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Influence of planting material and nutrients on herbage and oil yield of patchouli grown under coconut

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Abstract

A study was conducted at two locations to know the influence of planting materials and nutrient management practices on production of patchouli under coconut in 2004-2005. Influence of graded levels of nutrients (40:20:20, 60:30:30, 80:40:40 and 100:50:50 kg N:P:K ha^{-1} $crop^{-1}$) and vermicompost were studied on rooted cuttings and tissue cultured plants at Central Plantation Crops Research Institute, Research Centre, Kidu. Number of main branches, which is the main yield contributing attribute, was significantly influenced by nutrient levels. Dry herbage yield was not significantly influenced due to type of planting material indicating the similar performance of both rooted cuttings and tissue culture plants as intercrop in coconut. The yield of patchouli among different nutrient levels varied from 1092 to 1544 kg ha^{-1} and was significantly different. Significantly higher herbage yield of 1544 kg ha^{-1} was observed with 60:30:30 kg NPK ha^{-1}. This suggests that 60:30:30 kg NPK is optimum for patchouli when intercropped in coconut plantation. Planting materials and nutrient levels did not show any significant impact on oil content. In general, the oil content varied between 0.34 to 0.56 %. At Central Plantation Crops Research Institute, Regional Station, Vittal, patchouli was grown under coconut with organic farming approach. Different organic sources *viz.*, farmyard manure, vermicompost, neem cake, composted coir pith and green leaf manure (gliricidia) were applied in different combinations. The results revealed that the Composted Coir Pith (CCP) + green manure (gliricidia) treatment recorded significantly higher plant height at 45 DAP (37.6 cm) over other treatments. Combined application of composted coir pith and green leaf manure produced significantly higher herbage yield (2098 kg ha^{-1}) followed by combination of vermicompost, composted coir pith and green leaf manure (2043 kg ha^{-1}). Oil content among the treatments varied from 1.09 % to 2.3 % with combined application of vermicompost + CCP+ green manure resulting in higher oil content (2.3%) and oil yield (47.1 kg/ha).

Keywords: Coconut, organic cultivation, oil yield, patchuli, planting material

Introduction

Patchouli [*Pogostemon cablin* (Blanco) Benth.] oil is one of the important natural essential oils used to give a base and lasting character to a fragrance in perfume industry. The dry leaves of patchouli on steam distillation yield an essential oil called the oil of patchouli. Currently, India is producing a negligible quantity of patchouli oil and most of its domestic requirement is met by importing about 50 tons of pure oil and 100 tons of formulated oil. Hence its domestic cultivation holds promise to save foreign exchange. It is a fairly hardy plant which is capable of adapting to a wide range of soil and climatic conditions. The crop normally responds to application of N fertilizer (Singh, 1999; Bhaskar, 1995) and thrives under irrigated conditions. Though information is available on its nutrient management as sole crop (Singh *et al*., 2002; Singh and Ganesha Rao, 2009), similar information is scanty when grown as intercrop.

Perennial crops like coconut, which occupy the land continuously for several decades, utilize the natural resources only to a very limited extent producing less than 10 % of potential dry matter production. The scope for intercropping in coconut is well documented (Viswanathan *et al*., 1992; Maheswarappa *et al*., 1998; Reddy and Biddappa 2000). Intercropping of patchouli is an ideal option for conservation of all natural resources,

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crop diversification and value addition. Patchouli can be successfully grown under rubber/coffee/coconut plantations where humidity is high (Sharan and Vasantha Kumar, 1995). As patchouli flourishes well in partially shaded conditions (Puttanna *et al.*, 2005), the interspaces in coconut can be utilized for growing patchouli. This will give additional returns from coconut plantations (Viswanathan, *et al.*, 1992). It is also a soil exhaustive crop requiring fertile soils. With this background, the present investigation was conducted at two locations to assess the effect of planting material, organic and inorganic nutrition on productivity of patchouli grown as intercrop with coconut.

