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EFFECT OF NAA AND ETHEPHON ON FRUITING ATTRIBUTES AND YIELD IN CASHEW (*ANACARDIUM OCCIDENTALE* L.) GENOTYPES UNDER HILL ZONE OF KARNATAKA, INDIA

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ABSTRACT

The study entitled with Effect of NAA and ethephon on fruiting attributes and yield in cashew (*Anacardium occidentale* L.) genotypes under hill zone of Karnataka was conducted at college of horticulture, Mudigere during 2020-21. Two sprays (NAA @100 ppm and ethephon @ 50 ppm) along with water spray were given at three different stages (full flushing, flowering and fruit set). It was found that ethephon sprayed varieties showed significant variation with respect to fruiting attributes *viz*., maximum fruit set percentage is recorded in Priyanaka 26.60. Whereas minimum fruiting set percentage is recorder in Orchard (22.33). Yield attributes *viz.,* maximum yield observed in Priyanaka (4.53 kg/tree) and minimum yield observed in Amrutha (3.10 kg/ha). Maximum yield observed in Priyanaka (776.67 kg/tree). Whereas minimum yield observed in Amrutha (706.67 kg/ha) and maximum shelling percentage recorded in Sulabha (28.40%). Whereas, minimum shelling percentage is recorded in Ulall-2 (24.73%).

Keywords **:** Cashew, NAA, fruit set percentage, yield and shelling percentage.

Introduction

Cashew scientifically called as *Anacardium occidentale* L. and belong to a family Anacardiaceae. The family is rich in important secondary metabolites with varieties of interesting biological activities. Some other important species of Anacardiaceae include mango (*Mangifera indica*), pistachio (*Pistacia vera*), amra (*Spondia* spp.), pink peppercorn (*Schinus terebinthifolia*), marula nut (*Sclerocarya birrea*), and neotropical fruits (*Antrocaryon* spp.) (Saroj *et al*., 2014). Cashew is native of Brazil, was introduced in India during the later half of the Sixteenth Century for the purpose of afforestation and soil conservation.

Cashew has emerged as a major foreign exchange earner next only to tea and coffee. Cashew nut is one of the important nuts grown in the world and ranked first. Among various nuts such as hazelnuts, almonds, etc. (Saroj *et al*., 2014).

The increase in the global production is due to the benefits of the health and economic value of the crop. The ever-increasing global demand for cashew nuts as remarked by Adavi (2008) is because cashew kernels provide a predominantly unsaturated fat. Cashew nut contain all the essential amino acids and 1 kg of the nut yields about 6,000 calories, The cashew nuts are a valuable source of macro and micronutrients, such as protein (18 g 100 g^{-1}), fats (44 g 100 g^{-1}) and iron (7 g 100 g^{-1}), fat (47%), protein (21%) and carbohydrate (22%), and high levels of magnesium, zinc, copper, manganese and essential fatty acids (Nambiar, 1990). Cashew-nut industry plays a crucial role in the socio-economic development of the people in a cashew growing region. India has more than 3,900 processing units. The cashew sector in India provides employment to more than 15 lakhs of people which comprises 95 per cent of the rural women belonging to economically backward classes.

Cashew nut processing allows for the development of an important by-product, which can increase its value added products like tannins, ink, pectin obtained from residue of cashew, cosmetic industry, pharmaceutical industry, textile industry, paper industry, cashew nut shell liquid (CNSL) which is used in preservation of boats, nets, and wood, in insulating varnishes and resins (Murthy and Sivasamban, 1985).

Cashew tree is fast growing, an evergreen tropical tree, suitable to wide spectrum of climatic region. Morphologically, the architecture of cashew tree makes it a foremost tree crop for reclaiming land and act as bio-indicator that could have potential use in phytoremediation of polluted environments. At present area under cultivation of cashew is increasing not only for the income source but also prevention of desertification and soil erosion. Now cashew is considered as a gold mine of waste land crop (Adeigbe *et al*., 2015).

