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Growing of Intercrops in Cashew Based Cropping System under Coastal Sandy Soils of Andhra Pradesh

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ABSTRACT

A field experiment was conducted during 2011-16, to evaluate the performance of intercrops viz., Amaranthus (*Amaranthus tricolor*), Clusterbean (*Cyamopsis tetragonoloba*), Hibiscus (*Hibiscus cannabinus*) and Marigold (*Tagetus erecta*) under Cashew plantation at Cashew Research Station, Bapatla. Even though the average yield of intercrop was maximum in Hibiscus (*Hibiscus cannabinus*) with 79.25 qha^{-1} and the average yield of Cashew was recorded highest in Cashew + Amaranthus (T_4). Marigold has recorded highest benefit cost ratio (2.33) consistently for five years followed by Clusterbean (1.88). Hence, growing of Marigold as an intercrop in cashew plantation under coastal sandy soils of Andhra Pradesh at initial years can be recommended.

Keywords: *Cashew, Cost benefit ratio and Intercropping.*

Cashew (*Anacardium occidentale* L.) is a major commercial plantation crop in India that earns considerable foreign exchange. India earned a foreign exchange of Rs. 5168.78 crores during 2016-17. There is a lot of scope for area expansion of cashew in traditional and nontraditional areas of India during the coming years. In Andhra Pradesh, area expansion of cashew as commercial plantation crop increasing in big way in view of the assured market price for its raw nuts. Cashew is generally a spreading type of crop and requires lot of space for its canopy spread, with a spacing of 8mx8m. Plants take minimum of 6-7 years to cover the entire allotted space. During the initial period of cashew plantation, suitable intercrops would help in generation of additional income, conservation of soil and moisture and efficient utilization of space and natural resources in the initial stages of orchard life until bearing. Available inter space in the perennial crops can be utilized for cultivation of rhizomatous spice crops, vegetable and tuber crops etc. During initial years of plant growth pine apple, papaya, tapioca and vegetable are suggested in cashew plantations of Dakshina Kannada district. The important reason for intercropping is the improvement and maintenance of soil fertility. Fertilizers are more efficiently used in an intercropping system, due to the increased amount of humus and the different rooting systems of the crops, as well as differences in the amount of nutrients taken up. Water use efficiency is also another importance of intercropping system. Microclimate modification by cheap and simple means, such as intercropping might be acceptable as well as affordable (Gebru, 2015). Intercropping is one of the potential way to use the natural resources more efficiently than sole crop. Due to the paucity of information regarding the intercrops grown in cashew in Andhra Pradesh and depending on soil and climatic conditions and local situations annual crops like Amaranthus (*Amaranthus tricolor*), Clusterbean (*Cyamopsis tetragonoloba*), Hibiscus (*Hibiscus cannabinus*) and Marigold (*Tagetus erecta*) were tried for 5 years from 2011-2016 at Cashew Research Station, Bapatla.

MATERIAL AND METHODS

The field experiment was conducted at Cashew Research Station, Bapatla, Andhra Pradesh during 2011-2016 with intercrops between cashew plantation with a spacing of 8m x8m. Most of the area is under rainfed and exclusively sandy soils, irrigation was given by doruvu technology. The various intercropping treatments were, Cashew + Marigold (T_1), Cashew + Clusterbean (T_2), Cashew + Hibiscus (T_3), Cashew + Amaranthus (T_4), Cashew alone (T_5). The experiment was laid out in Randomized Block design with four replications. Recommended cultivation practices were followed for both intercrop and sole crop as per the package of practices recommended by Dr YSR Horticultural University, Venkata-ramannagudem. Observations on growth and yield attributes were recorded on Marigold, *Hibiscus Cannabinus*, Amaranthus and Clusterbean. As crops vary in their growth habit, the harvesting period also varied, the economic products were harvested as and when ready and quantified, Farm gate and local market rates were considered for computing the net returns and LER was worked out based on yield recorded

