Impact of composted coir pith on the nutrition and productivity of coconut

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Application of composted coir pith alone could not bring about increase in the nutrient composition of coconut leaf. However, application of NPK alone and combination of CCP with NPK resulted in higher K content of coconut leaf compared to other treatments.

Abstract

A field experiment was conducted at CPCRI, Regional Station, Vittal to study the effect of composted coir pith on the productivity of coconut cv. Laccadive Ordinary under lateritic soil. The treatments viz. no fertilizer (control), recommended chemical fertilizer (500g N, 320g P_2O_5 and 1200g K_2O $palm^{-1}$ $year^{-1}$), 50% of the recommended K supplied through chemical fertilizer and 50% of the recommended K supplied through composted coir pith (CCP) and 100% K supplied through composted coir pith only were given to the palms. The experimental results indicated that, application of Composted Coir Pith (CCP) alone and in combination with NPK (50%) resulted in the increase in organic carbon of the soil and higher K content of coconut leaf. The leaf K content was also higher in the treatments which received NPK alone and CCP +NPK combination. The nut yield produced with the application of CCP +NPK was significantly higher (115 nuts/palm/year) compared to other treatments.

Introduction

Coconut is an important plantation crop of the humid tropical region and is mainly cultivated in coastal belt of west and east coast of India. Kerala, Tamil Nadu, Andhra Pradesh and Karnataka are major coconut growing states accounting for more than 90 % of the area and production. Coconut is a perennial crop committed to the land for more than 60 years and because of its unique nature of continuing growth and yielding phases, any change in the cultivation practices may upset the growth and physiology of the crop. Coconut flowers and fruits throughout the year and hence, requires sustained supply of nutrients for this activity for successful productivity. The annual nutrient export by palm through nuts, fronds, trunk, bunch and spathe reported by different workers vary from 20 to 174 kg N, 2.5 to 20 kg P and 35 to 249 kg K ha^{-1} (Pillai and Davis, 1963; Ramadasan and Lal, 1966; Ouverier and Ochs, 1978), but there appears to be a general agreement on the ratio of N and K removed by the

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palms (1.00: 1.44 -1.75). Since the palm derives its mineral nutrition from a limited volume of soil around the bole, the nutrient depletion over a period of time will affect the growth and yield, if the soil is not replenished with the nutrients. Hence, nutrient management plays a key role in productivity of the palms.

The crop with a density of 175 palms/ha requires 353 kg of N, P and K as per Central Plantation Crops Research Institute recommendation. This is based on general recommendation from CPCRI for fertilizing the bearing palms at 500g N, 320g P_2O_5 and 1200g K_2O $palm^{-1}year^{-1}$, to be applied in two split doses *viz.* one-third in May-June and two-third in September-October (Nelliat, 1973).

Coir pith is a by product of coir industry, obtained after extracting coir from the husk, and is being naturally dumped as such. During monsoon, tannins leached out of this pith causes environmental problems. The studies conducted at various places have shown that coir pith can serve as an important source of organic manure for agricultural crops (Savithri and Khan, 1994). In general, coconut coir pith is acidic in nature, having low bulk density and high porosity. Being highly lignocellulosic in nature, it decomposes slowly under prevailing conditions, thereby, minimizing nutrient loss from the profile. Coir pith, a highly lignocellulosic material, has wider C:N ratios ranging from 112:1 (Nagarajan *et al.* 1985) to 58:1 (Ravichandran, 1988). Studies carried out by Sesha Reddy (1985) showed that some species of *Pleurotus* had the ability to produce laccase and degrade part of cellulose and lignin present in the coir dust. Many workers have reported positive effect of applying coir pith, enriched coir pith, composted coir pith on yield and soil properties in different crops (Nagarajan *et al.*, 1991; Singaram, 1994; Maheswarappa *et al.*, 1999a and 1999b). With the above background, a field experiment was conducted to evaluate the effect of substitution of inorganic fertilizer by composted coir pith on the nutrition and productivity of coconut.

