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Special Issue

Technological Interventions for Sustainable Cashewnut Production under Climatic Vagaries in Konkan Region

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Abstract

Cashew (*Anacardium occidentale* L.), a hardy and drought tolerant plantation crop which was introduced by Portuguese to India, has now extensively expanded to West as well as East Coast of India as a major source of livelihood of coastal population. Climatic fluctuations have affected the normal behaviour of cashew. Various climatic aberrations viz., dry spell, cloudy weather, and heavy rains during flowering and fruit set adversely modify phenology, pests' incidence as well as yield of cashew. Among various weather parameters humidity and temperature variation contribute significantly. These two weather parameters during differentiation exhibits significant effect on sex expression. The humidity alone had a significant positive correlation with yield, whereas rainy days were found to be most important weather determinant of yield variability of cashew hybrids. Continuous rains with cloudy weather also adversely affect yield and quality of nut due to increase in incidence of pests and diseases. The improved varieties of cashew not only produce bold nut with bunch bearing, high yield and high shelling but also perform well under changing climatic aberrations. Integrated nutrient management, proper soil conservation measures along with appropriate plant protection measures improve pollination and fruit set.

Key words: Cashew, Climate, agro-techniques, high yielding varieties, processing.

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Introduction

Cashew (*Anacardium occidentale* L) was introduced to India by the Portuguese in the sixteenth century with intention of soil conservation and afforestation in the coastal region. It is established on 47 lakh ha in India mostly on the Eastern and Western coastal area with production of 42 lakh MT which is the largest in the world. It is one of the major source to provide livelihood in the coastal region by offering employment opportunities in the farming, processing and trading. At present 3900 small and large industries in India providing gainful employment to over 1 million workers in farm and factories (Anonymous 2019). Cashew is essentially a hardy and drought-resistant tropical crop, grows best in warm, humid and typically tropical climate with a well-defined dry season of at least 4-5 months, followed by rainy season of 4-5 months to produce best yield. Climatic requirements of cashew crop are well documented by several workers in recent past (Salvi *et al*. 2016, Saroj *et al.* 2016, Haldankar *et al.* 2002, Haldankar *et al.* 2003).

Climate association with Cashew phenology

Cashew is an evergreen plantation crop and produces three to four vegetative flushes under normal climatic conditions. It thrives well even under rainfed conditions. It shades mature leaves in the month of October at the end of monsoon. At the beginning of winter, it produces new flushes which further produces flowering panicles. The panicles are andromonoecious containing male and hermaphrodite flowers. After initiation of panicle it takes 90 to 120 days to complete opening of flower. Cashew fruit is swollen peduncle with a nut and takes 60 days from fruit set to maturity. The recent climatic fluctuations have remarkably influenced the normal

Table 1. The maximum and minimum temperature and humidity for flowering in cashew.

