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Nutrient content and uptake by galangal (*Kaempferia galanga* L.) as influenced by agronomic practices as intercrop in coconut (*Cocos nucifera* L.) garden[1]

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Abstract

Field experiments conducted at Kasaragod, India, to study the influence of agronomic practices on galangal (*Kaempferia galanga*) grown as intercrop in coconut (*Cocos nucifera*) garden revealed that nutrient content did not differ significantly due to different types of planting material or plant population levels. Farm yard manure alone, vermicompost alone and farm yard manure and major nutrient combinations had higher nutrient contents. Nutrient uptake with mother rhizome treatment was significantly higher compared to finger rhizome. Population level of 5,00,000 plants per ha removed more nutrients. Farm yard manure alone, vermicompost application alone and farm yard manure and major nutrient combinations removed higher nutrients. Fresh rhizome yield was significanlty higher with mother rhizome and 5,00,000 population level. Farm yard manure in combination with major nutrients recorded significantly higher fresh rhizome yield.

Key words: galangal, *Kaempferia galanga*, nutrient content, nutrient uptake, organic manure.

Abbreviations: CCP : Composted coir pith; FYM : Farm yard manure; VC : Vermicompost.

Galangal or *kacholam* (*Kaempferia galanga* L.; Zingiberaceae) is an important medicinal and aromatic herbaceous plant, the rhizomes of which are used in ayurvedic medicine and also as flavouring agent. The rhizomes contain essential oil and oleoresin which are used in perfumery and curry flavourings. The crop comes up well under shaded conditions (Rajagopalan *et al.* 1992). However, information on the influence of agronomic practices on nutrient content, uptake and yield of galangal grown as intercrop in coconut (*Cocos nucifera* L.) garden is meagre.

The field experiments were conducted during 1995 to 1998 at Central Plantation Crops Research Institute, Kasaragod (Kerala, India) situated at 12°30' N latitude and 75°00' E longitude at an elevation of 10.7 m above MSL. The soil of the experimental site was red sandy loam with a 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 high in available P. The experiment was laid out in a split plot design with three replications. Types of planting material and population levels formed the main plot treatments namely, mother rhizome with 3,33,000 population ha^{-1} (20 cm x 15 cm spacing) (S_1P_1) and 5,00,000 population ha^{-1} (20 cm x 10 cm spacing) (S_1P_1), finger rhizome with 3,33,000 population ha^{-1} (S_2P_1) and 5,00,000 population ha^{-1}/S_2P_2). Organic manures, FYM : 24 t ha^{-1} (F_1), FYM : 32 t ha^{-1} (F_2), CCP : 29 t ha^{-1} (F_3), CCP : 39 t ha^{-1} (F_4), VC : 21 t ha^{-1} (F_5), VC : 28 t ha^{-1} (F_6), FYM (20 t ha^{-1}) + NPK (50:50:50 kg ha^{-1}) (F_7) (KAU 1996), NPK alone (50:50:50 kg ha^{-1}) (F_8) and control (F_9) (without any manures), formed the

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subplot treatments. The plot size was 2.0 m x 1.8 m. The interspace between the beds was 30 cm. The rhizomes were planted as per treatments on raised beds during the first week of June during 1995–96, second week of May during 1996–97 and third weed of May during 1997–98 and harvested during first week of February during 1995–96, third week of January during 1996–97 and fourth week of January during 1997–98. The duration of the crop was 8 months. The same treatments were superimposed in the same plot during the second and third years.

Nutrient content in leaf, rhizome and root was estimated by adopting the procedures suggested by Jackson (1973). Total uptake was estimated by multiplying nutrient content and total dry weight and expressed in kg ha^{-1}.

Nutrient content

Nutrient content (N, P and K) did not differ significanlty due to type of planting material and plant population levels (Table 1). Nitrogen content was significantly higher with FYM, VC and combination of FYM+NPK treatments compared to CCP and NPK alone. P and K contents were significantly higher with all organic manures, FYM+NPK and NPK alone treatments. The higher nutrient content in these treatments could probably be attributed to better availability of nutrients under these treatments. Plants in control plots had significantly lower N, P and K contents.

Table 1. Influence of agronomic practices on nutrient content and uptake in galangal (pooled data)