Flowering in cashew is usually profuse (200-800 flowers per panicle) and polygamous bears male and perfect or hermaphrodite flowers (Mohanty *et al*., 2006). The number of panicles per plant, flowers per panicle and

distribution of male and hermaphrodite flowers (sex ratio) in each panicle vary significantly, with an average observed ratio of 6:1 staminate to perfect flowers (Masawe *et al*., 1996), and less than 40% of hermaphrodite set fruit followed by a high rate of a premature fruit drop (Saroj *et al*., 2014). These are the major problems faced by cashew growers. All these problems overcome by foliar application growth regulators.

The plant growth regulators are considered as new generation agrochemicals after the fertilizers, pesticides and herbicides. Use of PGR in smaller doses results in modification of plant growth by stimulating system. At present there are about sixty commercial PGR available in market some of them are utilizing effectively in most of the horticulture crops (Anilkumar *et al*., 2005)

Material and Methods

An experiment was conducted on "Effect of NAA and ethephon on flower attributes and yield in cashew (*Anacardium occidentale* L.) genotypes under hill zone of Karnataka" was undertaken at College of Horticulture, Mudigere, Chikkamagaluru district of Karnataka, India during 2020-21. The research was implemented in Factorial Randomized Block Design (FRBD) with three replications.

Experiment conducted on ten-year-old uniform cashew genotypesThe experimental treatments comprised of tan varieties namely Kanaka, Priyanka, Sulabha, Vengurla-4, Dhanashree, Amrutha, Orchard, Ithcapur, Ulall-2, NDR-2-1 and 2 spray (NAA @ 100 ppm and ethephon) along with control (water spray).

Fruit set percentage was measured by the total numbers of hermaphrodite flowers were counted and using this data the per cent fruit set per panicle was worked out.

$$\text{Fruit set (\%)} \frac{\text{Total numbers of hermaphrodite flowers}}{\text{Fruit set per panicle}} \times 100$$

Yield per tree was recorded by collecting mature fallen nut and apple of each tree at 2-3 days interval, nut and apple of individual fruit were separated and weighed the total weight of nuts per tree in grams on weighing balance. This procedure was continued till the end of harvesting season and mean yield per tree was worked out.

Yield per hectare was worked out by multiplying the yield per tree with the number of plants per hectare and the mean yield per hectare was worked out.

Shelling percentage is a Processing of experimental raw nuts was done after completion of harvesting. Shelling per cent is calculated by dividing total weight of the kernel to the weight of raw nuts.

$$\text{Shelling (\%)} = \frac{Total\ weight\ of\ kernels}{Weight\ of\ raw\ nuts} \times 100$$

Results

Data on fruit set percentage presented in Table-1 revealed that, foliar application of NAA and ethephon on cashew genotypes. Significantly, maximum fruit set percentage is recorded in V_2 (Priyanka) *i.e.,* 26.50 % followed by V_3 (Sulabha) *i.e*., 25.83 %. Whereas, minimum fruit set percentage is recorded in V_7 (Orchard) *i.e*., 22.33 %. Among growth regulators *viz.,* S_2 (ethephon @ 50ppm) showed highest fruit set percentage (25.65 %). Whereas, S_3 (water spray) showed lowest fruit set percentage (24.40 %).Whereas ininteraction between cashew genotypes and growth regulators was found significant with respect to fruit set percentage. Maximum fruit set percentage is recorded in foliar application of ethephon on V_2 (Priyanka) *i.e*., 27.00 % followed by V_2S_1 (26.50cm). Whereas, lowest fruit set percentage is recorded in NAA and water spray on V_7 (Orchard) *i.e.,* 22.00%.