Materials and Methods

Experimental Site

The experiment was conducted at Central Plantation Crops Research Institute, Regional Station, Vittal, Dakshin Kannada district (Karnataka), which is located 58 m above mean sea level and receives an average annual rainfall of approximately 4000 mm. The mean maximum and minimum temperatures ranges from 36°C and 21°C respectively. The experimental site is a lateritic soil classified as *Oxic haplustults.* The soil had a pH of 5.6 and available soil nutrient status of 143 ppm N, 10.1 ppm P and 53 ppm K at a surface depth of 25 cm. The mechanical composition of soil is 60.8% sand, 4.6% silt and 34.6% clay at surface depth of 25 cm.

Experimental details

The experiment was laid out in randomized block design with five replications in a 22 year old coconut garden (cv. Laccadive ordinary). The treatment combinations are; T1: No fertilizer, T2: Recommended chemical fertilizer (500g N, 320g P_2O_5 and 1200g K_2O $palm^{-1}$ $year^{-1}$), T3: 50% of the recommended K supplied through chemical fertilizer and 50% of the recommended K supplied through composted coir pith (CCP) and T4: 100% K supplied through composted coir pith only. The quantity of chemical fertilizer and composted coir pith added to each palm is given in Table 1. The palms were planted at a distance of 7.5m x 7.5m in a square system and each treatment consisted of a plot size of six palms.

Table 1. Treatment details

Treatment	Chemical fertilizer (g $palm^{-1}$ $year^{-1}$)			Composted Coir pith (kg $palm^{-1}$)
	N	P_2O_5	K_2O	
T1: Absolute control	0	0	0	0
T2: 100% K supplied through chemical fertilizer	500	320	1200	0
T3: 100% K supplied through CCP*	0	320	0	80
T4: 50% K supplied through chemical fertilizer and 50 % K through CCP	80	320	600	40

* CCP – Composted Coir Pith

The composted coir pith was prepared as per the procedure given by Nagarajan *et al.* (1985) using *Pleurotus sajor caju* as lignin degrading fungi and urea as nitrogen source. The composted coir pith had the major nutrient composition as: N: 1.0 %, P:0.06 % and K : 1.2 %.

The N, P and K were applied in the form of urea, mussoorie-phos and muriate of potash respectively, in two splits *viz.* one-third (33%) in May-June (beginning of monsoon) and two-third (66%) in September-October (receding monsoon). Fertilizers were applied broadcast in circular basins of 1.8 m around the palm and mixed with soil thorughly. Composted coir pith was applied in September – October in the circular basin of 1.8 m around the palms. The palms were irrigated under drip system with 32 lit palm^{-1}day^{-1} during summer months ie., from November to May (CPCRI, 2001).

The yield data was recorded regularly from all the palms and annual yield palm^{-1} was computed. Pre-treatment (1995) and post-treatment (2000) soil and leaf samples were collected from three palms in each plot. Soil samples were drawn from the circular basins at 1.0 m away from the bole, at two depths *viz.* 0-25 cm and 25-50 cm using a tube augur. The soil samples were air dried in shade, ground to pass through 2 mm sieve and analysed for available nitrogen, phosphorus and potassium status by adopting standard procedures (Jackson, 1973). The leaf samples were collected from index leaf (14th leaf) of the palm by using a specially designed knife, by cutting 4-5 leaflets from the middle of the frond on both the sides. The leaf samples were washed with distilled water, oven dried at 65°C for 72 hrs and powdered using a Tecator Cyclotec sample mill. The powdered fraction (0.5 mm) of leaf sample was digested in di-acid mixture of HNO_3 : $HClO_4$ (3:1) and analysed for phosphorus and potassium content (Jackson, 1973). The nitrogen content in plant sample was estimated according to modified Kjeldahl procedure as described by Jackson (1973) using Tecator Kjeltec Auto Analyser.