Week	Max. Temp. ºC			Min. Temp. ºC			Humidity %		
	95-96	96-97	98-99	95-96	96-97	98-99	95-96	96-97	98-99
20-26 Aug	30.77	29.40	30.66	24.21	23.9	24.91	88.50	87.07	88.92
27-2 Sept.	26.87	27.30	28.60	23.57	23.60	24.58	91.86	88.85	87.50
3-9 Sept.	29.91	29.90	28.20	24.00	23.90	24.50	82.36	86.72	89.43
10-16 Sept.	30.39	30.90	28.60	23.61	24.00	23.98	85.00	84.29	90.71
17-23 Sept.	31.14	30.60	29.90	24.03	23.70	23.92	81.35	78.79	81.36
24-30 Sept.	30.97	31.40	30.50	23.77	23.90	24.71	83.29	82.64	88.50
1-7 Oct	32.06	26.60	30.20	23.49	22.80	23.80	80.43	85.00	86.71
8-14 Oct	30.71	33.60	30.80	24.18	22.90	25.20	85.93	72.36	87.36
15-21 Oct	31.32	32.80	29.90	23.29	18.40	23.31	85.93	74.14	83.14
22-28 Oct	33.51	30.80	30.50	22.53	23.50	23.14	76.14	76.86	81.93
29-4 Oct	34.03	30.90	32.50	17.93	21.80	21.97	72.36	74.78	80.30
5-11 Nov.	33.01	32.40	31.80	16.97	18.10	23.39	67.99	71.07	80.71
12-18 Nov.	32.89	33.50	32.20	18.06	21.20	21.27	67.92	66.28	76.14
19-25 Nov.	32.74	33.60	32.40	21.51	17.20	18.74	73.78	62.64	71.85
26-2 Dec.	31.69	33.40	31.80	20.17	16.80	16.69	73.28	65.78	62.28
3-9 Dec.	32.91	31.60	33.75	18.26	18.40	16.34	66.14	59.57	62.28
10-16 Dec.	32.63	33.40	33.11	15.29	21.30	21.66	62.85	67.57	69.21
17-23 Dec.	32.83	31.90	32.25	15.49	25.20	14.93	65.71	72.78	66.21
24-31 Dec.	31.93	31.60	32.82	16.54	19.90	16.02	68.56	67.68	57.67
1-7 Jan.	31.50	30.90	31.88	18.23	16.20	15.04	69.63	64.42	65.50
8-14 Jan.	31.20	32.00	30.96	16.93	18.80	16.17	64.28	69.00	66.78
15-21 Jan.	30.97	31.80	32.50	17.07	11.50	15.44	64.42	57.35	64.71
22-28 Jan.	32.21	30.20	31.13	16.16	13.90	14.50	69.21	65.21	68.35
29-4 Feb.	32.73	30.10	30.60	16.44	16.50	14.75	64.00	66.51	68.07
5-11 Feb.	31.90	30.40	31.60	16.40	14.70	18.87	62.99	68.64	67.07
12-18 Feb.	32.30	33.80	33.01	19.30	12.80	19.60	64.99	57.07	71.64
19-25 Feb.	32.80	29.90	33.10	17.00	15.20	17.04	67.63	63.64	64.50
26-4 Mar.	31.80	31.40	31.10	18.30	18.40	20.29	66.85	79.35	73.14
5-11 Mar.	31.40	31.10	32.00	20.30	19.30	21.91	77.49	78.14	73.28
12-18 Mar.	32.80	31.60	32.13	22.80	22.50	24.90	76.78	78.50	66.28
19-25 mar.	32.20	33.20	32.43	22.50	22.20	23.20	69.63	60.28	69.14
26-1 April	31.35	32.70	32.00	21.60	21.60	23.70	67.92	61.14	72.00

Source: Haldankar *et al.* 2004

behavior of cashew. Various climatic aberrations like dry spell during flowering and fruit set, high temperature (39-42ºC) during marble stage of fruit development have been observed which aggravates fruit drop, pest and disease incidence and their by yield. The dry spell during flowering and fruit setting ensure better harvest (Haldankar *et al.* 2004). The effects of weather parameters 4 weeks, 6 weeks, 12 weeks and 16 weeks before flowering was studied and used for multiple coefficient analysis.

The flowering in cashew commenced from last fortnight of December in 1995-96 and 1996-97 whereas it started in first week of January during 1998-99. The shortest flowering span (53 days) was observed in 1995-96 whereas it was extended upto 127 days in 1996-97. The male flower production during 1998-99 was maximum