Data on yield presented in Table-1 revealed that, foliar application of NAA and ethephon on cashew genotypes. Significantly maximum yield is recorded in V_2 (Priyanka) *i.e.,* 4.53 kg followed by V_1 (Kanaka) *i.e.,* 4.07 kg. Whereas, minimum yield is recorded in V6 (Amrutha) *i.e.,* 3.10 kg. With respect to foliar application of NAA and ethephon, significantly, S_2 (ethephon @ 50ppm) showed highest yield per tree (3.98 kg/tree). Whereas, S_3 (water spray) showed lowest yield per tree (3.37 kg/tree) and among interaction effect between cashew genotypes and growth regulators was found significant with respect to yield per tree. Highest yield were recorded in foliar application of ethephon at 50 ppm on V_2 (Priyanaka) followed by V_3 (Sulabha) (4.90 kg/tree) and NAA spray on V_2 (Priyanaka) recorded (4.50 kg/tree). Whereas, lowest yield was recorded in water spray on V_5 Dhanashree (2.90 kg/tree).

The data on yield in cashew genotypes as influenced by NAA and ethephon is presented in Table-2. Significantly variety V_2 (Priyanka) shows highest yield per ha (776.67 kg/ha) followed by V_8 (Itchapur) *i.e.,* 760.00 kg per ha. Whereas, V_1 (Priyanka) shows lowest yield per ha (700.00 kg/ha). Among foliar spray of growth regulators significantly, S_2 (ethephon @ 50 ppm) spray showed highest yield per ha (769.00 kg/ha). Whereas, S_3 (Water spray) shows lowest yield per ha (718.00 kg/ha) and Interaction of cashew genotypes and growth regulators was found significant with respect to yield per ha. Highest yield per ha recorded in V_2S_2 (810.00 kg/ha) followed by V_3S_2 (800.00 kg/ha). Whereas, lowest yield was recorded in V_1S_3 (680.00 kg/ha).

Data pertaining to shelling percentage presented in Table-2 revealed that, foliar application of NAA and ethephon on cashew genotypes. Significantly maximum shelling percentage (28.40) observed in V_3 (Sulabha). Whereas, minimum shelling percentage (23.67) was recorded in V_1 (Kanaka). The shelling percentage had significant difference among growth regulators. S_2 (ethephon @ 50ppm) showed highest shelling percentage (26.35). Whereas, S_3 (water spray) showed lowest shelling percentage (24.74). Whereas, in interaction effect between cashew genotypes and growth regulators, it was found significant with respect to shelling percentage. Highest shelling percentage (29.00) is observed in foliar application of ethephon on V_3 (Sulabha) and is on par with foliar application of NAA @ 100ppm on V_3 (Sulabha). Whereas, lowest shelling percentage (22.00) was observed in water spray on V_1 (Kanaka).

Discussion

In cashew fruit set and their retention are the major limiting factors for low yield therefore which needs due attention (Mog and Nayak, 2020). In cashew only 55 per cent of fruit set is observed. Significantly, the highest fruit set percentage is recorded with foliar application of ethephon on Priyanka. Whereas, lowest percentage was recorded in water spray in Orchard variety. This variation is mainly due to increased number of bisexual flowers (Singh and Dhillon.,

1986). Ethephon mainly acts on sex expression by activating endogenous auxin this leads to reduction in stamiate flowers and increase in bisexual flowers reported by Mariappan *et al.* (1995). Similar observation recorded by Gawankar *et al.* (2010) in *cv*. Vengurla-7 and Lakshmipathi *et al.* (2014) in *cv*. Bhaskara. Higher fruit set in cashew with the application of ethrel was earlier reported by Pappiah *et al.* (1980), Gawankar *et al*. (2010) and Lakshmipathi *et al*. (2014).

Foliar application of ethephon @ 50 ppm shows significant increase in yield cashew genotype. Priyanka showed higher yield per tree and yield per hectare. Whereas, orchard showed lower yield per tree and yield per hectare. All these variation could be due to application of ethephon @ 50 ppm increases hermaphrodite flowers by reducing male flowers (Gawankar *et al.,* 2010). Nut yield positively correlated with number of flowering laterals per square meter, total number of laterals per square meter, duration of male flowers, duration perfect flowers, number of male flowers per panicle, number of perfect flowers per panicle, fruit set percent per panicle, fruit retention per panicle and nut weight (Kumar *et al*., 1995*)*. Similar observation also recorded by Mohan and Rao (1995), Lakshmipathi *et al*. (2014) in cultivar Bhaskara and Kulkarni *et al.* (2017).

