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FLOWERING CROPS IN COCONUT BASED CROPPING SYSTEM INCREASES THE PRODUCTIVITY UNDER INDO GANGETIC PLAINS OF SOUTH ASIA

D. K. GHOSH (LKN)[1], A. BANDYOPADHYAY[2], H. P. MAHESWARAPPA[3], P. K. SAHU[4], K. CHAKRABARTI[5] AND BENUKAR BISWAS[6]*

[1]AICRP on Palms, BCKV, Kalyani - 741 235, WB, INDIA
Department of Spices & Plantation crops, BCKV, Kalyani - 741 252, WB, INDIA
[3]AICRP on Palms, ICAR-CPCRI, Kasaragod - 671 124, Kerala
[4] Department of Agril. Statistics, BCKV. Mohanpur - 824 232, Nadia
[5] Senior Economists, BCKV. Kalyani - 741 252
*AICRP - IWM, BCKV, Kalyani - 741 252, WB, INDIA
e-mail: kripahi@yahoo.com

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***Corresponding author**

ABSTRACT

Both intensification and diversification of coconut based cropping systems (CBCS) may allow improving the productivity, economics, sustainability and maintenance of orchard in the Indo-Gangetic Plain of south Asia, but the choices to be made require assessment of performance of various intercrops. An experiment was carried out at Horticulture Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya during 2014-15 and 2015-16 , to study the economic returns per unit area under CBCS model by utilizing the inter space with different short duration flowering crops like gladiolus, tube rose, gerbera and marigold. Introduction of intercrop recorded additional flower production into the coconut orchard by 1.50 lakh gladiolus/ha/year or 1.86 lakh tube rose stick /ha/ year or 2.53 lakh gerbera/ha/year or 25.18 lakh marigold/ha/year. Average flower of intercrops was 1.65 gladiolus sticks/plant /year, 7.17 tuberose sticks /clump /year, 8.49 gerbera sticks /clump/year and 41.4 marigold flowers/ plant /year. However, CBCS with gerbera recorded maximum B: C ratio of 1: 2.19 followed by with gladiolus (1:2.15). Growing of gerbera and gladiolus in existing coconut orchard may be ecologically beneficial as well as remunerative option for the farming community of Indo Gangetic plains of South Asia.

INTRODUCTION

Coconut is grown in more than 93 countries on a total area of 12.5 million ha producing 5562 million nuts annually (Bagde et al, 2014). Coconut plays an important role in the national economy of India contributing 700 cores per annum to the national GDP (CDB, 2015) and grown approximately in 2 million ha area with an estimated production of 20440 million nuts in 2014-15. In West Bengal the average area under coconut was 29410 ha with a production of 372.2 million nuts/year and recorded average productivity of 12657 nuts/ha in the same year (CDB, 2015). But the income derived from small holdings of coconut garden is not sufficient to sustain even the small families. In traditional coconut growing states of India, with mono cropping, the farm yields are poor and farmers are under employed spending only 135 man days under rain fed and 175 man days under irrigated system of cultivation respectively. As a result, coconut plantations are subjected to utter negligence and resultantly coconut farming becomes a non-profitable enterprise. High cost of production and low profit are the main problem now faced by the coconut farmers. Therefore, there is an urgent need to make coconut cultivation profitable through maximization of return per unit area for which different management practices are needed to increase the yield. Nelliat, (1978) reported that in coconut garden 60% of the space is utilized for coconut and 40% sunlight are left unutilized which provides ample scope for introducing compatible inter crops in the interspace of coconut. In humid tropics, higher efficiency of utilization of basic resources of crop production viz. land, solar radiation and water can be achieved by adopting intensive cropping system (Nelliat, 1973). Intercropping is popular because of many advantages like increased productivity per unit area, better use of available resources, (land, labor, time, light, water and nutrients),reduction in damage caused by pests, diseases , weeds and socio economic factors (greater stability, economics, human nutrition and biological aspects) as reported by Vandermeer(1989). In coconut based cropping systems cultivation of compatible crops in the interspaces of coconut offer considerable scope for increasing production and productivity per unit area, time and inputs by more efficient utilization of natural resources like sunlight, soil, water and labor. Jayakumar *et al.* (2017) reported that water and nutrients are the major inputs contributing to higher productivity of crops. In perennial crops like coconut, where the land remains committed to the same crop for several decades, one of the feasible ways of increasing the production is to raise compatible inter crops in the interspaces. Coconut

