Research Article

doi: 10.25081/jpc.2018.v46.i1.3539
Journal of Plantation Crops, 2018, 46(1): 52-56

Performance of flower crops as intercrops in coconut garden in southern dry region of Karnataka

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(Manuscript Received: 17-12-17, Revised: 25-02-18, Accepted: 15-03-18)

Abstract

An experiment was conducted for three years in a 40 year old coconut garden of Tiptur Tall variety planted with a spacing of 10 m x 10 m to identify suitable flower crops for intercropping in coconut gardens of southern dry region of Karnataka. Five flower crops *viz.*, jasmine (Kakada), chrysanthemum, crossandra, China aster and marigold were grown in the inter-row spaces of coconut. The number of leaves on the crown, annual leaf production, number of bunches and buttons and nut yield of coconut were not significantly influenced by the flower crops grown in coconut garden. The leaf nutrient status of coconut was also not significantly influenced by flower crops. The mean yield of flowers was 1045 kg ha^{-1} in jasmine, 4393 kg ha^{-1} in chrysanthemum, 1070 kg ha^{-1} in crossandra, 2158 kg ha^{-1} in China aster and 4874 kg ha^{-1} in marigold. The cropping system of coconut + chrysanthemum recorded significantly higher net income (₹ 200558 ha^{-1}) followed by coconut + crossandra (₹ 179483 ha^{-1}), coconut + jasmine (₹ 166767 ha^{-1}), coconut + China aster (₹ 121692 ha^{-1}) and coconut + marigold (₹ 96350 ha^{-1}). The monocrop of coconut recorded significantly the lowest net income of ₹ 54250 ha^{-1}. The study indicated the suitability and profitability of chrysanthemum, crossandra, jasmine, China aster and marigold as intercrops in coconut garden.

Keywords: Coconut, intercropping, economics, flower crops

Introduction

The coconut palms are generally planted at a wider spacing due to their morphological features. The crop does not fully utilize the basic natural resources such as soil and sunlight available in the garden due to its rooting pattern and canopy structure (Kushwah *et al*., 1973; Nair and Balakrishnan, 1977). The underutilized soil space and solar radiation in monocrop stands can be utilized by growing a variety of crops having different stature, canopy shape and size and rooting habits in compatible combinations. In southern dry region of Karnataka, coconut is mainly grown as a monocrop with a spacing of 9 m x 9 m or 10 m x 10 m. In recent years, the farmers are experiencing the non profitability of coconut cultivation due to fluctuating prices of coconut and increasing incidence of pests and diseases in addition to low and erratic rainfall. Hence, there is need for crop diversification and intensification in coconut gardens with compatible crops to increase the productivity and income by ensuring effective and efficient utilization of soil space and solar radiation.

Flower crops are important in our daily life as well as national economy. Commercial flower production helps in increased earning of the grower. Scent and perfumes can be extracted from the fragrance of flowers. Flowers can also be a source of huge foreign currency by exporting them. The studies on intercropping with coconut carried out in the southern dry region of Karnataka indicated the possibility of growing finger millet, cowpea, pigeon pea, soybean, sunflower, groundnut, french bean, chilli, potato, drumstick, banana and guinea grass (Shanthamallaiah *et al*., 1982; Hanumanthappa

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et al., 1996; Basavaraju *et al*., 2008) and medicinal and aromatic crops like lemon grass, holy basil, kalmegh, garden rue, arrow root and Makoi (Basavaraju *et al*., 2011). However, the information on suitable flower crops for intercropping in coconut garden is lacking. Therefore, an experiment was conducted to identify the suitable flower crops for intercropping in coconut gardens of southern dry regions of Karnataka.

Materials and methods

The experiment was conducted at AICRP on Palms Centre, Horticulture Research Station, Arsikere in Karnataka state for three years from 2012-13 to 2014-15 in a 40 year old coconut garden of Tiptur Tall variety planted at a spacing of 10 m x 10 m. The experimental site was situated at 13° 15' N latitude and 76° 15' E longitude with an altitude of 808 m above MSL and receives an annual rainfall of 816 mm distributed mainly during April to October. The soil of the experimental site was medium black with medium in available nitrogen (310 kg N ha^{-1}), phosphorous (44 kg P_2O_5 ha^{-1}) and potassium (261 kg K_2O ha^{-1}). Five flower crops *viz.,* jasmine (*Jasminum multiflorum*), chrysanthemum (*Dendranthema grandiflora*), crossandra (*Crossandra infundibuliformis*), China aster (*Callistephus chinensis*) and marigold (*Tagetes erecta*) were grown in the inter-row spaces of coconut. The intercropping system of flower crops with coconut was compared with the sole crop of coconut. The experiment was laid out in RBD with four replications.