Significantly maximum shelling percentage is observed in Sulabha and minimum in kanaka. Shelling percentage directly influenced on the total weight of the kernel and total weight of the raw nut Vikram *et al*. (2013).

Conclusion

Growth regulators significantly alleviate the fruit set percentage and yield parameters in cashew. Foliar application of ethephon at 50 ppm during flushing, flowering and fruit set stages of cashew genotypes showed positive response towards fruit set percentage, yield per tree and yield per hectare.

Priyanka showed good response with respect to fruit set percentage, panicle, number of yield (kg/tree) and yield (kg/ha) followed by variety Sulabha showed good response to the foliar application ethephon @ 50 ppm.

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Table 1 : Effect of NAA and ethephon on fruit set percentage and yield (kg/tree) in cashew (*Anacardium occidentale*L.) genotypes.

	Fruit set percentage	**Yield (kg/tree)**
Factors-1 (genotypes)		
V_1 (Kanaka)	25.57	4.07
V_2 (Priyanka)	26.50	4.53
V_3 (Sulabha)	25.83	3.97
V_4 (Vengurla-4)	25.50	3.70
V_5 (Dhanashree)	25.33	3.27
V_6 (Amrutha)	24.50	3.10
V_7 (Orchard)	22.33	3.50
V_8 (Itchapur)	25.17	3.57
V_9 (Ullal-2)	24.83	3.50
V_{10} (NDR-2-1)	24.50	3.37
S.Em ±	0.23	0.03
C.D @ 5%	0.64	0.09
Factors – 2 (Sprays)		
S_1 (NAA @ 100 ppm)	24.97	3.62
S_2 (ethephon @ 50ppm)	25.65	3.98
S_3 (water spray)	24.40	3.37
S.Em ±	0.12	0.02
C.D @ 5 %	0.35	0.05

Cont…

Interaction effect (v × s)		
V_1S_1(Kanaka NAA @ 100 ppm)	25.20	4.20
V_2S_1(Priyanka NAA @ 100 ppm)	26.50	4.50
V_3S_1(Sulabha NAA @ 100 ppm)	26.00	3.90
V_4S_1(Vengurla-4 NAA @ 100 ppm)	26.00	3.70
V_5S_1(Dhanashree NAA @ 100 ppm)	25.00	3.20
V_6S_1(Amrutha NAA @ 100 ppm)	24.50	3.40
V_7S_1(Orchard NAA @ 100 ppm)	22.00	3.00
V_8S_1(Itchapur NAA @ 100 ppm)	25.00	3.60
V_9S_1(Ullal-2 NAA @ 100 ppm)	25.00	3.50
V_10S_1(NDR-2-1 NAA @ 100 ppm)	24.50	3.20
V_1S_2(Kanaka ethephon @ 50 ppm)	26.50	4.10
V_2S_2(Priyanka ethephon @ 50 ppm)	27.00	4.90
V_3S_2(Sulabha ethephon @ 50 ppm)	26.50	4.50

V_4S_2(Vengurla-4 ethephon @ 50 ppm)	26.00	4.00
V_5S_2(Dhanashree ethephon @ 50 ppm)	26.00	3.70
V_6S_2(Amrutha ethephon @ 50 ppm)	25.00	3.70
V_7S_2(Orchard ethephon @ 50 ppm)	23.00	3.30
V_8S_2(Itchapur ethephon @ 50 ppm)	26.00	3.90
V_9S_2(Ullal-2 ethephon @ 50 ppm)	25.50	4.00
$V_{10}S_2$(NDR-2-1 ethephon @ 50 ppm)	25.00	3.70
V_1S_3(Kanaka water spray)	25.00	3.90
V_2S_3(Kanaka water spray)	26.00	4.20
V_3S_3(Sulabha water spray)	25.00	3.50
V_4S_3(Vengurla-4 water spray)	24.50	3.40
V_5S_3(Dhanshree water spray)	25.00	2.90
V_6S_3(Amrutha water spray)	24.00	3.40
V_7S_3(Orchard water spray)	22.00	3.00
V_8S_3(Itchapur water spray)	24.50	3.20
V_9S_3(Ullal-2 water spray)	24.00	3.00
$V_{10}S_3$(NDR-2-1 water spray)	24.00	3.20
S. Em±	0.39	0.05
C.D @ 5%	1.11	0.15

Table 2 : Effect of NAA and ethephon on yield kg/tree and shelling percentage in cashew (*Anacardium occidentale*L.) genotypes.

