Indian Journal of Agronomy 45 (1) : 86-91 (March 2000)

Nutrient content and uptake by arrowroot (*Maranta arundinacea*) as influenced by agronomic practices when grown as intercrop in coconut (*Cocos nucifera*) garden

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Received : March 1999

ABSTRACT

A field experiment conducted during rainy season of 1995 to 1998 at CPCRI, Kasaragod revealed that sizes of planting material and plant-population levels did not influence the nutrient content of arrowroot (*Maranta arundianacea* L.). But organic manures like farmyard manure, vermicompost and combination of FYM + NPK, NPK alone treatments had higher average N, P and K contents compared with composted coir-pith treatment. Nutrient uptake did not differ significantly due to sizes of planting material, whereas with 166,00 population the uptake was significantly higher. Under farmyard manure, vermicompost and combination of FYM + NPK treatments, the N, P and K removal was higher. The fresh- rhizome yield did not differ significantly due to size of planting material and population level. FYM + NPK combination recorded significantly higher fresh-rhizome yield.

Key words : Arrowroot (*Maranta arundinacea* L.), Coconut (*Cocos nucifera* L.), Intercrop, Nutrient content and uptake, Organic manures

Arrowroot (family Marantaceae),which is considered as a minor tuber crop having medicinal value, is erect, perennial herb but cultivated as an annual crop. It is indigenous to tropical America and widely distributed throughout the tropical countries like India, Sri Lanka, Indonesia, Philippines, Australia and West Indies. The economic part is rhizome, which is used for the production of starch. The starch is valued as a food especially for infants, invalids and convalescents. It is used in the preparation of biscuits, cakes, puddings and jellies. It possesses demulcent properties and given in bowel complaints. It is employed as a suspending agent in the preparation of barium meals and the starch is preferred as base material for making

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tablets, since it produces rapid disintegration. Starch is also used as a base for face powders and in the preparation of special glues. Arrowroot grows well under shaded conditions. The information on influence of agronomic practices on nutrient content, uptake and yield of arrowroot when grown as intercrop in coconut garden is meagre. Hence a study was conducted at CPCRI, Kasaragod on these aspects.

MATERIALS AND METHODS

Field experiments were conducted during rainy season of 1995 to 1998 at Central Plantation Crops Research Institute, Kasaragod, which is situated at 12° 30' N latitude and 75° 00' E longitude at an elevation of 10.7 m above mean sea level. The soil of the experimental site was red sandy loam with field capacity of 7.40 and 8.95% at 0-25 and 25-50 cm respectively. The soil was low in available N and K, and was high in available P. The field experiment was laid out in a split-plot design with three replications. Sizes of planting material and plant population levels formed main-plot treatments, viz. S_1P_1= 15-20 g with 111,000 plant population (30 × 30 cm spacing)/ha; S_1P_2= 166,000 plants (30 × 20 cm spacing)/ha; S_2P_1=25-30 g with 111,000 plants/ha; and S_2P_2=166,000 plants/ha. Organic manures like farmyard manure (FYM) 26 t/ha (F_1), FYM 34 t/ha (F_2), composted coir pith (CCP) 32 t/ha (F_3), CCP 42 t/ha (F_4), vermicompost (VC) 22 t/ha (F_5), VC 30 t/ha (F_6), FYM 20 t/ha + NPK (75:50:50 kg/ha) (F_7), NPK alone (75:50:50 kg/ha) (F_8) and control (F_9) formed the subplot treatments. The same treatments were superimposed in the same plot during second and third years also. The planting was done during the first week of June 1995-96, second week of May in 1996-97 and third week of may in 1997-98. Pooled data of the years were analysed and the results were interpreted

RESULTS AND DISCUSSION

Nutrient content

Nutrient content with respect to N, P and K did not differ significantly due to sizes of planting material and plant population levels. The P and K contents were significantly higher with FYM, VC, FYM + NPK and NPK alone treatments compared with CCP and control (Table 1). Higher content in these treatments was attributed mainly to easy availability of nutrients with FYM, VC application for plants.

