on improvement of sex ratio, fruit set, fruit retention and yield by use of growth regulators conducted earlier have indicated beneficial effects in cashew. Increase in the percentage of fruit set by 55 per cent in cashew with foliar application of 10 ppm NAA was reported by Murthy *et al.* (1975). Though, the cashew var. Bhaskara is very popular among the farmers in Karnataka, in general, and in south west coast region of Karnataka, in particular, no attempt has been made so far to study the effect of growth regulators on its reproductive growth parameters. Hence, the present investigation was undertaken to study the effect of foliar application of growth regulators on flowering, fruit set and nut yield of cashew var. Bhaskara.

The experiment was conducted at Directorate of Cashew Research, Puttur, Karnataka during 2011 and 2012. The experimental site, situated in a cashew growing belt, has lateritic sandy loam soils of the west coast, located 87 m above mean sea level with latitude of 12°77'N and longitude of 75°22'E. The climate is hot and humid throughout the year with an average annual rainfall of 3,500 mm, distributed mainly from June to September. The study was carried out in a 10 year old cashew plantation (variety Bhaskara) by adopting randomized block design (RBD) with 9 treatments and 3 replications. The detail of the treatments are Control (T_1), 50 ppm Ethrel (T_2), 10 ppm 2,4-D (T_3), 25 ppm NAA (T_4), 10 ppm IAA (T_5), 1000 ppm BA (T_6), 50 ppm GA_3 (T_7), 25 ppm NAA + 50 ppm GA_3 (T_8) and 100 ppm IAA + 50 ppm GA_3 (T_9). The treatments were fixed based on the earlier work carried out by Singh *et al*. (1992) and Kumar *et al*. (1996). The plant growth regulators were sprayed during flushing, panicle initiation and flowering

**Corresponding Author: kalainith2003@gmail.com*

stage using foot pump paddle sprayer covering the entire canopy. Observations on number of flowering laterals per square metre, number of non-flowering laterals per square metre, total number of laterals per square metre, duration of male flowers, duration of perfect flowers, number of male flowers per panicle, number of hermaphrodite flowers per panicle, total number of flowers, number of fruits set per panicle, number of fruits drop per panicle, number of fruits retained per panicle, nut yield (kilogram) per tree and nut weight (gram) were recorded in all the treatments.

The number of flowering laterals and non-flowering laterals were counted from one square metre area of canopy from four directions using a one-metre square bamboo frame. The duration of flowering was determined by counting the number of days between first flowering and last flowering.

Four panicles were selected from the observational trees and tagged for determining the sex ratio. The number of hermaphrodite flowers and male flowers appearing in each of the four tagged panicles were counted on alternate days and the counted flowers were removed from the panicles. One day old flower was identified by the change of flower colour from cream to light red. Recording of flower count was continued till all the flower buds were exhausted from that panicle. The number of hermaphrodite flowers from each day from the particular panicle was added to get the total number of hermaphrodite flowers from that panicle. Similarly, total number of male flowers was also obtained. Mean of hermaphrodite and male flowers per panicle were determined. The sex ratio was worked out with mean number of hermaphrodite flowers to total number of flowers per panicle. Fifty raw nuts were sun dried for two to three days, weighed and mean weight of nut was calculated. Two years data (2011 and 2012) on all the observed reproductive parameters were pooled and analyzed using SAS 9.3 software.

Data on flowering and yield parameters of cashew var. Bhaskara as influenced by plant growth regulators are presented in Table 1. The trees sprayed with 50 ppm Ethrel produced highest number of flowering laterals (19.5) and least number of non-flowering laterals (5.5) per square metre. The trees sprayed with 25 ppm NAA and the combination of 25 ppm NAA with 50 ppm GA_3 also influenced flowering and non-flowering laterals. The least number of flowering laterals and highest number of non-flowering laterals were recorded with control.