	Yield (kg/tree)	**Shelling percentage**
Factors -1 (genotypes)		
V_1 (Kanaka)	700.00	23.67
V_2 (Priyanka)	776.67	26.23
V_3 (Sulabha)	760.00	28.40
V_4 (Vengurla-4)	741.33	26.45
V_5 (Dhanashree)	713.33	25.22
V_6 (Amrutha)	706.67	25.67
V_7 (Orchard)	736.67	24.93
V_8 (Itchapur)	750.00	25.17
V_9 (Ullal-2)	746.67	24.73
V_{10} (NDR-2-1)	733.33	25.10
S.Em ±	6.72	0.21
C.D @ 5%	19.02	0.60
Factors – 2 (Sprays)		
S_1 (NAA @ 100 ppm)	722.40	25.58
S_2 (ethephon @ 50ppm)	769.00	26.35
S_3 (water spray)	718.00	24.74
S.Em ±	3.68	0.12
C.D @ 5 %	10.42	0.33

Cont….

Interaction effect (v × s)		
V_1S_1(Kanaka NAA @ 100 ppm)	690.00	24.00
V_2S_1(Priyanka NAA @ 100 ppm)	750.00	26.00
V_3S_1(Sulabha NAA @ 100 ppm)	750.00	28.30
V_4S_1(Vengurla-4 NAA @ 100 ppm)	724.00	26.60
V_5S_1(Dhanashree NAA @ 100 ppm)	700.00	25.00
V_6S_1(Amrutha NAA @ 100 ppm)	690.00	26.00
V_7S_1(Orchard NAA @ 100 ppm)	720.00	24.90
V_8S_1(Itchapur NAA @ 100 ppm)	730.00	25.00
V_9S_1(Ullal-2 NAA @ 100 ppm)	740.00	24.70
V_10S_1(NDR-2-1 NAA @ 100 ppm)	730.00	25.30
V_1S_2(Kanaka ethephon @ 50 ppm)	730.00	25.00
V_2S_2(Priyanka ethephon @ 50 ppm)	810.00	27.00
V_3S_2(Sulabha ethephon @ 50 ppm)	800.00	29.00
V_4S_2(Vengurla-4 ethephon @ 50 ppm)	790.00	27.00
V_5S_2(Dhanashree ethephon @ 50))ppm)	750.00	26.00
V_6S_2(Amrutha ethephon @ 50 ppm)	730.00	27.00

V_7S_2(Orchard ethephon @ 50 ppm)	780.00	25.40
V_8S_2(Itchapur ethephon @ 50 ppm)	780.00	25.60
V_9S_2(Ullal-2 ethephon @ 50 ppm)	770.00	25.50
$V_{10}S_2$(NDR-2-1 ethephon @ 50 ppm)	750.00	26.00
V_1S_3(Kanaka water spray)	680.00	22.00
V_2S_3(Kanaka water spray)	770.00	25.70
V_3S_3(Sulabha water spray)	740.00	27.90
V_4S_3(Vengurla-4 water spray)	720.00	25.76
V_5S_3(Dhanshree water spray)	690.00	24.67
V_6S_3(Amrutha water spray)	700.00	24.00
V_7S_3(Orchard water spray)	710.00	24.50
V_8S_3(Itchapur water spray)	720.00	24.90
V_9S_3(Ullal-2 water spray)	730.00	24.00
$V_{10}S_3$(NDR-2-1 water spray)	720.00	24.00
S. Em±	11.65	0.37
C.D @ 5%	32.94	1.04

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