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# Effect of planting material, plant population and organic manures on growth components and yield of galangal (*Kaempferia galanga*) when grown as intercrop in coconut garden*

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Due to increased health consciousness of the people in general and carcinogenic hazards of the synthetic drugs, there is enhanced demand for the products of medicinal plants. However, as their availability from natural resources is limited, there is need to find a place for these crops in our existing cropping system and also workout appropriate agro-techniques. The scope for increasing the land area under cultivation being negligible, intensive cultivation of crops and raising the productivity per unit area is the only means of increasing food production. In case of coconut which remains committed to the land for decades with long gestation period, it is advisable to practice inter/mixed cropping for getting additional and staggered income. Studies on land and solar energy utilization in coconut garden revealed the amenability of the palm in intensive cropping to harness the unutilised space, solar energy and other resources.

Galangal (*Kaempferia galanga* L.) is an important medicinal-cum-aromatic herbaceous stemless plant belonging to Zingiberaceae family. The rhizomes of this crop are the economic part, and are used in ayurvedic medicine as stimulant, diuretic, stomachic, carminative and also used as flavouring agent, etc. The rhizomes on distillation yield an essential oil, which finds use in perfumery and curry flavourings. In addition to essential oil, the rhizomes also yield oleoresin. Oleoresin is the total flavour extract comprising of essential oil, non-essential oil, pungent principles, colours and fats. This crop comes up very well under shaded condition. The information on effect of planting material, plant population and organic manures on growth of galangal when grown as intercrop in coconut garden is meagre. Hence, a study was conducted at Kasaragod during 1995-98 to study the effect of agronomic practices on growth and yield of galangal.

Field experiments were conducted during 1995 - 98 at the 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 was red sandy loam with the 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. Types of planting material and population levels formed the main plot treatments, viz mother rhizome with 333 thousands population/ha (20 cm × 15 cm spacing) ($S_2P_1$), and 500 thousands population ha (20 cm × 10 cm spacing) ($S_1P_2$), finger rhizome with 333 thousands population/ha ($S_2P_1$) and 500 thousands population/ha ($S_2P_2$). Organic manures like farmyard manure : 24 tonnes/ha ($F_1$), farmyard manure : 32 tonnes/ha ($F_2$), composted coir pith : 29 tonnes/ha ($F_3$), composted coir pith : 39 tonnes\ha ($F_4$), vermicompost (VC) : 21 tonnes/ha ($F_5$), vermicompost : 28 tonnes/ha ($F_6$), farmyard manure (20 tonnes/ha) + NPK (50:50:50 kg/ha) ($F_7$), NPK alone (50:50:50 kg/ha) ($F_8$) (KAU, Trissur 1991) and control ($F_9$) formed the subplot treatments. The raised beds of 2 m × 1.8 m size were prepared in between coconut rows by leaving 2 m radius from the bole of the coconut, aged 35 years old and spaced at 7.5 m × 7.5 m. The rhizomes were planted on a raised bed during first week of June (during 1995-96), second week of May (during 1996-97) and third week 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 intercrop was irrigated during November till the harvest. Duration of the crop was 8 months. The same treatments were superimposed in the same plot during the second and third year.

Observation on growth characters were carried out from labelled plants. The leaf area (LA) cm²/plant), leaf area index and leaf area duration (LAD) (days) (Watson 1952) were calculated using the following formula;

Length × breadth method was used Leaf factor for

*Short note

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Table 1 Sprouting (%), number of tillers/plant and number of leaves/plant as influenced by different treatments in galangal*

