



Effect of Supplementary Irrigation with Reference to Growth and Yield of Cashew under South Konkan Region of Maharashtra

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A field trial was conducted at Regional Fruit Research Station, Vengurle, Dist. Sindhudurg (Maharashtra) with an objective to study the effect of post monsoon irrigation on flowering, fruiting and yield of cashewnut. (*Anacardium occidentale* L.) under South Konkan region of Maharashtra under AICRP-Cashew programme during the year 2014-15 and 2015-16. The experiment was laid out with 5 treatments viz., Irrigation at 20%, 40%, 60% and 80% CPE and control, under Randomized Block Design with four replications through drip irrigation methods daily from January to April. The quantity of water required in liter tree⁻¹ day⁻¹ and month-wise as per treatment was calculated on the basis of daily evaporation averages of 5 years. The recommended package of practices was simultaneously followed including the plant protection schedule. The various flowering, fruiting and yield parameters were recorded at appropriate stages during both the years. Among the different irrigation levels investigated, application of drip irrigation at 80% CPE (T₅) recorded significantly the highest number of flowering panicles (20.11 m²), number of nuts per panicle (6.8), nut weight (9.9 g), apple weight (81.0 g) and nut yield of 10.54 kg tree⁻¹ and it also increased the nut yield by 91.6% over control. While, the lowest yield 5.50 kg tree⁻¹ was recorded in control (No irrigation).

(*Key words*: Cashew, CPE, Drip irrigation, Panicles, Yield)

Konkan region of Maharashtra has been bestowed with diversified natural resources. In spite of high annual rainfall of 3250 mm, scarcity of water is the normal phenomenon during post monsoon period especially during critical stages like flowering and fruiting stages of cashew which resulted into severe moisture stress and further availability of soil nutrients (uptake) might be low that affect the yield of nuts.

Cashew is mainly grown under rainfed conditions. However, in homestead gardens supplementary irrigation during summer (January to April) at fortnightly intervals @ 200 liters per plant doubles the yield (Anon., 1989). Earlier studies on irrigation of cashew indicated doubling the yield of cashewnut by providing irrigation during flowering and fruiting season.

Fertilizers are generally applied to cashew during monsoon season. However, cashew experiences severe moisture stress from January to May, as a result there is low availability of nutrients, which adversely affects the size of nut, apple, nut drop and further the total yield. Considering the heat stress during March-April, it is suggested to provide the micro irrigation to cashew orchard. In this view attempt has been made to assess the effect of post monsoon irrigation on flowering, fruiting and yield of cashewnut.

MATERIALS AND METHODS

A field trial was conducted during 2014-15 to 2015-16 at All India Coordinated Project on Cashewnut, Regional Fruit Research Station, Vengurle, Dist. Sindhudurg (Maharashtra). The soil of the experimental field was lateritic sandy clay loam in texture with acidic reaction. The experiment was laid out with 5 treatments (levels) viz., irrigation at 20%, 40%, 60% and 80% cumulative pan evaporation (CPE) and control, under randomized block design with four replications. Uniform 15 years old trees of cashew cv. Vengurla-7 planted at 10m x 7m (142 plants ha⁻¹) were used for the present experimentation. The recommended package of practices including fertilizers application (2.17 kg Urea, 1.5 kg SSP and 400 g of MOP plant⁻¹ year⁻¹) by excavating round trenches of 30 cm x 20 cm size under the tree and 1.5 m away from trunk was uniformly followed simultaneously including plant protection schedule.

The lateral lines of 16 mm diameter LDPE pipes were laid along the crop rows and each lateral served each row of crop. The laterals were provided with on line turbo key dripper of 4 litres per hour discharge capacity. LDPE pipes of 75 mm diameter were used for main and 63 mm diameter was used for sub-main. The main line was directly connected to a 10 HP electric pump installed

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to lift water from an open well. The manifold unit consisted of a screen filter, pressure gauge and control valve. The duration of delivery of water to each treatment was controlled with the help of gate valves provided at the inlet end of each lateral.

The daily drip irrigation treatments were applied at 50% flowering and it continued for 4 months from January to April. The quantity of water required in liters tree⁻¹ day⁻¹ as per treatment based on daily evaporation averages of 5 years was calculated. Similarly duration of irrigation in minutes to operate drip irrigation system as per application rate per plant was worked out (Table 1). Irrigation was applied daily as per treatment from January to April end. Total four drippers per tree were placed in round manner at 1.5 m distance away from the tree trunk at East, West, North and South directions. The flow rate per dripper was @4 liters water per hour.

The various growth and yield attributes were recorded during both the years (2013-14 & 2014-15) at appropriate stages. The data were statistically analyzed by following the procedure given by Panse and Sukhatme (1995).

RESULTS AND DISCUSSIONS

Effect of drip irrigation levels on flowering and fruiting attributes of cashew

The pooled data on flowering and fruiting parameters of cashew presented in Table 2 revealed that the various supplementary irrigation treatments significantly influenced the production of panicles per m², number of nuts per panicle and flowering duration (days) during investigation period and pooled study except the sex ratio during both the years as well as in pooled analysis and flowering duration in pooled analysis.