Materials and methods

Two field experiments were conducted to study the influence of planting materials and nutrients on patchouli grown under coconut.

Experiment 1. Effect of different nutrient management practices on the growth and yield of Patchouli *(Pogostemon cablin)* intercropped under adult coconut plantation.

The experiment was laid out in the experimental farm of Central Plantation Crops Research Institute, Research Centre, Kidu in Karnataka during 2004-2005. The place is located 291 m above MSL with an average rainfall of 3500 mm and mean maximum and minimum temperatures of 24°C and 18°C, respectively. The rainfall received during the experimental year was 3800 mm. The soil of the experimental site is laterite with a pH of 5.8, 0.8% organic carbon, 5.0 ppm Bray's P and 51 ppm available K at 0-25 cm.

The experiment was conducted during 2004-2005 with 10 treatment combinations laid out in 2X5 factorial RBD with three replications in 32 year old coconut plantation (cv. WCT). The treatments included two types of planting materials (rooted cuttings and tissue culture plants) and five nutrient levels (40:20:20 NPK kg ha^{-1} $crop^{-1}$, 60:30:30 NPK kg ha^{-1} $crop^{-1}$, 80:40:40 NPK kg ha^{-1} $crop^{-1}$, 100:50:50 NPK kg ha^{-1} $crop^{-1}$ and vermicompost alone). NPK nutrients were applied in three splits viz., 50 % as basal, 25 % after 30 days of planting and remaining 25 % after the first harvest. Organic sources of nutrients were applied before planting. Patchouli was planted on 04-08-2004 in between the rows of coconut with a spacing of 75 cm X 60 cm. Each plot occupied 13.5 m^2 and had 30 plants making the plant population in one hectare of coconut garden to 22,222. The planting was done in ridges and furrow system.

Experiment 2. Intercropping Patchouli *(Pogostemon cablin)* under coconut plantation - An organic farming approach

The investigation was conducted at Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka during 2004-2005. The place is located 91 m above MSL with an average rainfall of 3670 mm distributed over 120 days. The rainfall received during the experimental year was 3200 mm. Mean temperature ranges from 21°C (minimum) to 36°C (maximum). The soil of the experimental site is sandy clay loam (laterite) with a pH of 5.6, 1.0 % organic carbon, 10 ppm Bray's P and 53 ppm available K at 0-30 cm soil depth.

The experiment was conducted in a coconut plantation (cv. Laccadive Ordinary) of 35 years old planted at a spacing of 7.5 m X 7.5 m. The experiment had eight treatments which were arranged in randomized block design with three replications. The treatments consisted of different sources of organics viz., Farm yard manure (0.5:0.12:0.45 % NPK), vermicompost (1.5:0.29:1.0 % NPK), neem cake (3.5:0.8:1.2 % NPK), composted coir pith (2.0:1.5:2.0 % NPK), green leaf manure (glyricidia, 3.6:0.24:2.07 % NPK) with control. All the organic treatments were applied before planting of patchouli. Patchouli was planted on 06-08-2004 in between the rows of coconut with a spacing of 60 cm X 45 cm. Each plot occupied 6.75 m^2 and had 25 plants making the plant population in one hectare of coconut garden to 37,000.

In both the experiments, as the planting was done during the rainy season, necessary drainage was provided to drain out the excess rain water from the experimental field. During post monsoon season the fields were irrigated regularly using hose method. The experimental fields were kept free from weeds by way of manual weeding regularly. First hand weeding was done 15 days after planting and subsequent weeding was done after one month. Furadan was applied to the entire field as a prophylactic measure against nematode infestation.

Growth observations

The growth parameters like plant height, plant spread and number of branches were recorded before harvests. Ten plants were selected at random and number of branches and the height of plants were measured from the base of the plant to the leaf tip of the longest branch at 30 days interval.