garden itself offer excellent opportunities for maximization of returns per unit area, by improving the soil nutrient status and exploiting the inter space potential. The beneficial effect of inter cropping or mixed cropping of coconut with different crops in improving soil nutrient status of the system has already been reported by Maheswarappa *et al*. (2003, 2005). Several other workers were also reported about the beneficial effects of such cropping system (Bavappa and Jacob, 1982; Bavappa *et al*., 1986). Coconut palm has a typical adventitious root system. Kushwah et al. (1973) reported that about 74% of the roots produced by a palm under good management did not go beyond 2m lateral distance and 82% of the roots were confined to the 31 to 120 cm depth of soil. With respect to the lateral root spread, Maheswarappa *et al*.,(2000) reported that, the percentage of roots emerging from the bole were confined to 2m radius and only 12.2% and 7.5% of roots were extended up to 3m and 4m radius respectively. Thus the active root zone of coconut is confined to 25% of the available land area and the remaining area could be profitably exploited for raising subsidiary crops. A high efficiency in the use of available soil moisture and nutrients can be achieved by growing different types of partially shade loving short durational fruit plants, vegetables as intercrops outside 2 m radius around the base of the coconut palms. Shadap et al (2013) reported the highest rhizome production in ginger as intercrop planted in the month of May in the coconut plantation. But to increase the economic return, information on cultivation of flowering crops as inter crop in coconut based cropping system is very meager. CPCRI (2003) reported that among the flowering crops grown in coconut garden Heliconia and Anthurium had a good vase life. It was also reported that out of five Jasminum genotypes tried in coconut shade, *J. pubescence* was found to grow well than all other genotypes tested in coconut shade. Arunachalam and Reddy (2007) reported that large variety of crops have been found suitable for growing under irrigated and rain fed conditions in coconut garden including flowering crops like Heliconia, Anthurium, *Jasminum sp*. Keeping these in views, the present investigation was carried out to determine the performance of different flowering crops under coconut based cropping system model and its impact on growth and yield of coconut as to improve the productivity and economic return of coconut based cropping system model under Eastern Indo-Gangetic plain.

MATERIALS AND METHODS

Experimental title and treatments

An experiment was laid out in the Horticultural Research Station of BCKV at Mondouri (under ICAR- All India Coordinated Research Project on Palms) during the year 2014-15 and 2015-16, in a 33 years old coconut garden planted at a spacing of 7.5x7.5m just to study the performance of different short durational flowering crops under the shade of coconut plantation so that production and productivity per unit area, time and inputs may be increased by more efficient utilization of natural resources like sunlight, soil, water and labor. The place of the experimental plot comes under the subtropical humid climate situated at 23.5^{0}N latitude and 89^{0}E longitude with an average altitude of 9.75 m above sea level. Average annual rainfalls at the experimental site over last 2 years were 1593 mm and 1451mm during 2014-15 and 2015-16 respectively (Table 1). Mean monthly temperature over the experimental period ranges from 11.8^{0}C (minimum) in January and 37.6^{0}C (maximum) in April (Fig. 1). Mean daily maximum and minimum relative humidity over the period was 92% and 63%, respectively. The rainfall exceeds evapotranspiration during May to October and the reverse trend was observed rest of the year (Fig.2). The soil of the experimental site is well drained clay loam with pH 6.9. Soil samples were collected from 30 to 60cm soil depth at 40-50cm away from the base of the palm during May before onset of monsoon at the time of initiation and completion of the experiment and analyzed using standard procedures (Jackson, 1973). The experiment was laid out in RBD with the following five treatments.