Treatment	Nutrient content (%)			Nutrient uptake (kg ha^{-1})		
	N	P	K	N	P	K
Planting material						
S_1 : Mother rhizome	1.06	0.73	1.85	49.3	30.0	84.7
S_2 : Finger rhizome	1.06	0.74	1.85	47.6	29.9	81.5
'F' test	NS	NS	NS	*	NS	*
SE±m/	0.005	0.007	0.013	0.12	0.09	0.22
CD (P<0.05)	-	-	-	0.43	-	0.79
Plant population (ha^{-1})						
P_1 : 3,33,000	1.07	0.73	1.84	39.6	26.3	66.5
P_2 : 5,00,000	1.07	0.73	1.84	57.4	34.8	99.5
'F' test	NS	NS	NS	*	*	*
SE±m	0.005	0.007	0.013	0.12	0.09	0.22
CD (P<0.05)	-	-	-	0.43	0.31	0.79
Organic manure (t ha^{-1})						
F_1 : FYM (24)	1.18	0.76	1.88	60.6	36.4	96.8
F_2 : FYM (32)	1.19	0.75	1.89	60.6	37.8	97.3
F_3 : CCP (29)	0.93	0.75	1.92	34.1	24.2	69.3
F_4 : CCP (39)	0.90	0.75	1.96	32.5	23.8	71.3
F_5 : VC (21)	1.14	0.77	1.86	56.8	35.6	92.7
F_6 : VC (28)	1.15	0.76	1.88	59.5	36.7	93.8
F_7 : FYM (20 t ha^{-1})+NPK (50:50:50 kg ha^{-1})	1.16	0.76	1.89	59.5	37.8	96.9
F_8:NPK(50:50:50 kg ha^{-1})	1.09	0.76	1.87	49.9	30.3	85.0
F_9 : Control	0.86	0.58	1.49	26.6	17.4	45.3
'F' test	*	*	*	*	*	*
SE±m	0.001	0.001	0.002	0.24	0.19	0.41
CD (P<0.05)	0.04	0.005	0.006	0.67	0.50	1.16

NS = Non significant; Significant at P < 0.05

Since the soil was low in available N and K, their content was also lower in control plot plants, where additional manure was not added.

Nutrient uptake

Nitrogen, phosphorus and potassium uptake was significantly higher with mother rhizome compared to finger rhizome (Table 1) probably because of better vegetative growth of the crop in the initial stages which resulted in higher uptake of these nutrients. The uptake of N, P and K was significantly superior with 5,00,000 population ha^{-1}. This is mainly attributed to accommodating more number of plants per unit area which resulted in higher nutrient removal compared to 3,00,000 ha^{-1} population level. Among organic manures, FYM+NPK and FYM at both the levels removed significantly higher N, P and K, compared to other treatments.

Significantly higher N uptake was noticed with the combination of mother rhizome and 5,00,000 ha^{-1} population level of FYM+NPK compared to other combinations of treatments (Table 2). CCP at both levels with either mother or finger rhizome or with different population levels removed significantly less N. Population level of P_2 with FYM+NPK removed higher P compared to other combinations (Table 3). In general, K uptake was higher than the applied dose in this study. Rajagopalan *et al.* (1989) also reported higher uptake of K compared to N and P in galangal. K removal was higher with the combination of mother rhizome and 5,00,000 ha^{-1} population level and FYM+NPK combination (Table 4).

Higher uptake of nutrients under FYM+NPK, FYM and VC treatments was attributed to better availability of nutrients. This was reflected in better growth of the crop and ultimately higher fresh rhizome yield. The enhanced microbial activities caused the transportation of soluble

Table 2. Interaction effects of S x P x F on N uptake in galangal (pooled data)

Treatment	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9
S_1P_1	53.8	54.4	27.1	26.5	49.7	49.7	50.0	41.2	21.2
S_1P_2	72.9	73.3	40.4	34.4	66.0	72.4	75.6	58.7	31.3
S_2P_1	47.5	48.9	27.9	26.4	43.2	44.0	46.6	37.8	21.2
S_2P_2	73.4	74.9	38.6	42.6	64.0	63.6	73.0	58.8	31.4

CD (5%) for F at the same levels of S x P = 1.56
CD (5%) for S x P at the same or different levels of F = 1.66
S = Planting material; P = Plant population; F = Organic manure

Table 3. Interaction effects of P x F on P uptake in galangal (pooled data)

Treatment	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9
P_1	31.7	31.6	22.2	21.9	31.0	30.8	31.6	27.7	14.3
P_2	47.0	47.2	32.9	32.8	45.2	44.8	48.6	40.9	21.7

CD (5%) for the same levels of P = 0.83
CD (5%) for P at the same or different levels of F = 0.87
S = Planting material; P = Plant population; F = Organic manure

Table 4. Interaction effects of S x P x F on K uptake in galangal (pooled data)

Treatment	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9
S_1P_1	75.6	75.9	61.1	60.5	74.6	75.5	77.3	67.8	34.4
S_1P_2	111.9	115.3	81.1	85.1	115.1	115.2	119.7	108.2	52.1
S_2P_1	74.2	75.2	55.2	56.4	71.1	72.3	76.0	66.1	39.8
S_2P_2	110.7	117.4	76.2	81.8	109.6	110.2	114.0	97.4	51.0

CD (5%) for F at the same levels of S x P = 1.96
CD (5%) for S x P at the same or different levels of F = 2.01
S : Planting material; P : Plant population; F : Organic manure

nitrogen into microbial protein thereby preventing nitrogen loss by leaching as reported by Tiwari *et al.* (1989). Increase in P uptake was attributed to release of fixed P to available form by phosphatase enzymes. Application of FYM, increased the activity of phosphatase enzymes which enhanced P availability (Bopaiah & Shetty 1991).

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