Harvesting and oil estimation

The crop was harvested 20 cm above ground level and plot wise fresh herbage yields were recorded from

an area of 6.75 m^2. Two harvests were done and combined yield is presented. The oil content in the air-dried herbage was estimated using Clevenger's apparatus (Clevenger, 1928). Total essential oil yield was calculated by multiplying the percentage of oil content by air-dried herbage and expressed in kg/ha. Statistical analysis was done using standard analysis of variance (ANOVA) technique.

Results and Discussion

Experiment 1

Growth parameters

The growth of patchouli in terms of plant height was not significantly influenced by different nutrient levels at Kidu. However, rooted cuttings were slightly taller than the tissue cultured plants (Fig. 1). Number of main branches, which is the main yield contributing attribute, was significantly influenced by nutrient levels (Fig. 2). Rooted cuttings applied with nutrient level of 100:50:50 kg NPK registered maximum number of branches (23.1) at 60 DAPS followed by tissue cultured plant with 60:30:30 kg NPK (20.7). Plant spread was found not significant among inorganic nutrition levels both in rooted cuttings and tissue culture plants

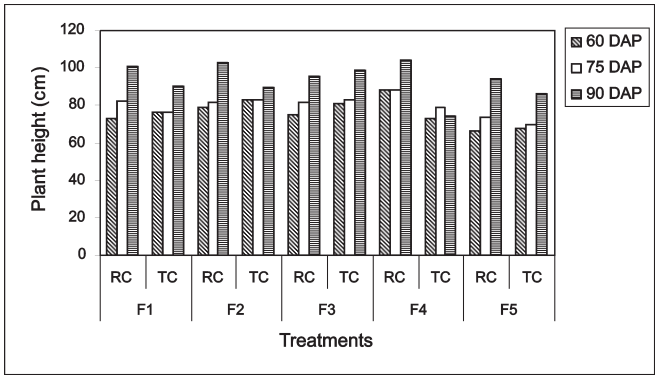

Fig. 1. Effect of planting material and nutrient levels on plant height of patchouli at different days after planting (DAP) at Kidu

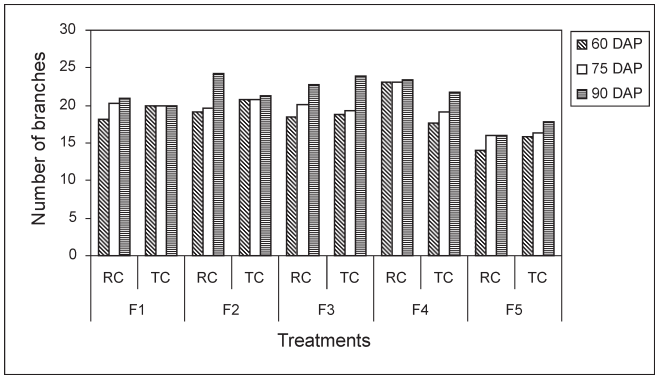

Fig. 2. Effect of planting material and nutrient levels on number of branches in patchouli at different days after planting(DAP) at Kidu

(Table 1). In addition growth of patchouli in terms of height and plant spread and number of branches was less in vermicompost treatment compared to inorganic fertilizer treatments. This suggests the importance of chemical fertilizer application for faster growth and leaf production in patchouli as leaf is the economic produce in low fertility soils.

Table 1. Plant spread of patchouli as influenced by different treatments at Kidu.

Treatment	Plant spread (cm)	
	Rooted cuttings	Tissue culture plants
1. 40:20:20 kg NPK/ha/crop	47.50	49.33
2. 60:30:30	53.17	57.90
3. 80:40:40	47.67	56.23
4. 100:50:50 ,,	60.83	44.87
5. Vermicompost alone (10t/ha/crop)	35.97	38.07
CD (P=0.05)	13.86	

Dry herbage yield and oil yield

Dry herbage yield was not significantly influenced due to type of planting material indicating the similar performance of both rooted cuttings and tissue culture plants as intercrop in coconut. However, nutrient levels significantly influenced the dry herbage yield of patchouli (Table 2). The yield of patchouli among different nutrient levels varied from 1092 to 1544 kg/ha. Higher herbage yield of 1544 kg/ha was observed with 60:30:30 kg NPK/ha, which was directly related to better growth response