T_1-: Coconut + Gladiolus, T2:- Coconut + Tube Rose, T_3:- Coconut + Gerbera, T_4:- Coconut + Marigold, T_5:- Coconut (control)

Fertilizer schedule

Recommended dose of fertilizers in the form of Urea (46%N), Single Super Phosphate (14%P,) and Muriate of Potash (60% K) were used as source of nitrogen, phosphate and potassium respectively. In case of gladiolus and marigold recommended dose of fertilizers were applied in two split doses once at the time of land preparation and rest 21 days after planting as broadcasting followed by earthing up. In case of gerbera and tube rose as these plants are to be kept for three years therefore from second year onwards fertilizers were applied in four split doses per annum as broadcasting followed by irrigation preferably in the month of June, September and December and April. In the 1st year at the time of land preparation one third to be applied and rest two third in two split doses before and after rainy season. Weeding, plant protection measures and other cultural operations were done as per recommendation of the AICRPP, BCKV. Growth, and yield parameters were recorded at appropriate stages using standard operating procedures followed for coconut.

Irrigation

Irrigation in the garden was applied through sprinkler system. Four full circle micro sprinklers were installed on the bed of the flowers around the coconut tree @ 60 Lh^{-1} micro sprinklers to cover the entire basin. The micro sprinkler type was full circle with a height of 30 cm and it sprinkled an area of 60 cm. Based on the water requirement of flowering plants and coconut (20 liters tree^{-1} day^{-1}), the duration of irrigation was worked out.

Soil analysis

Initial and final soil samples were collected during the period of experimentation from 30 to 60 cm depth at about 100 cm away from the base of the palm from each treatment in May. Soil NPK contents were analyzed using standard analytical procedures (Jackson, 1973).

Growth and Yield parameters of flowering plants

Five plants from each replication were selected for recording of growth and yield parameters of different flowering plants. Investigations were conducted during the period of experimentation starting from the onset of flower initiation to till harvesting

Yield parameters of coconut

Total three plants from each replication were selected for recording of yield parameters. Nuts were harvested four times in a year at three months intervals. Fresh kernels were removed from the de-husked nuts of collected samples. Kernels were dried in oven to get copra and oil was extracted treatment wise through oil extraction unit.

Leaf analysis

Coconut leaf samples were collected initially from the index leaf (14th leaf) in the month of September and also at the end of experiment for analysis. Leaf N content on dry weight basis was estimated in percentage by Microkjeldahl's method as described by Jackson (1973). Leaf P content was estimated by colorimeter using vanadomolybdate yellow color method as described by Fiske and Subba Rao (1925). Leaf K content was determined by flame photometer by following the method as described by Ward and Johnston (1962).

Statistical analysis

Statistical analysis for each variable was conducted as per the procedure given by Gomez and Gomez (1984). Wherever the results were significant, critical differences (CD) were worked out at probability level $p \leq 0.05$ using the ANOVA.

Economics

We calculated production cost including family labour at the mean wage rate of hired labour to ignore possible opportunity costs as described by Biswas et al, 2006. Gross return of the economic produce of different flowering plants and coconut were calculated based upon the market price. Cost of production was also calculated considering the prevailed labor charges, cost of manures and, fertilizers, planting materials and other inputs used for raising the crops. The coconut equivalent yield (CEY) of the flowering crops, and economics were worked out for input and output. The net return was calculated as the difference between the gross returns and the cost of production.

$$CEY = \frac{\text{Yield of intercrop (kg/ha) x Market price of intercrop (Rs/ kg)}}{\text{Market price of cocount (Rs)}}$$

Benefit: Cost ratio was calculated based upon the formulae given below.

$$BCR = \frac{PV_{benefits}}{PV_{costs}}$$

where:

$PV_{benefits}$ = present value of b

PV_{costs} = present value of c

RESULTS AND DISCUSSION

Height of the plants

It was observed from Fig. 3, that gladiolus recorded maximum height of 76.60 cm during 2015-16 and lowest height of 75.60 cm during the year 2014-2015 with an average height of 76.1 cm. However in tube rose the plant height was maximum (35.60 cm) during the year 2014-15 and lowest (34.65 cm) during the year 2015-16. In gerbera maximum plant height of 32.35cm was recorded during 2014-15 and minimum height of 31.45 cm was recorded during 2015-16 with an average height of 31.90 cm. Marigold recorded maximum height of 88.40 cm during the year 2014-15 and minimum height of 85.40cm was recorded during the year 2015-16 with an average height of 86.9 cm.