Table 2. Leaf nutrient composition of coconut as influenced by different treatments

Treatment	N (%)		P (%)		K (%)	
	1995	2000	1995	2000	1995	2000
Control	1.78	1.85	0.132	0.102	1.15	1.30
NPK 100%	1.91	1.92	0.134	0.105	1.28	1.67
CCP 100%	1.87	1.81	0.135	0.110	1.18	1.34
CCP 50 %+ NPK 50%	1.84	1.88	0.138	0.115	1.19	1.64
CD (5%)	NS	NS	NS	NS	NS	NS

Results and Discussion

Coconut leaf nutrient composition

It is evident from the results that, application of composted coir pith alone could not bring about increase in the nutrient composition of coconut leaf (Table 2). However, application of NPK alone and combination of CCP with NPK resulted in higher K content of coconut leaf (1.64 to 1.67 %) compared to other treatments. This may be due to the increase in the soil available K content (Table 3). However there was not much

Table 3. Soil chemical properties as influenced by different treatments in coconut

Treatments	Av. N (ppm)				Av. K (ppm)			
	0-25cm		25-50 cm		0-25cm		25-50 cm	
Year	1995	2000	1995	2000	1995	2000	1995	2000
Control	143.6	143.28	106.2	111.72	97.0	136.06	80.0	113.97
NPK 100%	140.2	164.64	114.6	99.68	369.0	348.92	209.0	211.81
CCP 100%	167.4	172.48	114.2	110.32	135.0	181.12	173.0	96.31
CCP 50% + NPK 50 %	149.6	157.08	107.6	127.12	246.0	341.47	198.0	191.72
CD (5%)	NS	NS	NS	NS	110.7	103.52	NS	NS

Table 3. Soil chemical properties as influenced by different treatments in coconut (Contd.)

Treatments	Av. N (ppm)				Av. K (ppm)			
	0-25cm		25-50 cm		0-25cm		25-50 cm	
Year	1995	2000	1995	2000	1995	2000	1995	2000
Control	28.17	45.69	8.24	35.61	1.34	1.84	0.75	1.52
NPK 100%	31.30	55.11	7.80	36.86	1.30	1.99	0.93	1.42
CCP 100%	28.47	63.18	8.96	43.21	1.59	2.36	0.93	1.54
CCP 50% + NPK 50 %	38.58	51.26	18.29	17.82	1.53	2.51	0.86	1.73
CD (5%)	NS	NS	NS	NS	NS	0.46	NS	NS

variation in the leaf content with respect to N and P.

Soil chemical properties

The soil chemical properties under the treatment studied are presented in table 3. The available N and P in the soil did not differ significantly among the treatments during 2000. Whereas, application of NPK alone and CCP+NPK resulted in increase in available K status of the soil at top depth. The organic content under different treatments during 1995 was non significant and ranged 1.34 to 1.59 %. There was increase in the organic carbon content of the soil at 0-25 cm depth under CCP treatments (2.36 % and 2.51%) compared to other treatments, during 2000, which depicts impact of CCP on improvement of organic carbon status of the soil. At lower depths the OC content did not differ significantly among the treatments. Improvement in soil properties after application of coir pith and CCP has been reported by many workers in different crops (Nagarajan *et al.*, 1991, Singaram, 1994, Maheswarappa *et al.*, 1999b).

Coconut nut yield

In general, over the years there was a progressive increase in the nut yield of the palms (Table 4). Among the treatments, CCP+NPK combination treatment produced significantly more number of nuts (68, 105 and 115 nuts/palm/year) compared to other treatments during 1998-99, 1999-00 and 2000-01, respectively. Application of NPK alone and CCP alone also recorded significantly higher nut yield compared to control, which recorded significantly lower number of nuts when compared to CCP+NPK combination (45, 56 and 55 nuts/palm/year) during 1998-99, 1999-00 and 2000-01, respectively. Over the years, it was observed that, even in control treatment also there was increase in nut yield which was mainly due to irrigation provided during summer months. Application of composted coir pith in different crops resulted in the increase in yield (Nagarajan *et al.*, 1991, Singram, 1994, Maheswarappa *et al.*, 1999b).

Conclusion

From the above study it can be concluded that, application of composted coir pith (50% of K requirement ie. 40 kg per palm) in combination with NPK (50%) could be recommended for higher yield along with maintaining soil fertility status in coconut garden.

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Table 4. Nut yield as influenced by different treatments

Treatments	Yield (nuts/palm/year)					
	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-01
Control	30	31	49	45	56	55
NPK 100%	25	20	46	52	82	78
CCP 100%	33	31	49	46	82	80
CCP 50 %+ NPK 50%	35	31	61	68	105	115
CD (5%)	NS	NS	NS	12.6	14.2	13.8