The application of drip irrigation at 80% CPE (T₅) produced significantly maximum 31.00 and 31.87 laterals per m² during the year 2014-15 and 2015-16, respectively and similar trend was observed in pooled analysis (31.43 m⁻²). However, it was on par with all the treatments during the year 2014-15 and on par with T₄ (29.80 m⁻²) during the year 2015-16 and in pooled study (29.56 m⁻²). Present findings are in conformity with results of Mishra *et al.*, (2008) who reported that the maximum canopy area (34.1 m²) was obtained under application of 80% irrigation requirement through drip with black LDPE mulch.

Table 1. Drip irrigation schedule (2014-15 and 2015-16)

Month	Daily evaporation Av. of 5 years	Treatments	Liters of water tree ⁻¹ day ⁻¹ as per the treatment	Duration of irrigation (Minutes)
January	4.0	I ₁ = Control	–	–
		I ₂ = 20% CPE	22.6	85
		I ₃ = 40% CPE	45.2	170
		I ₄ = 60% CPE	67.8	255
		I ₅ = 80% CPE	90.4	340
February	4.5	I ₁ = Control	–	–
		I ₂ = 20% CPE	25.43	95
		I ₃ = 40% CPE	50.86	190
		I ₄ = 60% CPE	76.29	285
		I ₅ = 80% CPE	101.7	380
March	5.3	I ₁ = Control	–	–
		I ₂ = 20% CPE	30.0	113
		I ₃ = 40% CPE	60.0	226
		I ₄ = 60% CPE	90.0	339
		I ₅ = 80% CPE	120.0	452
April	5.9	I ₁ = Control	–	–
		I ₂ = 20% CPE	33.34	125
		I ₃ = 40% CPE	66.68	250
		I ₄ = 60% CPE	100.02	375
		I ₅ = 80% CPE	133.36	500

Remarks: Drippers having flow rate of 4 L h⁻¹

Table 2. Effect of drip irrigation levels on flowering and fruiting parameters of cashew

Treatments	No. of laterals m ⁻²			No. of flowering panicles m ⁻²			Sex ratio (Bisexual : male)			No. of nuts panicle ⁻¹			Flowering duration (days)		
	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean
T1 : No irrigation	28.3	25.0	26.6	16.38	15.55	15.96	0.17	0.16	0.16	8.2	2.4	5.3	98.70	97.75	98.22
T2 : Irrigation at 20% CPE	28.6	27.6	28.1	17.40	16.62	17.01	0.18	0.17	0.17	8.4	3.0	5.7	98.75	98.25	98.54
T3 : Irrigation at 40% CPE	28.9	28.8	28.9	17.65	17.37	17.51	0.19	0.18	0.18	8.5	3.5	6.0	98.83	98.25	98.54
T4 : Irrigation at 60% CPE	29.3	29.6	29.5	18.65	18.22	18.43	0.19	0.18	0.18	8.6	3.6	6.1	100.1	100.5	100.3
T5: Irrigation at 80% CPE	31.0	31.8	31.4	20.02	20.20	20.11	0.21	0.19	0.20	9.0	4.7	6.8	101.5	103.2	102.4
SEm ±	1.08	1.04	0.72	0.38	0.29	0.22	0.002	0.009	0.001	0.09	0.23	0.16	2.70	1.24	1.36
C.D. at 5%	3.08	3.20	2.09	1.18	0.91	0.69	NS	NS	NS	0.28	0.73	0.47	8.33	3.85	NS

Table 3. Effect of drip irrigation levels on yield attributes of cashew

Treatments	Nut wt. (g)			Apple wt. (g)			Yield (kg tree ⁻¹)			Yield (t ha ⁻¹)			Shelling (%)		
	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean	2014-15	2015-16	Pooled mean
T1 : No irrigation	8.2	9.4	8.8	61.0	65.0	63.0	5.90	5.11	5.51	0.83	0.72	0.78	31.2	29.2	30.2
T2 : Irrigation at 20% CPE	8.4	9.8	9.1	64.5	70.0	67.2	7.12	5.58	6.35	1.01	0.79	0.90	31.4	30.0	30.7
T3 : Irrigation at 40% CPE	8.5	10.0	9.3	65.1	75.0	70.1	8.84	6.18	7.51	1.25	0.88	1.13	31.1	29.7	30.4
T4 : Irrigation at 60% CPE	8.6	10.2	9.4	66.2	80.2	73.1	10.53	7.11	8.82	1.49	1.00	1.18	31.0	30.5	30.7
T5: Irrigation at 80% CPE	9.0	10.9	9.9	72.1	90.0	81.0	13.49	7.59	10.54	1.92	1.07	1.49	30.8	31.5	31.2
SEm ±	0.09	0.13	0.08	1.60	3.53	2.02	0.54	0.50	0.51	0.09	0.07	0.07	0.32	0.26	0.25
C.D. at 5%	0.28	0.40	0.24	4.93	10.9	5.86	1.99	1.55	1.48	0.28	0.22	0.22	NS	0.80	NS

In the present study slightly uniform production of laterals m^{-2} during the year 2014-15 was due to late monsoon showers during November and December that might have directly affected the actual treatment effects. While, considerably lesser production of number of laterals m^{-2} during 2015-16 is contributed to very low annual rainfall (less than 50% of average).