Table 1. Effect of growth regulators on flowering and yield parameters of cashew var. Bhaskara

Treatment	NFL	NNFL	NTL	DMF	DHF	NH	NM	TNF	Sex ratio	NFS	NFD	NFR	NY	NW
Control	05.50	09.33	14.8	43.2	27.3	108	314	422	0.26	05.17	2.33	2.83	05.20	6.57
50 ppm Ethrel	19.50	03.83	23.3	67.7	40.5	306	434	740	0.41	14.83	1.67	13.17	14.25	8.17
10 ppm 2, 4-D	10.33	05.83	16.2	49.7	29.7	132	267	398	0.33	06.50	2.67	03.83	07.42	6.58
25 ppm NAA	15.83	05.33	21.2	63.3	33.7	278	397	675	0.41	11.83	2.00	10.17	12.22	8.07
100 ppm IAA	07.83	10.83	18.7	49.5	29.5	162	320	482	0.34	06.67	2.00	04.67	07.58	6.58
1000 ppm BA	07.50	10.83	18.3	49.8	30.2	146	299	445	0.33	07.00	2.33	04.67	10.30	6.72
50 ppm GA_3	10.00	10.50	20.5	59.5	29.8	218	318	536	0.41	10.00	3.00	07.00	11.62	7.50
25 ppm NAA + 50 ppm GA_3	15.50	05.67	21.2	59.5	29.8	262	330	592	0.44	10.17	2.83	07.33	12.92	7.75
100 ppm IAA + 50 ppm GA_3	10.17	08.33	18.5	59.5	29.8	225	330	555	0.41	07.33	2.00	05.33	07.98	7.50
SEm±	0.46	0.38	0.68	0.84	1.08	5.00	7.29	10.46		0.60	0.30	0.40	0.40	0.10
LSD (p<0.05)	1.30	1.09	1.93	2.41	3.09	14.26	20.80	29.84		1.71	0.85	1.14	1.13	0.29

NFL-Number of flowering laterals per square metre, NNFL- Number of non flowering laterals per square metre, NTL- Number of total laterals per square metre, DMF-Duration of male flowers, DHF-Duration of hermaphrodite flowers, NH-Number of hermaphrodite flowers per panicle, NM-Number of male flowers per panicle, TNF- Total number of flowers, NFS-Number of fruits set per panicle, NFD-Number of fruits drop per panicle, NFR-Number of fruits retained per panicle, NY-Nut yield (kg) per tree and NW-Nut weight (g).

A significant increase in number of flowering laterals per square meter with the spray of 50 ppm Ethrel over control might be due to increased activity of peroxidase and α-amylase which ultimately release more sugar for induction of flowering (Yamdagni and Khangia, 1989). Application of 50 ppm Ethrel recorded highest number of total laterals (23.3) per square metre whereas, lowest number of total laterals (14.8) per square metre was recorded in control. Duration of male and hermaphrodite flowers was also significantly increased with the spray of 50 ppm Ethrel followed by 25 ppm NAA whereas, the duration of male and hermaphrodite flowers got decreased in control.

Application of 50 ppm Ethrel had positive effect in increasing number of hermaphrodite flowers (306) and male flowers (434) followed by 25 ppm NAA (278 and 397 hermaphrodite and male flowers, respectively). The least number of hermaphrodite flowers and male flowers were recorded with control and 10 ppm 2,4-D. The total number of hermaphrodite and male flowers was significantly higher for 50 ppm Ethrel than rest of the treatments which improved the sex ratio also. Improvement in sex ratio with application of growth regulators was mainly due to increased number of bisexual flowers. Both auxin and ethrel had stimulating effect and caused the physiological changes in the tissues influencing the flowering characters (Salisbury and Ross, 1986). The increase in length and number of secondary branches per panicle are important attributes for the production of more number of flowers which increases the yield. The flowering in other fruit crop as influenced by ethrel and auxin was also reported by Chacko *et al.* (1974) and Rawash *et al*. (1983) in mango. Singh *et al*. (1992) reported that the spray of 15 ppm NAA and 100 ppm Ethrel had marked influence on increasing the total number of flowers, hermaphrodite flowers and sex ratio (male:hermaphrodite) in cashew. Dorajeerao *et al.* (2001) reported that clones having broader sex ratio were high yielders.