Table 2. Dry herbage yield, oil content and oil yield of patchouli at Kidu

Treatments	Dry herbage yield (kg/ha)	Oil %	Oil yield kg/ha
Planting material			
1. Rooted cuttings	1270	0.50	6.35
2. Tissue culture plants	1286	0.47	6.04
CD (P=0.05)	NS	NS	NS
Nutrient levels			
1. 40:20:20 kg NPK/ha/crop	1092	0.49	5.35
2. 60:30:30	1544	0.48	7.41
3. 80:40:40	1285	0.56	7.20
4. 100:50:50 ,,	1313	0.34	4.46
5. Vermicompost alone (10t/ha/crop)	1156	0.56	6.47
CD (P=0.05)	378.8	NS	NS

NS = Not Significant

from planting stage onwards. This nutrient level was at par with 80:40:40 NPK and 100:50:50 NPK levels. Growth pattern and herb yield indicate that 60:30:30 kg NPK level is optimum for both rooted cuttings and tissue cultured plants when intercropped in coconut plantation. Similar trend as that of dry herbage yield was noticed in case of oil yield. Planting materials and nutrient levels did not show any significant impact on oil content. In general, the oil content varied between 0.34 to 0.56 % and the oil yield varied between 4.46 to 7.41 kg/ha.

Experiment 2

Growth parameters

The growth of patchouli in terms of plant height and number of branches was found significant at 45 DAP due to different nutrient treatments (Table 3). Though the growth was slow at initial stages, the growth rate was faster between 45 and 90 DAP. The Composted Coir Pith (CCP) + green manure (gliricidia) treatment recorded significantly higher plant height at 45 DAP (37.6 cm) over other treatments. The same treatment registered maximum number of branches (10.1 and 20.8) at different stages. The better growth with this treatment might be due to higher nutrient content in CCP and green manure.

Table 3. Growth of patchouli as influenced by different treatments at different days after planting (DAP) at Vittal.

Treatment	Plant height (cm)		Number of branches	
	45 DAP	90 DAP	45 DAP	90 DAP
Vermicompost, neem cake	27.5	60.2	8.65	19.6
Vermicompst, neem cake, CCP	32.4	60.8	9.75	20.2
Neem cake, CCP	29.8	70.9	9.04	18.6
Neem cake, green leaf manure	27.2	64.1	8.47	17.9
CCP, green leaf manure	37.6	64.7	10.14	20.8
Vermicompost, neem cake, CCP, green leaf manure	28.3	60.0	8.75	19.1
Vermicompost, CCP, green leaf manure	27.3	63.1	8.55	16.6
Control	26.5	61.9	8.53	17.9
CD(P=0.05)	2.41	NS	NS	NS

NS = Not Significant

Dry herbage and oil yield

Production of dry herbage yield was significant due to application of different organic treatments (Table 4). The yield of patchouli ranged from 884 to 2098 kg/ha under coconut plantation. It was observed that combined application of composted coir pith and green leaf manure produced significantly higher herbage yield (2098 kg/ha), which can be substantiated from growth performance. This treatment was closely followed by this combination with vermicompost (2043 kg/ha). This study shows that combined application of CCP + green manure is more efficient as it might have resulted in better soil moisture conservation in laterite soil, ultimately leading to higher growth and herbage yield. Thus it can be concluded that application of organic manures in no way hinder the yield. Patchouli was successfully grown under arecanut with organic nutrients only (Sujatha et al., 2006) Oil content in patchouli varied between 1.09 to 2.30 %. Combined application of vermicompost + CCP+ green manure resulted in higher oil content (2.3 %) and oil yield (47.1 kg/ha).