Nutrient uptake

In general, the uptake of N, P, and K was higher than the N, P and K dose that was adopted in this investigation. Nitrogen, phosphorus and potassium uptake did not differ significantly due to size of the planting material (Table 1). The growth and development of the crop was almost similar at both the sizes, resulting in similar uptake of nutrients. Among the population levels, the uptake was significantly higher with 166,000 plants/ha population due to higher number of plants per unit area and higher dry matter.

Among organic manures, the uptake was significantly higher with FYM+NPK, FYM, VC and NPK alone treatments compared with CCP at both the levels. This can

Table 1. Nutrient content and uptake by arrowroot as influenced by different treatments (pooled data)

Treatment	Nutrient content (%)			Nutrient uptake (kg/ha)		
	N	P	K	N	P	K
Size of planting material						
S_1 :15-20 g	0.87	0.42	0.99	122.1	54.3	130.8
S_2 : 25-30 g	0.87	0.42	0.99	122.2	54.2	130.9
CD (P = 0.05)	NS	NS	NS	NS	NS	NS
Plant population						
P_1: 111,000/ha	0.87	0.41	0.98	99.4	46.0	110.9
P_2: 166,000/ha	0.87	0.41	0.98	145.6	56.2	153.2
CD (P=0.05)	NS	NS	NS	0.55	0.31	1.17
Organic manure (t/ha)						
F_1 : FYM : 26	0.96	0.47	1.01	153.4	71.3	163.8
F_2 : FYM : 34	0.99	0.47	0.99	161.5	72.6	157.3
F_3 : CCP : 32	0.73	0.37	0.82	57.3	29.2	82.3
F_4 : CCP : 42	0.72	0.37	0.83	55.6	28.3	81.6
F_5 : VC : 22	0.96	0.45	1.01	154.6	73.2	168.6
F_6 : VC : 30	0.97	0.46	1.01	157.3	71.6	169.7
F_7 : FYM (20t/ha) + NPK (75:50:50 kg/ha	0.98	0.44	1.04	198.5	81.3	210.0
F_8 : NPK (75:50:50 kg/ha)	0.96	0.46	1.01	115.3	51.2	143.2
F_9 : Control	0.65	0.29	0.73	41.0	13.7	45.1
CD (P = 0.05)	0.005	0.004	0.008	1.06	0.67	1.55

DAP=Days after planting, NS=non-significant

mainly be attributed to better growth under these treatments and better availability of nutrients. The N and K uptake was more than the applied dose under NPK alone treatment. The enhanced microbial activities caused the transportation of soluble nitrogen into microbial protein, thereby preventing nitrogen loss by leaching (Tiwari *et al.*, 1989) and increased the uptake by crops. Increase in P uptake was attributed to release of fixed P to available form by phosphatase enzymes. Application of farmyard manure increased the activity of phosphotase enzymes, which in turn increased the P availability (Bopaiah and Shetty, 1991).

Higher plant population level in combination with FYM + NPK removed higher N, P and K compared with other combinations (Table 3). FYM and VC at both the levels with higher population also removed higher N, P and K compared with CCP at both the levels, and NPK alone in combination with higher population.

Yield components and fresh-rhizome yield

Yield components like number of rhizomes, length of rhizome and girth of rhi-

Table 2. Yield components and yield of arrowroot as influenced by different treatments (pooled data)