Number of flowers/plant

The data presented in Fig-4, revealed that in case of average number of sticks/plant /year, gladiolus grown as intercrop with coconut recorded an average of 1.65 numbers. However the number of sticks/plant /year was recorded maximum (1.95 no's) during the year 2015-16 and lowest (1.35 no's) during the year 2014-15. In tuberose maximum (7.18) number of sticks /clump /year was recorded during the year 2015-16 and minimum number of 7.16 was recorded during the year 2014-15 with an average number of flowering sticks of 7.17. Gerbera recorded maximum 8.78 no of sticks /clump/year during 2014-15 and minimum 8.20 no's during 2015-16 with an average of 8.49 no of sticks /clump/year. In marigold maximum number of flowers/ plant /year (42.6) was recorded during 2015-16 and lowest (40.2) number was recorded during 2014-15 with an average of 41.4 number of flowers/ plant /year.

Number of suckers and branches/ plant:

From Fig-5, it was found that average number of suckers / plant/year of gladiolus grown as intercrop with coconut was recorded 2.17. However the number of suckers/plant/year was recorded maximum (2.2) during the year 2015-16 and minimum number of 2.15 was recorded during the year 2014-15. In tuberose maximum number of suckers /plant/year (3.6) was recorded during the year 2015-16 and minimum (3.4) was recorded during the year 2014-15 with an average of (3.5)/year. Gerbera recorded maximum (7.51) during 2014-15 and minimum number of suckers /plant /year (7.17) was recorded during 2015-16 with an average of 7.34. In marigold maximum number of branches/plant/year (66.60) was recorded during 2015-16 and lowest number of branches/plant/year (63.60) was recorded during 2014-15 with an average of 65.1.

Yield of flowers /ha/ year

In case of yield of flowers /ha/ year, it was found from Fig-6 that gladiolus grown as intercrop with coconut was recorded average 150000 number of flowers / year. However the number of flowers /ha/ year was maximum (168750) during the year 2015-16 and lowest (131250) number of flowers /ha/ year was recorded during the year 2014-15.In tuberose maximum number of flowers /ha/ year was recorded as 189000 during the year 2015-16 and minimum 183750 numbers of flowers /ha/ year was recorded during the year 2014-15 with an average 186375 number of flowers /ha/ year. Gerbera recorded maximum 257276 numbers of flowers during 2014-15 and minimum of 249480 numbers of flowers /ha/ year during 2015-16 with an average of 253378 numbers /year. In case of marigold maximum 2577125 numbers of flowers /ha/ year was recorded during 2015-16 and lowest 2458140 number

Table 1: Weather at the experimental **site in West Bengal, India**

Month	Maximum Temperature (°C)		Minimum Temperature (°C)		Maximum Relative Humidity (%)		Minimum Relative Humidity (%)		Sunshine hour		Rainfall (mm)		Evaporation (mm)	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
January	25.8	26.6	11.9	11.8	92.8	83.9	53.3	58.1	4.6	6.0	3.0	2.5	31.4	35.8
February	30.7	31.7	18.0	15.6	92.8	82.9	53.9	47.2	5.2	6.9	31.9	13.6	53.9	53.6
March	34.3	35.5	21.8	19.2	91.7	82.0	47.5	39.1	7.4	8.6	35.8	21.4	94.1	108.1
April	39.4	35.9	26.6	24.0	88.8	89.6	46.6	56.7	8.2	6.9	1.0	102.3	152.7	99.2
May	35.5	37.6	25.0	27.2	90.8	88.9	60.4	59.0	7.5	7.3	223.4	33.1	119.2	132.2
June	34.2	34.6	26.5	26.9	94.5	91.9	75.3	72.0	6.6	5.0	160.3	344.0	92.3	104.5
July	31.9	32.3	26.2	25.9	97.0	97.8	86.4	86.1	2.8	2.5	370.0	464.3	65.9	57.4
August	31.9	33.4	26.1	26.8	96.9	94.8	85.4	76.8	4.3	4.1	448.4	193.6	63.6	75.6
September	33.2	33.1	26.3	26.1	96.3	96.0	78.5	71.0	5.2	5.6	200.7	227.3	62.6	72.3
October	33.0	33.4	23.9	23.7	96.0	94.2	68.5	62.5	7.1	7.3	101.4	42.1	69.4	70.0
November	29.7	31.3	17.7	18.8	93.4	93.1	58.7	53.3	6.6	6.9	16.6	0.0	40.5	49.6
December	26.3	26.3	12.9	15.0	93.8	93.1	59.1	56.3	5.3	3.2	0.0	6.6	31.8	32.9