Table 4. Dry herbage yield, oil content and oil yield of patchouli at Vittal

Treatments	Dry herbage yield (kg/ha)	Oil (%)	Oil yield (kg/ha)
1. Vermicompost, neem cake	1277	1.52	19.4
2. Vermicompst, neem cake, CCP	922	1.21	11.2
3. Neem cake, CCP	1646	1.16	19.1
4. Neem cake, green leaf manure	926	1.69	15.6
5. CCP, green leaf manure	2098	1.09	22.8
6. Vermicompost, neem cake, CCP, green leaf manure	1330	1.70	22.5
7. Vermicompost, CCP, green leaf manure	2043	2.30	47.1
8. Control	884	1.72	15.2
CD(P=0.05)	776.9	NS	22.3

NS=Not Significant

Conclusions

At Kidu, the performance of both rooted cuttings and tissue cultured plants as intercrop in coconut was at par in terms of growth and dry herbage yield. The optimum response of both rooted cuttings and tissue cultured plants to nutrition was observed at 60:30:30 kg NPK level. Planting material and nutrition did not show any significant effect on oil content. At Vittal, combined application of composted coir pith and green leaf manure produced significantly higher herbage yield. Combined application of vermicompost + CCP+ green manure resulted in higher oil content and oil yield. The large variation in oil content at both locations can be attributed to nutrient management practices. Organic farming approach has contributed to higher oil content than chemical fertilizer application. Overall, these two studies clearly show the merit of organic farming approach over chemical fertilizer application.

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References

Bhaskar, S. 1995. Growth, herbage and oil yields of patchouli (*Pogostemon patchouli*) as influenced by cultivars and nitrogen fertilization. *Ind. Perfum.* **39**: 35-38.

Clevenger, J.V. 1928. Apparatus for the determination of volatile oil. *J. Am. Pharm. Assoc.* **17**: 346-348.

Maheswarappa, H.P., Hegde, M.R., Nanjappa, H.V. 1998. Kacholam (*Kaempferia galanga L.*) - a potential medicinal-cum-aromatic crop for coconut gardens. *Indian Coconut J.* **29** (5): 4-5.

Puttanna, K., Prakasa Rao, E.V.S., Ganesh Rao, R.S., Gopinath, C.T. and Ramesh, S. 2005. Effect of shade and nitrogen on herb yield and longevity of patchouli (*Pogostemon cablin*). *J. Medicinal and Aromatic Plant Sci*. **27**: 297-300.

Reddy, D.V.S. and Biddappa C.C. 2000. Coconut based cropping/ farming systems in India. *J. Plantn. Crops* **28**(1): 1-18.

Sharan, P.A. and Vasantha Kumar, T. 1995. Patchouli. pp. 751-771. In: *Medicinal and Aromatic Plants, Advances in Horticulture* Vol. 11. (Eds.) Chadha, K.L. and Rajendra Gupta. Malhotra Publishing House, New Delhi.

Singh, M. and Ganesha Rao, R.S. 2009. Influence of sources and doses of N and K on herbage, oil yield and nutrient uptake of patchouli [*Pogostemon cablin* (Blanco) Benth.] in semi-arid tropics. *Industrial Crops and Products*, **29**: 229-234.

Singh, M., Sharma, S. and Ramesh S. 2002. Herbage, oil yield and oil quality of patchouli [*Pogostemon cablin* (Blanco) Benth.] influenced by irrigation, organic mulch and nitrogen application in semi-arid tropical climate. *Industrial Crops and Products* **16**: 101-107.

Sujatha, S., Bhat Ravi., Balasimha, D. and Kannan, C. 2006. Crop diversification in arecanut plantation through intercropping of medicinal and aromatic plants. *J. Plantn. Crops* **34**(3): 318-322.

Viswanathan T.V., Radhakrishnan V.V., Reghunath, B.R. and Prasannakumari, K.T. 1992. Patchouli (*Pogostemon cablin*) as an intercrop in young coconut (*Cocos nucifera*) garden. *Indian J. Agric. Sci.* **62**(9): 616-617.