Significantly higher number of panicles m^{-2} was noticed during both the years 2014-15 (20.20 m^{-2}) and 2015-16 (20.02 m^{-2}) when irrigation was applied at 80% CPE (T_5). Similar trend was also observed in pooled analysis (20.11 m^{-2}). The increased number of panicles m^{-2} in T_5 treatment over other treatments could be attributed to sufficient availability of soil moisture and further efficient use of nutrients thereby led to an increase in number of panicles in m^{-2} . The increase in number of panicles during 2015 inspite of low rainfall could be attributed to availability of optimum moisture through supplementary irrigation during flowering stage that might have enhanced the production of panicles m^{-2} .

Significantly the maximum number of nuts per panicle was recorded during both years (9.0 and 4.67) and also in pooled study (6.8), when drip irrigation was applied at 80% CPE. The present results are in line with the findings of Mishra *et al.* (2008) who reported highest number of nuts per panicle of cashew (7.0) with 80% irrigation requirement through drip irrigation with LDPE mulch.

Production of slightly lesser number of nuts per panicle during 2015-16 could be due to low annual rainfall as well as drying of flowers and low fruit set due to climatic influence that prevailed during flowering and fruiting stage. However, later on during March and April, there was improvement in setting of nuts per panicle.

Treatment T_8 (irrigation at 80% CPE) significantly recorded the maximum flowering duration during both the years 2014-15 (101.5 days) and 2015-16 (103.25 days) however, result are non-significant for pooled analysis (Table 2). While, minimum flowering duration of 98.70 days and 97.75 days during the year 2014-15 and 2015-16 respectively, were recorded when trees were not irrigated (T_1 - Control).

Effect of drip irrigation levels on yield attributes of cashew

It is seen from the data presented in Table 3 that the drip irrigation levels significantly influenced the nut weight (g), apple weight (g), yield (kg tree^{-1}) and shelling percentage during both years and pooled study.

Significantly the maximum nut weight of 9.0 g and 10.9 g was observed when irrigation was imposed at 80% CPE during the year 2014-15 and 2015-16, respectively and pooled study (9.9 g). While, minimum nut weight of 8.2 g, 9.4 g and 8.8 g was noted under control (T_1 : no irrigation) during both years and also in pooled study. The present investigation are accordance with Mishra *et al.* (2008) who reported maximum nut weight (7.3 g) in treatment with application of 80% irrigation requirement through drip irrigation with LDPE mulch.

In the present investigation, weight of nut was slightly lower during 2014-15. It was mainly due to late monsoon showers that increased the number of nuts panicle⁻¹. However, during 2015-16 the numbers of nuts panicle⁻¹ were decreased and resulted in increase in nut weight as compared to the year 2014-15. This phenomenon was also reported by Oliveira (2002) that, when irrigation was applied to cashew plants, the number of nuts per tree increased with decrease in nut weight.

The apple weight of cashew was found maximum 72.1 g, 90.0 g and 81.0 g during 2014-15, 2015-16 and also in pooled study, respectively when trees were irrigated at 80% CPE while lower apple weight of 61.0 g and 65.0 g was observed during both years respectively under control (T_1 : no irrigation). In the present finding, there was increment of yield (kg tree^{-1}) as the quantity of water application increased. Significantly maximum yield of $13.49 \text{ kg tree}^{-1}$ and 7.59 kg/tree was recorded by application of irrigation at 80% CPE (T_5) during the both the years 2014-15 and 2015-16, respectively and similar trend was observed in pooled study ($10.54 \text{ kg tree}^{-1}$) and it was superior over rest of treatments. While, comparatively lowest yield was recorded under control (T_1 – no irrigation) during both the years 2014-15 ($5.90 \text{ kg tree}^{-1}$) and 2015-16 ($5.11 \text{ kg tree}^{-1}$).

Application of irrigation at 80% CPE (T_5) increased yield (kg tree^{-1}) by 128.6% and 48% over control (T_1) during the 2014-15 and 2015-16, respectively. The present results are in agreement with the finding of Mishra *et al.* (2008) who reported that the use of drip either alone or in combination with mulching can increase the cashew yield up to an extent of 108%. Oliveira *et al.* (2006) found an increase of around 70% (mean over seven years) in the production of nuts of irrigated plants. The reasons of low yield in non irrigated crop may be due to water stress which the crop has to undergo especially during the critical growth periods. Similar findings were also reported by earlier workers

(Subramanian *et al.*, 1997; Pattanaik *et al.*, 2003; Mishra *et al.*, 2008).

CONCLUSION

Among the different irrigation levels tested, application of drip irrigation @ 80% CPE (T_s) recorded maximum number of flowering panicles, flowering duration, number of nut per panicle, nut weight, apple weight and nut yield during both years and it also increased mean pooled nut yield by 91% over control (no irrigation).

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