| Treatment | Sprouting | No. of tillers | | No. of leaves | | Leaf area | | LAD | | | Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 days after planting | 60 days after planting | 180 days after planting | 60 days after planting | 180 days after planting | 60 DAP | 120 DAP | 180 DAP | 60-120 DAP | 120-180 DAP | |
| *Planting material* | | | | | | | | | | | |
| S1 (Mother rhizome) | 88.2 | 2.2 | 3.5 | 4.4 | 11.0 | 141.4 | 243.6 | 377.6 | 47.9 | 79.9 | 4.8 |
| S2 (Finger rhizome) | 88.4 | 2.2 | 3.4 | 4.4 | 10.7 | 135.1 | 226.1 | 340.8 | 44.8 | 69.8 | 4.7 |
| 'F' test | NS | NS | | NS | | | | | | | |
| SEm± | 0.06 | 0.08 | 0.02 | 0.09 | 0.08 | 0.73 | 0.75 | 1.99 | 0.32 | 0.72 | 0.02 |
| CD (*P*=0.05) | | | 0.06 | | 0.28 | 2.54 | 2.60 | 7.89 | 0.45 | 1.02 | 0.07 |
| *Plant population levels* | | | | | | | | | | | |
| P1: 333 thousands/ha (20×15 cm) | 88.2 | 2.2 | 3.6 | 4.4 | 11.4 | 138.2 | 246.7 | 381.8 | 38.5 | 62.9 | 4.5 |
| P2: 500 thousands/ha (20×10 cm) | 88.3 | 2.3 | 3.4 | 4.4 | 10.3 | 138.3 | 222.0 | 336.5 | 54.1 | 83.8 | 4.8 |
| 'F' test | NS | NS | | NS | | NS | | | | | |
| Sem± | 0.06 | 0.08 | 0.02 | 0.09 | 0.08 | -0.73 | 0.75 | 1.99 | 0.32 | 0.72 | 0.02 |
| CD (*P*=0.05) | | | 0.06 | | 0.28 | | 2.60 | 6.89 | 0.45 | 1.02 | 0.07 |
| C *Organic manures and levels* | | | | | | | | | | | |
| $F_1$: FYM: 24 tonnes/ha | 88.4 | 2.5 | 3.8 | 4.8 | 11.7 | 160.7 | 303.4 | 392.0 | 57.7 | 86.1 | 5.2 |
| $F_2$: FYM: 32 tonnes/ha | 88.2 | 2.4 | 3.8 | 4.8 | 11.5 | 158.5 | 294.5 | 375.8 | 53.9 | 80.7 | 5.2 |
| $F_3$: CCP: 29 tonnes/ha | 87.9 | 2.1 | 3.2 | 3.8 | 9.3 | 107.2 | 158.6 | 266.5 | 32.7 | 52.4 | 3.4 |
| $F_4$: CCP: 39 tonnes/ha | 88.6 | 2.0 | 3.1 | 3.8 | 9.0 | 113.8 | 152.7 | 267.1 | 33.0 | 50.9 | 3.4 |
| $F_5$: VC: 21 tonnes/ha | 88.3 | 2.3 | 3.7 | 5.0 | 11.3 | 159.6 | 293.2 | 402.5 | 55.6 | 85.9 | 5.2 |
| $F_6$: VC: 28 tonnes/ha | 88.3 | 2.4 | 3.8 | 5.0 | 12.4 | 160.2 | 289.2 | 472.2 | 55.7 | 94.0 | 5.3 |
| $F_7$:FYM(20t/ha)+NPK (50:50:50kg/ha) | 88.2 | 2.4 | 3.9 | 5.0 | 12.2 | 159.6 | 300.6 | 439,3 | 57.3 | 91.6 | 6.0 |
| $F_8$:NPK(50:50:50kg/ha) | 88.2 | 2.3 | 3.5 | 4.4 | 11.2 | 127.2 | 196.7 | 401.8 | 40.6 | 73.8 | 4.6 |
| $F_9$: Control | 88.2 | 1.8 | 2.9 | 3.0 | 8.8 | 102.4 | 138.7 | 260.1 | 30.0 | 44.6 | 2.5 |
| 'F' test | NS | | | | | | | | | | |
| SEm± | 0.13 | 0.05 | 0.03 | 0.05 | 0.11 | 1.11 | 0.93 | 1.85 | 0.18 | 0.26 | 0.03 |
| CD (*P*=0.05) | | 0.15 | 0.11 | 0.14 | 0.32 | 3.16 | 2.65 | 5.23 | 0.51 | 0.73 | 0.09 |

FYM, Farmyard manure; CCP, composted coirwith; VC, vemicompost

kacholam=0.628 LAD= $L(i) + L(i+1) / 2 \times t_2-t_1$

L (i)= Leaf area index at ith stage

L (i+1) = Leaf area index at (i+1)th stage

$t_2-t_1$=Time interval between ith and (i+1)th stage in days

*Sprouting*

Sprouting was not influenced by the types of planting material or plant population levels and different organic manures. The overall sprouting % ranged between 88.0 and 88.7 % (Table 1). Since both mother rhizome and finger rhizome have sufficient reserve food material, the sprouting was similar in both the types of planting material.