Flower crops were grown in the interspaces of coconut leaving 2 m radius around the coconut palm basin. The area occupied by the intercrops was 84 per cent of the area of the plot. The recommended cultivation practices were followed for coconut as well as flower crops. Need based irrigations were given for flower crops through sprinklers during all the years of experimentation. Coconut palms were irrigated through drip system @ 50 litres per palm per day. Chrysanthemum, China aster and marigold were planted every year while crossandra and jasmine which are perennial in nature were planted during first year and maintained during subsequent years. Jasmine started yielding flowers from second year of planting. The flowers were harvested every year and yield data recorded.

The observation on the number of leaves on the crown, annual leaf production, number of bunches and buttons and nut yield of coconut were recorded. Leaf samples of coconut were drawn from the index leaf before and after the experiment and analyzed for leaf nutrient status (Jackson, 1973). The coconut equivalent yield (CEY) of flower crops was computed based on the selling price of flowers and coconut. The economics of the cropping system was worked out based the market price of inputs and produce prevailed during respective years. The establishment cost of jasmine during first year of planting (₹ 86000 ha^{-1}) was equally distributed to its expected life period of 10 years. The data on yield and returns of three years was averaged to get the data of mean yield and returns. The data was analyzed statistically as per the procedure given for analysis of variance (ANOVA) under RBD design (Gomez and Gomez, 1984).

Results and discussion

Growth and yield of coconut

The mean data of three years from 2012-13 to 2014-15 showed that the number of leaves on the crown, annual leaf production, number of bunches, buttons and the nut yield of coconut were not significantly different when flower crops were grown in coconut garden (Table 1 and 2). The leaf nutrient status of coconut after three years of experimentation was also not significantly influenced by flower crops (Table 3). This indicates that flower crops can be grown as intercrops in coconut without affecting the growth and yield of coconut. Earlier studies carried out in the southern dry region of Karnataka have also showed maintenance or increase in nut yield of coconut with intercropping of banana, french bean, ladies finger, drumstick, redgram (Basavaraju *et al*., 2008) and medicinal and aromatic crops (Basavaraju *et al*., 2011).

Flower yield and its coconut equivalent yield

The yield from flower crops recorded during three years of experimentation is presented in Table 4. The mean yield of flowers was 1045 kg ha^{-1} in jasmine, 4393 kg ha^{-1} in chrysanthemum,

Table 1. Growth and yield parameters of coconut in the intercropping system of flower crops with coconut (Mean of 3 years: 2012-13 to 2014-15)

Treatment	No. of leaves on the crown	Annual leaf production (No. year^{-1})	No. of bunches per palm	No. of buttons per palm
Coconut + jasmine	28.3	12.3	12.2	193.1
Coconut + chrysanthemum	27.7	12.4	12.4	206.5
Coconut + crossandra	27.7	12.3	12.2	194.4
Coconut + China aster	27.4	12.2	12.2	190.8
Coconut + marigold	28.4	12.2	12.2	191.8
Coconut monocrop	27.5	12.1	12.1	191.5
S. Em ±	0.9	0.3	0.2	5.8
CD (P=0.05)	NS	NS	NS	NS

Table 2. Nut yield of coconut in the intercropping system of flower crops with coconut

Treatment	Nut yield (No. palm^{-1} year^{-1})				Mean nut yield per ha (No. of nuts)
	2012-13	2013-14	2014-15	Mean	
Coconut + jasmine	75.2	80.4	83.6	79.7	7974
Coconut + chrysanthemum	75.0	85.1	82.9	81.0	8098
Coconut + crossandra	78.8	83.1	88.9	83.6	8358
Coconut + China aster	79.7	85.9	79.5	81.7	8171
Coconut + marigold	75.6	89.3	80.9	81.9	8194
Coconut monocrop	79.1	82.5	78.0	79.9	7985
S. Em ±	4.3	4.1	4.5	2.8	280
CD (P=0.05)	NS	NS	NS	NS	NS

Table 3. Leaf nutrient status of coconut in the intercropping system of flower crops with coconut (after 3 years of experimentation)

Treatment	Leaf nutrient status		
	N (%)	P (%)	K (%)
Initial	1.87	0.24	1.21
Coconut + jasmine	2.24	0.31	1.28
Coconut + chrysanthemum	2.60	0.29	1.20
Coconut + crossandra	2.53	0.28	1.18
Coconut + China aster	2.24	0.29	1.33
Coconut + marigold	2.47	0.30	1.26
Coconut monocrop	2.17	0.29	1.25
S. Em ±	0.16	0.01	0.08
CD (P=0.05)	NS	NS	NS

1070 kg ha^{-1} in crossandra, 2158 kg ha^{-1} in China aster and 4874 kg ha^{-1} in marigold. The yield of flower crops in terms of coconut equivalent yield (Table 5) was significantly higher with crossandra (21653 nuts ha^{-1} year^{-1}) followed by chrysanthemum (20737 nuts ha^{-1} year^{-1}), jasmine (18910 nuts ha^{-1} year^{-1}) China aster (10181 nuts ha^{-1} year^{-1}) and marigold (6946 nuts ha^{-1} year^{-1}). The productivity of the intercropping system of flower crops with coconut in terms of coconut equivalent yield was significantly higher in coconut + crossandra (30011 nuts ha^{-1} year^{-1})