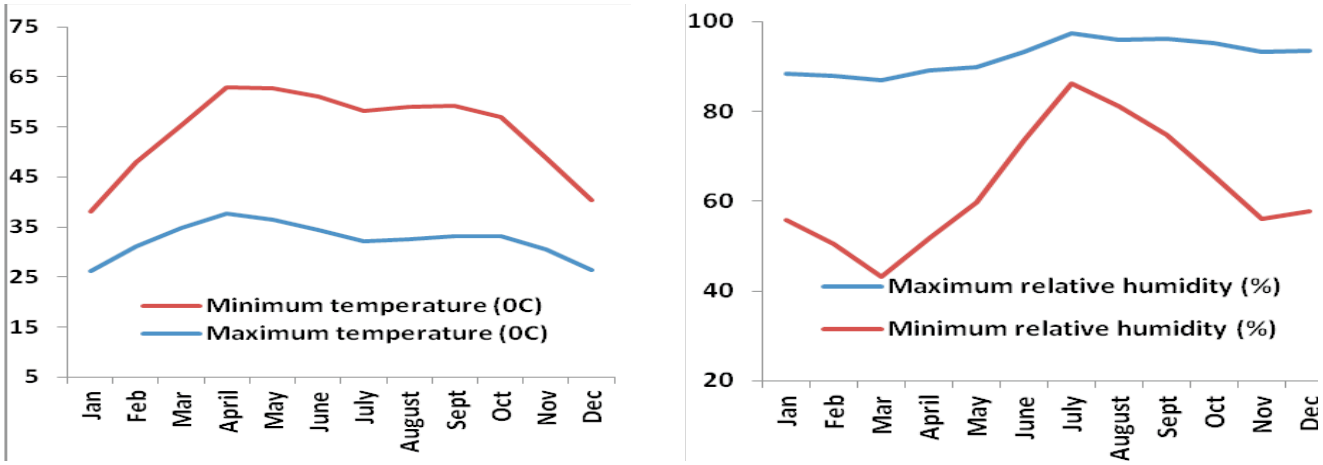

Figure 1: Mean monthly distribution of temperature and relative humidity at the experimental site in West Bengal, India

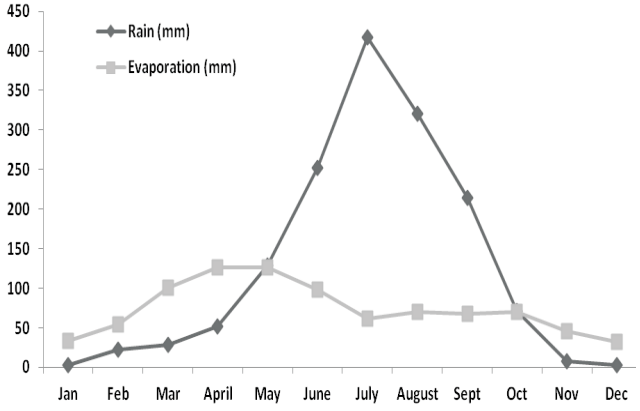

Figure 2: Mean monthly distribution of rainfall and evaporation at the experimental site in West Bengal, India

of flowers /ha/ year was recorded during 2014-15 with an average of 2517632 numbers /ha.

Arunachalam and Reddy (2007) also reported that flowering crops like Heliconia, Anthurium, Jasmine, can be grown successfully in coconut garden under irrigated and rain fed conditions.

Yield of coconut

No significant yield increase was recorded under any treatment in coconut yield in combination with different flowers, though maximum average nut yield of 17855 numbers/ha was recorded in treatment T_3 (Coconut+ Gerbera) followed by T_1 (17569numbers/ha.) e.g. Coconut +Gladiolus. Minimum average nut yield of 17276 numbers /ha was recorded in treatment T_2. (Table-2). In humid tropics, higher efficiency of utilization of basic resources of crop production viz. land, solar radiation and water can be achieved by adopting intensive cropping system (Nelliat, 1973). Adoption of coconut based farming system is one of the ways to augment the productivity by improving soil characters and coconut nutrition as well as income per unit area as recorded by Maheswarappa *et al* (1998)