*Number of tillers, number of Leaves and leaf area*

Number of tillers, number of leaves and leaf area produced with mother rhizome were significantly more at 120 and 180 days after planting (Table12) compared to finger rhizome, whereas above growth components were on a par with mother rhizome and finger rhizome at 60 days after planting. The mother rhizome, which is heavier than finger rhizome produced vigorous plants compared to finger rhizome. Rajagopalan and Gopalakrishnan (1985) also reported the vigorous growth of galangal (kacholam) with mother rhizome compared to finger rhizome.

Plant population levels did not show any significant difference with respect to number of tillers, number of leaves during 60 and 120 days after planting, whereas plant population at 333 thousands/ha gave more number of tillers, more number of leaves at 180 days after planting compared to 500 thousands/ha population level. Leaf area observed with 333 thousands/ha population was significantly superior at 120 and 180 days after planting, compared to 500 thousands/ha population level. The growth of galangal is very slow up to 120 days after planting, thereafter it picks up its growth. From 120 days after planting, due to faster growth, the higher plant population resulted in competition within the plant community resulting in lower leaf area per plant. Among organic manures, farmyard manure+NPK, farmyard manure and verm's compost at both the levels had higher number of tillers, number of leaves and leaf area at all the

Table 2 Interaction effects of S×P×F on number of tillers, leaf area ($cm^2$ /plant), leaf area duration (days) of galangal *

| Treatment | $F_1$ | $F_2$ | $F_3$ | $F_4$ | $F_5$ | $F_6$ | $F_7$ | $F_8$ | $F_9$ |
|---|---|---|---|---|---|---|---|---|---|
| $S_1P_1$ | 4.1 | 4.1 | 3.1 | 3.1 | 4.2 | 4.1 | 4.2 | 3.8 | 2.8 |
| $S_1P_2$ | 3.7 | 3.8 | 3.1 | 3.1 | 3.6 | 3.8 | 3.8 | 3.4 | 2.8 |
| $S_2P_1$ | 3.7 | 3.7 | 3.1 | 3.1 | 3.8 | 3.8 | 4.0 | 3.3 | 2.8 |
| $S_2P_2$ | 3.7 | 3.7 | 3.1 | 3.1 | 3.6 | 3.6 | 3.8 | 3.3 | 2.8 |
| CD ($P$=0.05) for F at the same levels of S×P = 0.20 | | | | | | | | | |
| CD ($P$=0.05) for S × P at the same or different levels of, F= 0.21 | | | | | | | | | |
| *Leaf area ($cm^2$/plant) at 180 days after planting** | | | | | | | | | |
| $S_1P_1$ | 425.0 | 402.3 | 282.6 | 287.9 | 442.5 | 517.6 | 491.8 | 462.3 | 241.7 |
| $S_1P_2$ | 388.1 | 380.1 | 270.4 | 230.9 | 427.4 | 490.9 | 422.5 | 418.9 | 207.6 |
| $S_2P_1$ | 406.8 | 381.7 | 274.0 | 288.5 | 403.7 | 482.3 | 440.3 | 417.6 | 214.7 |
| $S_2P_2$ | 345.2 | 333.0 | 239.1 | 243.1 | 336.2 | 397.1 | 401.5 | 305.4 | 213.5 |
| CD ($P$=0.05) for F at the same levels of S×P =10.45 | | | | | | | | | |
| CD ($P$=0.05) for S × P at the same or different levels of F= 13.79 | | | | | | | | | |
| *Leaf area duration (days) during 120-180 days after planting** | | | | | | | | | |
| $S_1P_1$ | 74.5 | 71.8 | 46.1 | 45.6 | 76.1 | 83.1 | 80.9 | 66.6 | 39.2 |
| $S_1P_2$ | 102.0 | 100.2 | 63.3 | 58.3 | 108.3 | 116.7 | 108.5 | 92.1 | 51.8 |
| $S_2P_1$ | 71.4 | 67.7 | 44.6 | 45.0 | 70.5 | 78.1 | 73.9 | 60.9 | 30.4 |
| $S_2P_2$ | 86.3 | 83.2 | 55.7 | 55.0 | 88.7 | 98.1 | 103.2 | 75.7 | 52.2 |
| CD ($P$=0.05) for F at the same levels of S×P = 1.47 | | | | | | | | | |
| CD ($P$=0.05) for S × P at the same or different levels of F= 2.0 | | | | | | | | | |