Table 1. Pooled data of Cashew based intercropping from 2011-12 to 2015-16 at Cashew Research station, Bapatla

Treatments	Yield of Intercrop	Yield of Cashew	Total cost of cultivation	Gross profit	Net return	Cashew Equivalent Yield	B:C Ratio
	Qha^{-1}	Qha^{-1}	$Rsha^{-1}$	$Rsha^{-1}$	$Rsha^{-1}$	tha^{-1}	
Cashew + Marigold (T_1)	43.53	6.78	35775	114344	78569	1.74	2.33
Cashew + Cluster bean(T_2)	47.13	6.76	33500	93109	59609	1.39	1.89
Cashew + Hibiscus(T_3)	79.25	7.29	25413	68015	42602	0.96	1.82
Cashew + Amaranthus(T_4)	58.21	7.40	25407	66270	36863	0.97	1.53
Cashew Alone(T_5)	0.00	6.56	15200	43587	28387	0.66	1.93
S.Em.±	10.32	0.21	1574.46	7127.34	6413.5		N.S.
C.D. 5%	31.20	0.63	4768.87	21551.75	19393.21		0.24
CV	50.57	6.65	13.01	28.65	29.15		27.66

Table 2. Land Equivalent Ratio (LER) of intercropping system in cashew nut plantation

Treatments	Land Equivalent Ratio (LER)					
	2011-12	2012-13	2013-14	2014-15	2015-16	Pooled
Cashew + Marigold (T_1)	1.13	1.79	2.08	1.88	1.93	1.76
Cashew + Cluster bean(T_2)	2.48	1.57	1.87	1.70	1.75	1.87
Cashew + Hibiscus(T_3)	1.82	1.46	2.05	1.67	1.62	1.72
Cashew + Amaranthus(T_4)	2.00	1.41	1.57	1.72	1.68	1.67
Cashew Alone(T_5)	1.00	1.00	1.00	1.00	1.00	1.00
S.Em.±	0.07	0.53	0.03	0.04	0.05	0.05
C.D. 5%	0.24	0.17	0.10	0.14	0.18	0.17
CV	7.31	6.15	3.14	4.26	5.57	5.65

Table 3. Cashew equivalent yield of intercropping system (t ha^{-1}) in cashew nut plantation

Treatments	Cashew equivalent yield of intercropping system					
	2011-12	2012-13	2013-14	2014-15	2015-16	Pooled
Cashew + Marigold (T_1)	1.18	2.22	2.32	1.52	1.49	1.74
Cashew + Cluster bean(T_2)	2.38	1.36	1.51	1.1	1.11	1.39
Cashew + Hibiscus(T_3)	1.18	0.84	1.09	0.91	0.91	0.96
Cashew + Amaranthus(T_4)	1.01	0.89	0.99	0.91	0.97	0.97
Cashew Alone(T_5)	0.65	0.66	0.7	0.62	0.66	0.66
S.Em.±	0.014	0.04	0.024	0.02	0.017	0.017
C.D. 5%	0.044	0.124	0.075	0.06	0.052	0.053

under sole cropping and intercropping situations.The statistical analysis was carried out as per the procedure given by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

The results of the pooled data indicated that, Cashew + Marigold recorded significantly highest cashew equivalent yield 1.74 t ha^{-1} followed by Cashew + Cluster bean intercropping with 1.39 t ha^{-1}

Among all the intercrops studied, maximum yield was reported in Hibiscus (79.25qha^{-1}) followed by Amaranthus (58.21 qha^{-1}) (Table.1). Intercrops yield performance was not affected, when they were grown in widely spaced cashew plantations. Abeysinghe *et al.,* 2003 revealed that the intercropping of young cashew (2-3 years from planting) has no deleterious effect on growth, development and yield, where as there was a significant decline in the growth and yield of food crops when intercropped with five year old cashew which could be due to the reduction in the rate of photosynthesis by shade effect.