Soil nutrient status

From table 3, it was found that the initial soil N content of the experimental field was recorded as 261.63 kg/ ha, P content recorded as 81.65 kg/ha and K content recorded as 278.55 kg/ ha. During the period of experimentation the N content

was recorded maximum under treatment T_1 (274.65 kg/ ha) and lowest content of N (270.85kg/ha) was recorded under treatment T_5 indicates that change of N was significantly higher (13.02kg/ha) in treatment T_1 (Coconut +Gladiolus) as compared to T_5 (9.22kg / ha) e.g. only coconut. Similarly, significant change in P content (4.7kg/ha) was recorded under treatment T_3 as compared to T_5 (0.98 kg/ ha). Significant change of K content of the soil was recorded under treatment T_3 (8.10 kg/ ha) e.g. Coconut + Gerbera combination as compared with the treatment T_5 (2.78 kg/ ha) which is significantly lowest. It is revealed from the data presented in Table-4 that build up of nutrient content in the experimental field was recorded under different treatments may be due to growing of intercrops and recycling of the organic residues available from the crops grown in the experimental plots. Khan, (1993) reported that coconut palm normally produces one leaf and bunch per month that necessitates continuous supply of nutrients throughout the year for its proper growth and development.

Table 2: Yield of coconut/ha under different flower based cropping system

Treatment	2014-15	2015-16	Mean
T_1	17483	17656	17569
T_2	17001	17551	17276
T_3	17778	17932	17855
T_4	17456	17435	17445
T_5	17697	17339	17518
S Em(±)	368	387	281
CD (5%)	NS	NS	NS

T_1 = Coconut +Gladiolus, T_2 = Coconut + Tube Rose, T_3 – Coconut + Gerbera, T_4 = Coconut + Marigold, T_5 = Coconut (Mono crop)

Leaf nutrient status of Coconut

Data presented in Table-4 on leaf nutrient status revealed that the leaf nutrient content of coconut recorded an increasing trend after completion of the experiment as compared to the initial leaf nutrient status of coconut. Significant change of leaf N content (0.170) was recorded under treatment T_2 (e.g. Tube Rose+ coconut) followed by treatment T_4 e.g. Coconut +Marigold (0.150) as compared with the treatment T_3 (e.g. Coconut + Gerbera) and T_5 (Coconut). Significant change in P content was also recorded irrespective of all treatments as

Table 3: Soil nutrient status as affected by different flower crops under coconut garden

Treatment	N(kg/ha)	Change of N(kg/ha)	P(kg/ha)	Change of P(kg/ha)	K (kg/ha)	Change of K(kg/ha)
T_1	274	13.0	83	1.48	285	6.80
T_2	273	12.1	85	3.68	284	6.08
T_3	274	12.9	86	4.7	286	8.10
T_4	272	10.8	83	1.68	285	6.98
T_5	270	9.2	82	0.98	281	2.78
S Em(±)	5.7	0.24	1.6	0.05	5.2	0.11
CD (5%)	Ns	0.75	4.7	0.15	16.2	0.35
Initial	261		81		278	

T_1 = Coconut +Gladiolus, T_2 = Coconut + Tube Rose, T_3 – Coconut + Gerbera, T_4 = Coconut + Marigold, T_5 = Coconut (Mono crop)

Table 4: Leaf nutrient status of Coconut as affected by different flower crops under coconut

Treatment	N(kg /ha)	Change of N(kg/ha)	P(kg /ha)	Change of P(kg/ha)	K(kg /ha)	Change of K(kg/ha)
T_1	1.67	0.110	0.12	0.040	1.24	0.060
T_2	1.73	0.170	0.11	0.030	1.26	0.080
T_3	1.66	0.100	0.13	0.050	1.27	0.090
T_4	1.71	0.150	0.12	0.040	1.26	0.080
T_5	1.66	0.100	0.11	0.030	1.25	0.070
S Em(±)	0.02	0.002	0.00	0.001	0.02	0.001
CD (5%)	0.06	0.005	0.01	0.002	0.06	0.004
Initial	1.56		0.08		1.18	

T_1 = Coconut +Gladiolus, T_2 = Coconut + Tube Rose, T_3 – Coconut + Gerbera, T_4 = Coconut + Marigold, T_5 = Coconut (Mono crop)