Table 2. Flowering pattern of cashew hybrids

Period of flowering	1995-96		1996-97		1998-99		Average	
	Male	Female	Male	Female	Male	Female	Male	Female
Total	**403.15**	**184.56**	**297.09**	**76.77**	**540.60**	**118.88**	**413.61**	**126.74**
10th to 16th Dec.	29.00	9.66	-	4.00	-	-	9.67	3.22
17th to 23rd Dec.	44.00	27.33	5.16	8.33	-	-	16.38	10.44
24th to 31st Dec.	73.66	27.00	33.00	6.06	-	-	35.55	11.78
01st to 07th Jan.	46.66	17.53	44.00	6.33	58.41	13.13	49.71	12.24
8th to 14th Jan.	52.53	20.60	52.66	7.46	141.15	7.20	82.05	11.38
15th to 21st Jan.	35.66	22.40	47.53	7.80	51.21	9.48	44.80	13.11
22nd to 28th Jan.	36.33	20.06	22.53	9.00	54.08	16.71	37.65	14.76
29th to 04th Feb.	24.66	12.26	25.86	5.13	39.95	12.30	26.82	11.19
05th to 11th Feb.	28.40	10.73	16.06	7.40	36.50	10.28	26.99	8.71
12th to 18th Feb.	23.86	10.46	17.80	3.53	32.50	9.01	24.72	8.96
19th to 25th Feb.	6.66	5.80	9.20	3.00	30.25	7.18	15.37	5.50
26th Feb. to 04th March	1.93	0.73	8.60	2.80	27.20	10.80	12.58	10.31
05th to 11th March	-	-	6.86	3.20	26.90	8.03	11.25	3.61
12th to 18th March	-	-	3.30	1.27	12.26	4.45	5.19	2.55
19th to 25th March	-	-	1.80	0.53	8.66	4.33	3.49	1.87
26th to 01st April	-	-	0.40	0.53	15.38	4.30	5.26	1.61
02nd to 08th April	-	-	0.73	0.20	6.15	1.68	2.29	0.74
09th to 15th April	-	-	0.60	0.20	-	-	0.20	0.06
16th to 22nd April	-	-	1.00	0.20	-	-	0.30	0.06
Total duration of flowering	53		127		98		92.66	
Male: Female ratio	2.18:1		3.86:1		4.54:1		3.26:1	

Source: Haldankar *et al.* 2004.

Table 3. Weather factors and yield for eleven years in cashew cv. Vengurla-1

Year	Yield (kg ha^{-1})	Max. Temp. (ºC)	Min. Temp. (ºC)	Humidity (%)	Rainfall (mm)	Rainy days
1990-91	1050	32.0	21.0	68	1413	124
1991-92	1172	32.0	19.4	65	2625	98
1992-93	1960	31.9	23.4	71	2552	88
1993-94	1107	32.5	19.8	65	2816	108
1994-95	1272	32.5	21.8	71	2389	132
1995-96	1856	32.2	18.5	73	3796	114
1996-97	1784	31.6	18.4	78	2763	86
1997-98	4392	32.4	22.3	85	3038	106
1998-99	2753	32.2	18.5	79	3138	133
1999-00	2299	32.2	19.2	77	3315	139
2000-01	1433	32.2	19.9	67	3831	136
Mean	1916	32.2	20.1	73	2879	14.9
CV	49	<1	8	8	23	16

Source: Haldankar *et al.* 2003.

(540.6) in 1998-99 whereas in 1995-96 the bisexual flowers were the highest (184.56).

It was also noticed that weather parameters 8 weeks before flowering contributes towards the significant variation in male flowers. The fruit bud differentiation might have started 8 weeks before flowering which have contributed in variation towards male flowering. Among the weather components humidity and temperature variation 8 weeks of flowering contribute towards significant change. It confirms role of weather during differentiation period causing variation in bisexual flower production in cashewnut. As the proportion of male and hermaphrodite dictated the production behavior in cashew an early evaluation of weather for possible change in sex ratio could be an important tool to predict production pattern (Haldankar *et al.* 2002).

The effect of weather on yield of cashew var. Vengurla-1 was investigated under costal climatic conditions of Konkan and the data depicted that the yield was highest (4392 kg ha^{-1}) in 1997-98 whereas it was lowest (1050 kg ha^{-1}) in 1990-91.

The correlation of coefficient of yield with monthly weather parameters was also estimated.

The humidity alone had close and highly significant positive association (r=+0.89) with yield. None of the other weather parameters showed marked association with cashewnut yield. The analysis of weekly weather parameters indicated moderate variation for maximum and minimum temperature and relative humidity. During 1997-98 the yield level was highest when mean maximum temperature ranged between 28.8 and 33.8 ºC. Minimum temperature between 16.9 and 24.5 ºC with relative humidity ranging from 71 to 92 percentage (Saroj *et al.* 2016). The variation in weather parameters also affected the yield of F_1 cashew hybrids.

The rainy days had significant positive correlation (r=0.735) with yield. The other weather components showed non significant association with yield of cashew hybrids.

The rainy days were the most important determinant of yield variability of cashew hybrids. The rainfall during different months did not show any relationship with yield except in May indicating that quality of rainfall after June is the component of less importance with respect to cashew yield (Salvi *et al.* 2016).