Spraying of 50 ppm Ethrel increased the number of fruits set, number of fruits retained per panicle, nut weight (g), nut yield (kg) per tree and reduced fruit drop per panicle over other treatments. However, the maximum fruit drop per panicle was recorded with control. Increased fruit set and fruit

Table 2. Simple correlation matrix among reproductive parameters of cashew var. Bhaskara

	NFL	NNFL	NTL	DMF	DHF	NH	NM	TNF	NFS	NFD	NFR	NY	NW	M:H
NFL	1													
NNFL	-0.86 **	1												
NTL	0.85 **	-0.46 *	1											
DMF	0.91 **	-0.62 **	0.93 **	1										
DHF	0.82 **	-0.65 **	0.76 **	0.80 **	1									
NH	0.88 **	-0.61 **	0.90 **	0.96 **	0.70 **	1								
NM	0.80 **	-0.56 **	0.81 **	0.90 **	0.89 **	0.88 **	1							
TNF	0.88 **	-0.61 **	0.89 **	0.96 **	0.80 **	0.98 **	0.96 **	1						
NFS	0.93 **	-0.76 **	0.83 **	0.91 **	0.81 **	0.90 **	0.86 **	0.91 **	1					
NFD	0.17	-0.21	0.09	0.02	-0.24	0.06	-0.31	-0.10	0.12	1				
NFR	0.89 **	-0.73 **	0.79 **	0.90 **	0.84 **	0.89 **	0.92 **	0.93 **	0.97 **	-0.08	1			
NY	0.84 **	-0.64 **	0.80 **	0.89 **	0.76 **	0.89 **	0.85 **	0.90 **	0.94 **	0.07	0.92 **	1		
NW	0.88 **	-0.67 **	0.84 **	0.92 **	0.71 **	0.95 **	0.87 **	0.95 **	0.93 **	-0.03	0.94 **	0.87 **	1	
M:H	0.79 **	-0.51 **	0.84 **	0.88 **	0.47 *	0.94 **	0.67 **	0.85 **	0.78 **	0.31	0.72 **	0.79 **	0.84 **	1

** Significant at 0.01 level (2-tailed), *Significant at 0.05 level (2-tailed)

NFL-Number of flowering laterals per square metre, NNFL- Number of non flowering laterals per square metre, NTL- Number of total number of laterals per square metre, DMF-Duration of male flowers, DHF-Duration of hermaphrodite flowers, NH-Number of hermaphrodite flowers per panicle, NM-Number of male flowers per panicle, TNF- Total number of flowers, NFS-Number of fruits set per panicle, NFD-Number of fruits drop per panicle, NFR-Number of fruits retained per panicle, NY-Nut yield (kg) per tree and NW-Nut weight (g), M:H – Male: hermaphrodite flowers

retention due to application of ethrel and other growth regulators could be attributed to the increased number of bisexual flowers and reduced pre mature fruit drop. Similar findings were also reported by Singh *et al*. (1986) in mango. Reduced fruit drop due to exogenous applications of growth regulators may be attributed to increased endogenous auxins which helps in overcoming the formation of abscission layer in the abscission zone, thereby reducing the immature fruit drop and increasing mobilization of nutrients to the developing fruit (Salisbury and Ross, 1986; Kumar *et al*., 1994). Reduced fruit drop in cashew due to application of growth regulators was also reported by Konhar and Arun Mech (1988). Increased nut yield with application of growth regulators could be attributed to increased number of bisexual flowers, fruit set, fruit retention and total number of nuts per tree (Veeraraghavathatham and Palaniswamy, 1983).

Correlation analysis for yield attributing characters using different parameters is given in Table 2. Nut yield (kg) per tree was found to be most significantly and positively correlated with number of flowering laterals per square metre (0.84), total number of laterals per square metre (0.83), duration of male flowers (0.89), duration of hermaphrodite flowers (0.76), number of male flowers per panicle (0.85), number of hermaphrodite flowers per panicle (0.89), total number of flowers (0.90), number of fruits set per panicle (0.94), number of fruits retention per panicle (0.92) and nut weight (0.87). However, the correlation of number of non-flowering laterals per square metre (-0.64) with nut yield was significant and negative. Kumar *et al*. (1996) observed that number of perfect flowers per panicle was positively correlated with yield in cashew. Similar correlation was also reported by Lenka *et al*., (2001).