Table 5: Economic analysis of CBCS with floricultural crops under W.B. condition

Intercropping systems	Main crop (number / ha)	Intercrop (number / ha)	Inter crop Price(Rs) / piece	Coconut equivalent yield (number/ ha)	COC	GR	NR	BCR
T_1	17518	150000	1.35	22500	167725	360162	192896	2.15
T_2	17276	186375	1.35	27956	201081	407088	208176	2.03
T_3	17855	253378	1.35	38007	229369	502758	272057	2.19
T_4	17445	2517632	0.07	19582	174449	333243	158920	1.91
T_5	17518	-	9.0	nil	89704	157662	66995	1.76

T_1 = Coconut +Gladiolus, T_2 = Coconut + Tube Rose, T_3 – Coconut + Gerbera, T_4 = Coconut + Marigold, T_5 = Coconut (Mono crop) ; Marigold 9500kg = 9500*265 number/ kg (Rate was calculated @ Rs1.25 for T_1, T_2, T_3 in 14-15 and Rs 1.45 in 15-16. T_4 @ Rs15/kg in 14-15 and Rs 20/kg in 15-16 and coconut @Rs8/ nut in 14-15 and Rs10/nut in 15-16)

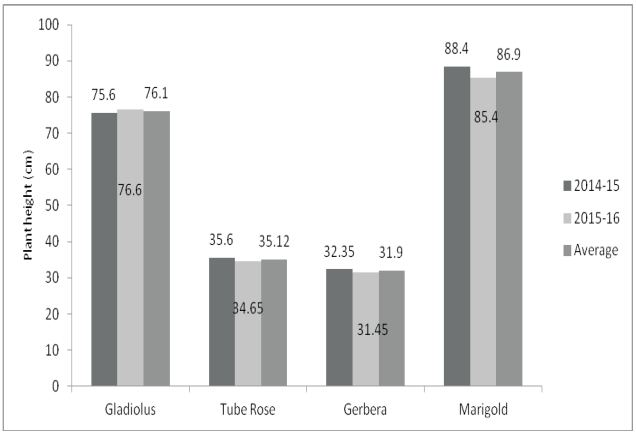

Figure 3: Plant height of different flowers in CBCS model

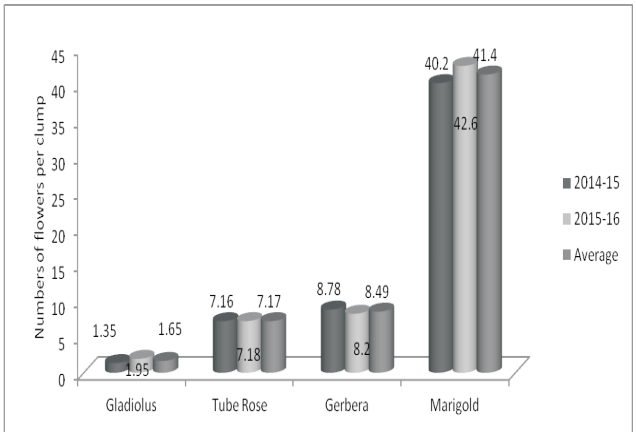

Figure 4: Numbers of flowers / plant / year in CBCS model

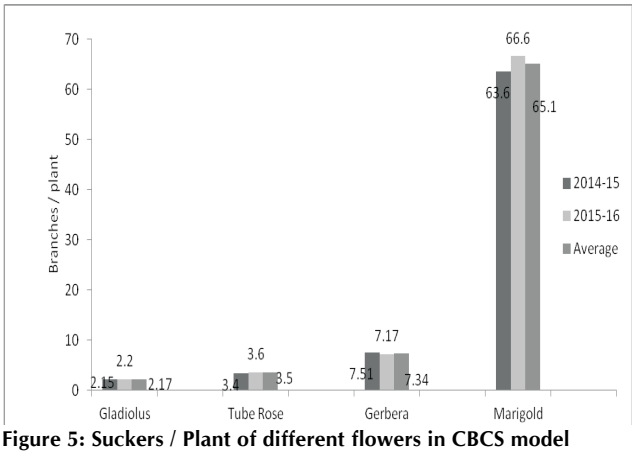

Figure 5: Suckers / Plant of different flowers in CBCS model

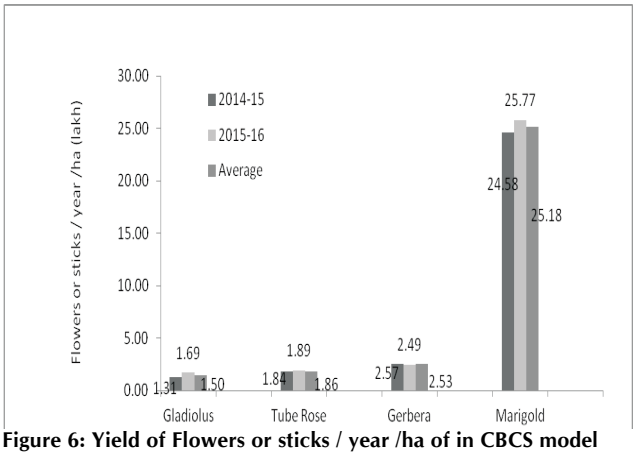

Figure 6: Yield of Flowers or sticks / year /ha of in CBCS model

compared with T_2 e.g. (Coconut + Tube Rose) and T_5 (Coconut). Similarly significant change in K content was also recorded among all treatments and maximum change was recorded in treatment T_3 (0.090kg/ha).

Cash flow analysis

To assess the economic viability of this coconut based cropping system model with floricultural crops, the cash flow analysis was performed to work out the benefit: cost ratio. From the table-5, it was clear that treatment T_3 that is Coconut + Gerbera model recorded maximum B: C ratio of 1:2.19 with a maximum net returns of Rs 272057/ha followed by T_1 that e.g. Coconut + Gladiolus with a B: C ratio of 1:2.15 indicates that for every 1 rupee investment in this system, the additional return from T_3 treatment (e.g. Coconut + Gerbera) was Rs 2.19, and T_1 treatment (e.g. Coconut + Gladiolus) was Rs 2.15 which confirmed that under well managed conditions of CBCS, treatment T_3 and T_1 are economically viable and recorded maximum benefit as compared to the other treatments. It was revealed from the above results that under coconut based cropping system model gerbera recorded maximum number of flowers, with better return during 2015-16 indicate that proper