During recent past, frequency of occurring unseasonal rains, partially during November to March, has increased. Such unseasonal rainy showers for short spell followed by bright sunshine hours may not be harmful but beneficial to cashew crop for yield but continuous rains with cloudy weather for few days, may adversely affect, as such conditions are congenial for outbreak of many pests and diseases which not only reduced the yield but also lead to blackening of nuts and market quality (Haldankar *et al.* 2003).

The thrips population was negligible below 18±1°C and 53±1% afternoon humidity. The maximum population was observed in between 18±1°C to 21±1°C and declined afterwards. The thrips infestation was high during the period of flushing and flowering which coincide with the winter season (January to March). The regression equation accounted for more than 89 per cent variability

Table 4. Correlation co-efficient of yield with monthly weather parameters in cashew

Weather parameters	Yield
Max. Temp.	0.150
Min. Temp.	0.214
Humidity	0.890**
Rainfall	0.313
Rainy days	0.031

**Significant at 1 per cent level, Source: Haldankar *et al.* 2003

Table 5. Correlation co-efficient of yield on the basis of weather parameters in cashew hybrids

	Max. Temp.	Mini. Temp.	Humidity	Rainfall	Rainy days	Yield
Max. Temp.	1.00000	0.18457	-0.05843	0.33314	0.60100*	0.5280
Mini. Temp.		1.00000	0.09371	-0.43037	-0.25200	-0.3100
Humidity			1.00000	0.27038	0.00067	-0.0870
Rainfall				1.00000	0.21601	0.4210
Rainy days					1.00000	0.7350*
						1.00000

*Significant at 5 per cent level of significance, Source: Haldankar *et al.* 2002.

Table 6. Association between rainy days in May and June with yield in cashew hybrids.

Year	Yield (kg)	Temp. Max. (ºC)	Temp. Min (ºC)	Humidity (%)	Rainfall (mm)	Rainy days
1991	2253	32.08	21.04	68.21	1413.00	124
1992	1430	32.00	19.49	65.77	2625.00	98
1993	1128	31.94	23.42	71.92	2552.00	88
1994	2120	32.59	19.86	65.28	2816.00	108
1995	2554	32.56	21.82	71.95	2389.00	132
1996	1928	32.27	18.50	73.35	3796.00	114
1997	1290	31.60	18.45	78.47	2763.10	86
1998	2534	32.45	22.32	85.09	3038.00	106
1999	2050	32.28	18.54	79.58	3138.40	138
2000	2774	32.28	19.28	77.21	3315.00	139
2001	4621	32.33	19.91	67.93	3831.40	136
Mean	2243.00	32.22	20.15	73.16	2879.68	114.90
Range	1128-4621	31.60-32.59	18.50-23.42	65.26-85.09	1413-3831	86-139
SD	953.01	0.28	1.65	6.03	647.0	18.51
CV	42.50	0.87	8.20	8.24	22.49	16.08

Source: Haldankar *et al.* 2002

in thrips population. The Tea Mosquito Bug infestation had significant negative correlation with RH (evening) and minimum temperature, whereas it had positive relationship with maximum temperature and forenoon humidity (Salvi *et al.* 2016).

The peak incidence of inflorescence blight in cashew was recorded during January (Gajbhiye *et al.* 2016a). The minimum temperature, afternoon relative humidity and number of rainy days had significant negative correlation with inflorescence blight.

Under the climate fluctuations especially during growth and flowering the cashew crop is adversely affected. Numbers of technologies are available to obtain sustainable yield from cashew even under abnormal climatic conditions.

Varietal Selection

Several improved cashew varieties Vengurla-3, Vengurla-4, Vengurla-5, Vengurla-6, Vengurla-7, Vengurla-8 and Vengurle-9 are available (Table 7) (Gawankar *et al.* 2010) which are high yielding, producing bold nut and apple, high shelling percentage. However, mixed population of these varieties in a commercial plantation is always advisable. The performances of variety also differ according to climate. The varieties V4, V7, V8 and V9 perform better in coastal as well as inlands whereas V1 flourish well under coastal inlands. The flowering in these varieties also differs. V1 is the earliest, V4 is early, V6 and V7 are midlate whereas V6 is late. The mix population of these varieties warrants the assured production even during abnormal climatic fluctuations during November to February (Gajbhiye *et al.* 2016).