Table 4. Yield of flowers in intercropping system of flower crops in coconut garden

Treatment	Yield of flowers (kg ha^{-1})			
	2012 -13	2013 -14	2014 -15	Mean
Coconut + jasmine	-	896	1194	1045
Coconut + chrysanthemum	3010	5754	4414	4393
Coconut + crossandra	1210	1075	924	1070
Coconut + China aster	1582	2695	2198	2158
Coconut + marigold	4991	5250	4382	4874

followed by coconut + chrysanthemum (28835 nuts ha^{-1} year^{-1}), coconut + jasmine (26884 nuts ha^{-1} year^{-1}), coconut + China aster (18352 nuts ha^{-1} year^{-1}) and coconut + marigold (15140 nuts ha^{-1} year^{-1}). The monocrop of coconut recorded significantly the lowest coconut equivalent yield of 7985 nuts ha^{-1} year^{-1}. Similar increase in productivity of coconut garden was reported by Basavaraju *et al*. (2008 and 2011) with intercropping of banana, french bean, ladies finger, drumstick, redgram and medicinal and aromatic crops and Marimuthu *et al*. (2001) and Singh *et al*. (2002) in coconut based high density multi-species cropping system.

Table 5. Coconut equivalent yield of intercropping system of flower crops in coconut garden - mean of 3 years from 2012-13 to 2014-15

Treatment	Coconut equivalent yield (No. of nuts ha^{-1})		
	Coconut	Flower crops	Total
Coconut + jasmine	7974	18910	26884
Coconut + chrysanthemum	8098	20737	28835
Coconut + crossandra	8358	21653	30011
Coconut + China aster	8171	10181	18352
Coconut + marigold	8194	6946	15140
Coconut monocrop	7985	0	7985
S. Em ±	280	291	393
CD (P=0.05)	NS	898	1186

Thus the present study indicated the suitability of chrysanthemum, crossandra, jasmine, China aster and marigold for intercropping in coconut gardens of southern dry region of Karnataka.

Acknowledgements

The financial assistance and facilities provided by AICRP on Palms to take up this study is gratefully acknowledged. The authors are thankful to the Director of Research, UHS, Bagalkot and Scientists and staff of HRS, Arsikere for their help and encouragement during the course of investigation.

Table 6. Economics of intercropping system of flower crops in coconut garden (Mean of 3 years: 2012-13 to 2014-15)

Treatment	Gross income (₹ ha^{-1})	Cost of production (₹ ha^{-1})	Net income (₹ ha^{-1})	B:C ratio
Coconut + jasmine	294317	127550	166767	2.3
Coconut + chrysanthemum	306125	105567	200558	2.9
Coconut + crossandra	318867	139383	179483	2.3
Coconut + China aster	194925	73233	121692	2.7
Coconut + marigold	160450	64100	96350	2.5
Coconut monocrop	85050	30800	54250	2.8
S. Em ±	4178		4178	0.1
CD (P=0.05)	12591		12591	0.2

Price of flowers (per kg): Jasmine (Kakada): ₹ 200/-; Chrysanthemum: ₹ 50/-; Crossandra: ₹ 200/- to ₹ 250/-; China aster: ₹ 50/-; Marigold: ₹ 15/-; Coconut: ₹ 10/- per nut (2012-13 to 2013-14) & ₹ 12/- per nut (2014-15).

Economics of the intercropping system

The cropping system of coconut + chrysanthemum recorded significantly higher net income (₹ 200558 ha^{-1}) followed by coconut + crossandra (₹ 179483 ha^{-1}), coconut + jasmine (₹ 166767 ha^{-1}), coconut + China aster (₹ 121692 ha^{-1}) and coconut + marigold (₹ 96350 ha^{-1}). The monocrop of coconut recorded significantly the lowest net income of ₹ 54250 per ha. Similar results of increased economic income in the intercropping systems of coconut with field crops (Shanthamallaiah *et al*., 1982; Hanumanthappa *et al*., 1996), vegetables (Basavaraju *et al*., 2008) and medicinal and aromatic plants (Maheswarappa, 1997; Basavaraju *et al*., 2011; Maheswarappa *et al*., 2013) were also reported. The experiments conducted on intercropping of flower crops in coconut garden in different parts of the country have indicated the suitability of marigold, gomphrena and chrysanthemum for Tamil Nadu, gerbera, tuberose and gladiolus for Assam, gladiolus, tuberose and gerbera for West Bengal and lily, jasmine and heliconia for Maharashtra (AICRP- Palms, 2016).

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