S: Sizes of planting material P : population levels, F: organic manures

observed growth stages compared to composted coir pith at both the levels, NPK alone and control. Better growth under these treatments was also attributed to better availability of nutrients.

Interaction effects of all the factors studied were significant at 180 days after planting for all the growth parameters (Table 2). Mother rhizome with 333 thousands/ha population plus $F_7$, farmyard manure at both the levels and vermicompost at both the levels produced significantly higher number of tillers, leaf area compared to other combinations.

*Leaf area duration*

Leaf area duration was significantly superior under mother rhizome treatment compared to finger rhizome at all the growth stages (Table 1). Higher leaf area duration under mother rhizome was mainly due to vigorous growth, production of more number of leaves (11 leaves/plant) and higher leaf area (377.6 $cm^2$/plant). Plant population level of 500 thousands/ha had higher leaf area duration compared to 333 thousands/ ha population level. At higher population level, the leaf area produced for the given area was higher due to narrow spacing provided within the rows (20 cm × 10 cm) resulting in higher leaf area duration compared to lower plant population level which has wider spacing within the rows (20 cm × 15 cm).

Among organic manures, farmyard manure+NPK, farmyard manure and vermicompost at both the levels recorded significantly higher leaf area duration at all the growth stages. This was mainly attributed to higher leaf area produced under these treatments and maintenance of functional leaves till the attainment of physiological maturity period.

Interaction effect of mother rhizome with 500 thousands per ha plus $F_7$, farmyard manure and vermicompost at both the levels showed significantly higher leaf area duration (Table 2) compared to other combinations.

*Fresh rhizome yield*

Pooled data of fresh rhizome yield under mother rhizome (4.8 tonnes/ha) was significantly higher compared to finger rhizome (4.7 tonnes/ha) (Table 1). The per cent reduction in the yield under finger rhizome treatment was only 2.1 per cent compared to mother rhizome. Similar results of superior yield with mother rhizome in galangal has been reported by Rajagopalan and Gopalakrishnan (1985). In taro, Mohankumar and Sadanandan (1988) reported the similar yields by planting side corms (cormel) or mother corms.

The fresh rhizome yield was significantly higher at 500 000 / ha population level (4.8 tonnes/ha) compared to 333 000 / ha population level (4.5 tonnes/ha). The per cent reduction in yield due to lower density population was 6.7 %. The increase in yield under higher population was attributed to more population per hectare. Eventhough the growth components were superior with 333 000/ha population level, as the yield components were only on par at both the levels of population, the 333 000 / ha population level could not compensate the total yield that was realised in 500 000/ha population level. Randhawa *et al.* (1972) reported that the yield obtained under spacing of 20 cm × 20 cm or 20 cm × 30 cm was found to be optimum compared to

lesser or wider spacing in ginger. Singh and Neopaney (1993) also reported that closer spacing was found to be optimum for getting maximum yield in ginger compared to wider spacing.

Fresh rhizome yield obtained was significantly superior with farmyard manure+NPK (6.0 tonnes/ha) compared to other treatments. Combination of organic manure with chemical fertilizer resulted in better growth of the crop as reflected in more number of leaves, tillers, higher leaf area duration and yield components. Farmyard manure and vermi-compost at both the levels also recorded significantly higher yield compared to composted coir pith at both the levels, NPK alone and control. NPK alone recorded significantly higher yield compared to composted coir pith at both the levels.

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