Appropriate Spacing

Cashew love sunshine and produce flowers and fruits on crown rather than inner canopy. It is advisable to provide sufficient space for each cashew plant in an orchard so as to aid it to harvest sufficient solar radiation. It should be planted at 7 to 8 m spacing (Gajbhiye *et al.* 2016b). High density planting should be avoided.

Soil conservation remedies

In coastal region cashew is planted in light soil that to on undulating hilly terrain which is prone to severe runoff resulting loss of fertile layer of soil. The staggered trenches across the slope proved to be the best option of reducing runoff, soil loss. The orchards with appropriate soil conservation measure recorded high productivity in long term. The performance of cashew in stone bunding, staggered trenches and continuous contour trench (CCT) of 0.60 m depth was superior over rest of the treatments. CCT of 0.60 m depth was the best soil conservation practice on area having 7 to 8 per cent slope (Anonymous 1995).

Integrated nutrient and water management

It is essential to maintain adequate N: P: K ratio in the soil. Application of 40 kg of farmyard/ green manure

Table 7. Salient features of the cashew varieties released by Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Maharashtra

Variety	Pedigree	Year of release	Average yield (kg tree^{-1})	No. of nuts kg^{-1}	Average weight of nut (g)	Shelling (%)	Apple Colour	Average cashew apple weight (g)	Cashew apple juice (%)	Herma-phrodite flower (%)	Kernel count grade (W. K. Ib^{-1})	Special characters
V-1	Selection (Ansur-1)	1974	15.74	160	6.25	31	Yellow	60	65	8	320	Early variety with medium size nut
V-2	Selection (WBDC-VI)	1979	23.1	230	4.35	32	Reddish	37	45	21	400	Small size nut, synchronized flowering
V-3	Vengurla-1 x Vetore-56	1982	16.66	115	9.09	27	Yellow	78	77	25	210	Bold size nut but low shelling %
V-4	Midnapur Red x Vetore-56	1984	19.08	140	7.69	31	Reddish	46	76	26	240	All purpose variety
V-5	Ansur Early x Maisur Kotekar	1984	25.6	220	4.54	30	Yellow	30	86	50	400	High yield and Compact canopy
V-6	Vetore-56 x Vengurla-1	1992	17	125	7.9	28	Yellow	70	75	7.5	210	Bold nut with less spreading habit
V-7	Vengurla-3 x VRI-1	1997	14.94	100	10	30.5	Yellow	65	85	26.5	180	Vigorous growth and Bold nut
V-8	Vengurla-4 x VRI-1	2001	16.5	86	11.5	28	Yellowish red	100	85	38.5	180	Very big size nut and apple
V-9	Vengurla-4 x M-10/4	2015	15.98	112	8.9	29.35	Reddish yellow	72.9	76	21	210	Compact canopy, Cluster bearing habit, bold nut and high yield

Source: Anonymous 1985

per cashew tree is advised to ensure adequate organic matter in the soil along with 1000 g N (2.1 kg urea), 250g P_2O_5 (1.56 kg single super phosphate) and 250 g K_2O (400 g muriate of potash) above the age of 4 years (Anonymous 1985, Haldankar *et al.* 2007). For organic cashew growing 20kg application of compost per tree per year is suitable (Gajbhiye *et al.* 2012).

Heavy rainfall results in leaching of nutrients due to run off and deep percolation of water (Gunjate 2016). The post monsoon fertigation using diffuser applicator help to minimize the nutrient losses and increase efficiency of applied nutrients and are beneficial for the yield and quality of cashew nut. Nitrogen applied through fertigation @ 200 kg ha^{-1} recorded maximum cashew nut yield (1.91 t ha^{-1}) followed nitrogen @ 100 kg ha^{-1} (1.44 t ha^{-1}) through fertigation. Irrigation at 75 per cent of potential evaporation (P.E.) produced the highest yield of nuts (1.44 t ha^{-1}) and was at par with irrigation at 50 per cent P.E (1.43 t ha^{-1}) through subsurface irrigation by diffuser (Gunjate 2016) (Table 8).