Treatment	No. of rhizomes/ plant	Length of rhizomes (cm)	Girth of rhizomes (cm)	Fresh-rhizome yield (t/ha)
Size of planting material				
S_1 : 15-20 g	7.4	17.1	4.8	12.4
S_2 : 25-30 g	7.5	17.0	4.8	12.5
CD (P = 0.05)	NS	NS	NS	NS
Plant population				
P_1 : 111,000/ha	7.7	17.1	4.8	12.5
P_2 : 166,000/ha	7.0	17.0	4.8	12.7
CD (P = 0.05)	0.16	NS	NS	NS
Organic manure				
F_1 : FYM : 26 t/ha	9.6	18.7	5.4	14.3
F_2 : FYM : 34 t/ha	9.6	18.8	5.4	14.4
F_3 : CCP : 32 t/ha	3.4	13.5	4.0	9.8
F_4 : CCP : 42 t/ha	3.5	13.6	4.1	9.7
F_5 : VC : 22 t/ha	9.5	18.8	5.4	14.8
F_6 : VC : 30 t/ha	9.6	18.9	5.4	14.9
F_7 : FYM (20t/ha)+NPK (75 : 50 : 50 kg/ha)	10.8	18.9	5.4	16.6
F_8 : NPK(75: 50 : 50 kg/ha)	8.0	18.6	5.4	12.2
F_9 : Control	2.7	13.1	4.0	6.1
CD (P=0.05)	0.26	0.22	0.07	0.18

DAP = Days after planting; NS=non-significant

zome was not influenced by size of planting material (Table 2). Plant population levels also did not influence the length and girth of rhizomes, whereas lower population recorded more number of rhizomes. FYM + NPK treatment recorded significantly more number of rhizomes compared with other treatments. Composted coir pith and control treatments recorded lower number of rhizomes. Fresh-rhizome yield did not differ significantly due to sizes of planting material and plant population levels. Among organic manures, FYM+NPK treatment recorded significantly higher fresh-rhizome yield (16.6 t/ha) compared with other treatments. FYM at both the levels also recorded significantly higher yield compared with CCP at both the levels and NPK alone. Superior yield with FYM+NPK was mainly due to the combined effect of organic and chemical fertilizers on growth and development of the crop, along with higher nutrient uptake. FYM and VC applied at two levels alone also favoured the crop growth, resulting in higher yield. Application of 150 : 75 : 150

Table 3. Interaction effect of levels of population and organic manures on N, P and K uptake in arrowroot (pooled data)

Treatment	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
	P_1	P_2	P_1	P_2	P_1	P_2
F_1	130.3	189.5	63.5	90.5	141.7	192.5
F_2	133.7	193.9	65.4	89.2	128.7	181.6
F_3	49.0	64.9	23.5	34.1	70.8	91.8
F_4	47.8	63.8	23.9	34.3	68.5	92.4
F_5	133.1	185.1	64.0	82.3	139.6	199.8
F_6	136.4	184.3	63.6	86.9	139.0	200.7
F_7	158.7	231.7	70.7	104.5	171.0	241.8
F_8	98.7	138.7	46.6	64.5	117.9	176.8
F_9	33.3	48.8	15.2	21.9	37.2	55.6
	CD (P=0.05) for F at the same levels of P=1.46 CD (P=0.05) for P at the same or different levels of F = 1.49		CD (P=0.05) for F at the same levels of P=1.15 CD (P=0.05) for P at the same or different levels of F=1.18		CD (P=0.05) for F at the same levels of P=2.12 CD (P=0.05) for P at the same or different levels of F=2.44	

P, Plant population, F, organic manures

kg NPK resulted in higher yield of arrowroot compared with that of lower doses when grown as pure crop (Ramesan, 1991). Increase in yield due to combined application of FYM and inorganic fertilizer has been reported in turmeric (Rao *et al.*, 1975). Application of FYM alone resulted in higher yield of amorphophallus (Patel and Mehta, 1987) and turmeric (Balashanmugam *et al.*, 1989) have been documented. VC application alone or in combination was found to increase the yield of turmeric (Vadiraj *et al.*, 1996). The overall better growth and yield under FYM and VC treatments also contributed to higher microbial population and dehydrogenase activity, which might have influenced the nutrient uptake, chlorophyll synthesis and plant growth, and further these microbes were found to promote soil aggregation and thus indirectly influence root environment and plant growth.

From this study it can be concluded that for growing arrowroot, the use of 15-20 g size planting material with the spacing of 30 cm × 30 cm is beneficial for higher yields. Application of FYM + NPK, FYM or VC alone was also found to give maximum yield compared with that of NPK alone.

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