With respect to the yield of Cashew, as a main crop the highest was recorded in T_4 Cashew + Amaranthus (7.40 qha^{-1}) followed by T_3 Cashew + Hibiscus (7.29 qha^{-1}), this was probably be due to better management, including regular watering and weeding, adequate application of fertilizers. Cashew intercropped with pineapple, Cumulative cashew yield was 61.49 kg compared to 37.74 kg in plot, where cashew was grown as monocrop as reported by Prabhakaran Nair in 2011. Abeysinghe *et al*., 2003 reported that the beneficial impact of intercropping on girth and height of cashew plants could be attributed to the better overall environment due to tillage, weeding and application of fertilizers for annual crops. Cashew alone (T_5) recorded the lowest yield of 6.56 qha^{-1} of Cashew nut (Table.1).

Land is becoming major limiting factor in the present day of agriculture. Invariably the efficiency of land use based on the land equivalent ratio (LER) should decide the choice of cropping system. Data on land equivalent ratio of the intercropping system during 2011-12 to 2015-16 presented in Table 2 and it is observed that Cashew + Clusterbean (T_2) recorded higher mean land equivalent ratio (LER) i.e.2.48 followed by Cashew + Amaranthus (2.00) during the year 2011-12.Where as treatment T_1 (Marigold) recorded highest mean land equivalent ratio (LER) from 2012-13 to 2015-16. During 2013-14 cashew Marigold recorded 2.08 LER, which was followed by cashew Hibiscus (2.05) All intercropping systems recorded average LER more than one and hence intercropping system is advantageous. Higher values of LER under cashew based intercropping system were due to satisfactory yield of turmeric, chilli, mango ginger and fenugreek as reported by Vikram *et al* ., 2015. Hegde and Sulikeri (2001) reported the highest LER for areca based intercropping system and cashew based intercropping system under Sri Lanka conditions by Abeysinghe *et al* ., 2003.

With regards to cashew equivalent yield, Cashew + Clusterbean recorded significantly the highest cashew equivalent yield during the year 2011-12 (2.38 tha^{-1}) and superior over rest of the treatments. Whereas, Cashew + Marigold recorded the significantly the highest yield during the year 2012-13 (2.22 tha^{-1}) 2013-14 (2.32 tha^{-1}), 2014-15 (1.52 tha^{-1}) and 2015-16 (1.49 tha^{-1}) followed by Cashew + Cluster bean.

Beneficial impact of intercropping

With respect to the B: C Ratio, the highest was reported in (T_1) Cashew + Marigold of 2.33 followed by (T_2) Cashew + Cluster bean of 1.89 (Table.1). Higher gross and net incomes might be the reason for higher return per rupee invested (Rajput and Mishra, 1995). Intercropping of glory lilly in cashew recorded higher return per rupee (B: C Ratio. 6) as reported by Deivasigamani, 2016. Increased yield and B: C ratio in mandarin was due to intercropping as reported by shirgure, 2012.

Fruit and Nut quality of cashew was not affected (more or less) by different intercrops grown in interspaces. Similar results were also reported by Kanwar, 1993 in mango and citrus and Ghosh 2001 in guava.

CONCLUSION

Among the different intercrops studied during 2011-2015, at Cashew Research Station, Bapatla, Marigold has recorded highest benefit cost ratio consistently for five years. Hence, growing of marigold as an intercrop in cashew under coastal sandy soils of Andhra Pradesh at initial growth period was recommended. As a general conclusion, through intercropping, farmers can achieve the full production of the main crop and also an additional associated with an increased plant population of the second component. Hence, intercropping can increase incomes obtained by smallholder farmers in areas through reduction of economic risk and market fluctuation resulting from growing of a single crop which is more prone to natural hazards and helping the farmers in better utilization of land by having more than one crop produced per unit area.

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