Cashew is preferably cultivated under rainfed conditions. However, double yield can be harvested by providing 200 L of water at 15 days interval from January to March at a time of fruit and nut development for adult bearing trees. Similarly, irrigating 80 L tree^{-1} once in four days through drip from December to March (Total irrigation of 2400 L tree^{-1} season^{-1}) also increased yield substantially (Anonymous 1985). For newly planted grafts protective irrigation after planting with 15 L water at 15 days interval during winter and at 8 days interval during summer season is advised. The use of black polythene mulch with irrigation at fortnightly interval (60 L tree^{-1} irrigation^{-1}) increased the fruit retention (66.15 %) over control (44.98%) (Nawale and Salvi 1992).

Intercropping and farming system

Intercropping provide opportunity to improve income from cashew plantation with diversifies crops. Cultivation of greater yam was found to be most remunerative to obtain additional returns during the

initial years of establishment. In the available interspace under cashew plantation of more than 15 years old, without disturbing the root system, which contributed ₹ 84440 ha^{-1} followed by lesser yam (₹ 66440) and ₹ 65350 from elephant foot yam as intercrop (Nawale and Salvi 1990). The sole cashew yield, 1120 kg nut ha^{-1}, which earned ₹ 89600 ha^{-1}. When it was integrated with back yard poultry (Giriraja Breed), an additional income of ₹ 1,75,000 was obtained (Sawake *et. al.* 1987).

Pollination Improvement

Poor pollination in cashew is one of the most important reasons for low productivity (Shingre *et al.* 2001). Cashew is an entomophilous and the fruit-set is only 48% in natural open pollination. Cashew pollens are heavy and sticky. Black and red ants are seen to visit the flower frequently. Attractants play vital role in luring ants and enriching the fruit set. The fruit-set and yield of cashew nut increased by two sprays of extract of low cost dried fish @ 500 g 10 l^{-1} of water, first at the time of flowering and second at 15 days after first spray. During the experiment, activity of various ants' species like *Tapinoma indicum, Myrmicaria brumea, Sanders, Componotus compressus* and *Anoploepsis lengipes* was noticed (Shingre *et al.* 2001). Similarly, foliar application of 3 % urea along with insecticidal sprays thrice, coinciding with vegetative flush, flowering and fruit set increased the yield by 60-65 per cent (Shingre *et al.* 2003). Ethrel @ 100 ppm significantly increased number of flowering panicles per m^2 (12.0), number of perfect flowers per panicle (52.8), fruit-set per m^2 (28.8) number of nuts per panicle (2.9) and yield (1.51 kg $tree^{-1}$) over control (Sagvekar *et al.* 2005) (Table 9).

Foliar nutrient management

Apart from nutrient management through soil the foliar application of various nutrients help to elevate cashew productivity. Foliar spray of 3 per cent urea helped to produce high nut yield (5.987 kg $tree^{-1}$), as well as total Ca and Mg content in cashew kernel (Bhat *et al.* 2010). The feasibility of different major and micro nutrients as a supplementary feed in the form of foliar sprays for boosting the yield of cashew was also evaluated (Sapkal *et al.* 1998). The foliar application of 0.25 % Urea +

Table 8. Combined effect of irrigation and fertilizer on yield of nuts (t ha^{-1})

Treatments	I_1 (75% P.E.)	I_2 (50% P.E.)	I_3 (25% P.E.)	Mean
N_0- 0 kg N ha^{-1}	1.484	1.329	1.077	1.217
N_1- 100 kg N ha^{-1}	2.014	1.724	1.559	1.766
N_2 - 200 Kg N ha^{-1}	2.510	2.228	1.852	2.197
Mean	2.003	1.760	1.496	
	Irrigation	Fertilizer	Interaction I x F	
SE ±	0.144	0.430	0.249	
CD at 5%	0.430	0.144	NS	