In the present study, it was concluded that the application of 50 ppm Ethrel and 25 ppm NAA were found to be beneficial for increasing the nut yield through improvement in sex ratio, fruit set and fruit retention in cashew *var*. Bhaskara.

References

Chacko, E.K., Kohli, R.R. and Randhawa, G.S. 1974. Investigation on the use of 2- chloroethyl phosphoric acid (ethephon, CEPA) for control of biennial bearing in mango. *Scientia Horticulturae* **2**: 389-398.

Dorajeerao, A.V.D., Ravishankar, C. and Reddy, M.L.N. 2001. Influence of flowering phases on nut yield of different cashew clones. *Journal of Plantation Crops* **28**: 55-60.

Haribabu Sri, R. 1982. Increasing fruit set in cashew by growth substances. *Cashew causerie* **4**(4): 14-15.

Konhar, T. and Arun Mech. 1988. Effects of growth regulators on flowering, fruit set and fruit retention in cashew (*Anacardium occidentale* L.). *Indian Cashew Journal* **18**: 17-19.

Kumar, D.P., Khan, M.M. and Melanta, K.R. 1996. Effect of nutrition and growth regulators on apple characters and yield in cashew (*Anacardium occidentale* L.). *The Cashew* **10**(2): 17-24.

Kumar, D.P., Khan, M.M. and Melanta, K.R. 1994. Effect of growth regulators on sex expression, fruit set, fruit retention and yield of cashew. In: *Proceedings of the PLACROSYM XI*, 30 November - 3 December 1994, Calicut, Kerala, India. pp. 610-627.

Lafer, G. 2008. Effects of different bioregulator applications on fruit set, yield and fruit quality of 'williams' pears. *Acta Horticulturae*, 800p.

Lenka, P.C., Mohapatra, K.C., Dash, S. and Mishra, N.K. 2001. Genetic variability and character association in cashew (*Anacardium occidentale* L.). *Horticultural Journal* **14**(2): 105-110.

Murthy, K.N., Kumaran. P.M. and Nayar, N.M. 1975. Increasing fruit set in cashew by hormone spraying. *Journal of Plantation Crops* **3**: 81-82.

Rawash, M.A., El-Hammady, A., El-Nabawy S., Khalifa, A.S. and El-Massy, H. 1983. Regulation of flowering and fruiting in mango trees by using some growth regulators. *Annals of Agricultural Sciences* **28**(11): 227-240.

Salisbury, F.B., Ross, C.W., 1986. *Plant Physiology* (Third edition). Wadsworth Publishing Company, Belmont, California, USA. pp. 309-349.

Singh, M., Choudhary, A.S. and Prasad, M.A. 1986. A note on effect of some plant growth regulators on fruit retention in *Mangifera indica* L. *Haryana Journal of Horticultural Sciences* **15**(3&4) : 221-223.

Singh, S.K., Syamal, M.M. and Maurya, A.N. 1992. Effect of NAA and Ethrel on vegetative growth, flowering, fruiting and yield of cashew nut (*Anacardium occidentale* L.). *The Cashew* **6**(2): 11-12.

Veeraraghavathatham, D. and Palaniswamy, K.P. 1983. Effect of certain growth regulators on the yield of cashew (*Anacardium occidentale* L.) *Cashew Casuerie* **3**: 3-4.

Vision 2050. 2013. Directorate of Cashew Research, Puttur-574 202, Karnataka.

Yamdagni, R. and Khangia, B. 1989. Effect of growth regulators on enzyme activities in shoot tips at various stages of bud differentiation in mango (*Mangifera indica* L.) cv. S.B. Chausa. *South Indian Horticulture* **37**(4): 194-198.