crop diversification could help farmers to realize better returns even if the price of the one commodity get reduced in one year. In treatment T_3 e.g. (Coconut + Gerbera) coconut also recorded maximum nut yield of 17932 numbers per hectare during 2015-16 (Table-2) as compared with the other treatments (models) may be due to the proper utilization of underutilized nutrients in the inter spaces of the coconut garden by flowering crops. Coconut equivalent yield (CEY) of inter crops were also worked out and presented in table-5. T_3 e.g. (Coconut + Gerbera) recorded highest coconut equivalent yield of 38007 nuts /ha followed by T_2 (Coconut + Tube rose) 27956 nuts/ ha. Lowest coconut equivalent yield of 19582 nuts / ha was recorded with T_4 e.g. Coconut + Marigold. However higher coconut equivalent yield in the cropping system model Coconut + Gerbera can be attributed to relatively better yield performance of flowering crops especially gerbera and also due to the better market price of the gerbera grown as inter crops in coconut garden. Arunachalam and Reddy (2007) reported that flowering crops like Heliconia, Anthurium, Jasmine can also grown successfully in coconut garden under irrigated and rain fed condition. Basavaraju *et al*. (2008) and Krishnakumar *et al*. (2011) also reported the increased coconut equivalent yield in coconut based cropping system model .With respect to soil nutrient status an increasing trend of NPK were also noticed from initial to end of experimentation and all the treatments having coconut + flowering crops recorded higher change in quantity of NPK content of soil as compared to the mono crop of coconut may be due to the continuous

accumulation of NPK in the inter spaces of coconut garden through decomposition of debris of flowering plants and coconut palms. Similarly leaf NPK content of coconut were also recorded an increasing trend over all the treatments during the period of experimentation as compared to the initial stage of experimentation. The increase in soil nutrients content and leaf nutrient content may help in increasing the yield and productivity of coconut. Prabhu *et al*., (2002) also reported the beneficial effect of integrated nutrient management in improving soil physical, chemical and biological properties which in turn helps in better nutrient absorption by plant and resulting in higher yield of the crops.

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