Source: Sawake *et al.* 1985

Table 9. Effect of Ethrel spray on flowering and yield in Cashew

Treatments	Total No. of staminate flowers	Total No. of perfect flowers	% perfect flowers	Mean fruit set m^{-2}	Mean No. of nuts per panicle	Mean yield (kg $tree^{-1}$)	Mean nut weight (g)
Control (No spray)	515.3	19.0	3.6	17.3	1.6	0.88	8.2
Water spray	629.0	12.8	2.0	23.8	1.6	0.93	8.3
Ethrel 100 ppm	240.0	52.8	18.0	28.8	2.9	1.51	8.5
Ethrel 100 ppm	347.3	20.0	5.4	18.0	2.0	0.95	7.0
Ethrel 100 ppm	371.0	48.8	11.6	18.0	2.4	0.88	8.2
SE±	34.2	8.2	1.4	1.4	0.2	0.06	0.4
CD at 5%	105.4	25.2	4.2	4.3	0.7	0.19	NS

Source: Gawankar *et al.* 2010

SOP+SSP each + 0.25 % $ZnSO_4$ + Borax + $CuSO_4$ each + 0.01 % Ammo. molyb increased the cashew yield (3.50 kg plants^{-1}) significantly over control (2.15 kg plant^{-1}). The feasibility of different complex nutrients available in the market for sex expression, fruit set and its relevance with nut yield of cashew through foliar sprays was assessed (Sawake *et al.* 1985).

Foliar application of Urea (2 %) could produce maximum number of laterals, flowering panicles and total number of staminate flowers over control. Similarly, total number of perfect flowers was significantly higher in foliar application of 0:52:34 (2 %) and 19:19:19 (1 %) than control. The foliar spray of 19:19:19 (2 %) recorded significantly greater fruit set and yield kg tree^{-1} over control. Foliar application of N in the form of urea 3 % mixed with endosulfan 0.05, thrice a year, coinciding with new vegetative flushing, flowering and fruit set improved cashew yield (Sawake *et al.* 2009)

Plant protection

Cashew possesses threat by several pests and diseases. The incidence and severity are highly dependent on climate and weather. Over 58 species of insect and pests on cashew are reported in the Konkan region of Maharashtra (Gajbhiye *et al.* 2012).

Tea mosquito bug (*Helopeltis antonii)*, flower thrips (*Thrips dorsalis)* are the major pest on cashew. The other pests *viz.,* apple and nut borer (*Nephopteryx* sp.), shoot tip caterpillar (*Hypatima haligramma)* and leaf miner (*Acrocereops syngramma)* also cause considerable damage to cashew crop (Gajbhiye *et al.* 2016b).

Plant protection

The fungus, *Beauveria bassiana* (4 g l^{-1}) was most effective against *H. antonii* and recorded 91.67 % nymphal mortality after 10 days which was followed by *Verticillium lecanii* (4 g l^{-1}) and *Ritha* fruit extract (10 %), which had 78.33 and 71.67 % nymphal mortality, respectively. *Metarhizium anisopliae* (4 g l^{-1}) was least effective among the fungi imposed against the nymphs. The botanicals, *undi* (*Calophyllum inophyllum*) oil (5 %) and *Karanj* oil (5 %) showed 68.33 and 65 % nymphal morality after 10 days of application (Sawake *et al.* 1987).

All the accessions of cashew were susceptible to TMB infestation. Only the degree of susceptibility varied among the accessions. Vengurle-1, 2, 3, 5, 6, 7, 8, H-303, H-320, M-44/3, 30/1, 10/19, 3/28, 15/4, NRCC Selection -1 and 2 were less susceptible whereas Vengurle-4 and 3/33 were moderately susceptible to TMB (Palsande *et al.* 2015). The predatory spider plays an important role in the management of tea mosquito bug. The spiders *Telamonia dimididata* (Salticidae) and *Oxyopes shweta* (Oxyopidae) were the major predator of cashew tea mosquito bug (Patil *et al.* 2016).

Conclusions

Cashew is one of the most important plantation crops of marginal lands especially under coastal agroclimatic conditions. The climatic aberration esecially during flowering and fruiting affect the phenology as well as yield of cashew. However, adoption of technology especially related to varietal selection, nutrient management, pollination improvement and integrated pest and disease management help to mitigate the adverse effect in terms of increase in productivity. Further, yield improvement is also possible by adopting intercropping as well as need based foliar nutrition and irrigation. Sustainability in production of cashew even under climatic fluctuations will help to improve standard of living of coastal population.

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