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Effect of cultivars and fertilizer levels on growth, yield and quality of patchouli [*Pogostemon cablin* (Blanco) Benth.] under shaded condition

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Abstract

A field experiment was conducted at Bengaluru (Karnataka) to study the influence of culivars (Johore and CIM-shreshtha) and three fertilizer levels [Control (no fertilizers); recommended NPK (200:50:50 kg ha^{-1}) and vermicompost 10 t ha^{-1} + 50% recommended NPK (100:25:25 kg ha^{-1})] on growth, herbage and oil yield of patchouli under shaded condition. Results showed that among the cultivars, CIM-shreshtha recorded significantly higher plant height and plant spread than Johore. CIM-shreshtha produced 29.25% and 43.28% higher herbage and oil yield compared to Johore. The application of recommended NPK (200:50:50 kg ha^{-1}) produced maximum herbage and oil yield compared with control and was at par with vermicompost 10 t ha^{-1} + 50% recommended NPK (100:25:25 kg ha^{-1}). Oil quality was not influenced by cultivar and fertilizer levels.

Keywords: fertilizer levels, oil yield, patchouli, *Pogostemon cablin*, shade condition

Patchouli [*Pogostemon cablin* (Blanco) Benth. Family: Labiatae] oil is one of the important natural essential oils used to give a base and lasting character to fragrance in perfumery industry. Dry patchouli leaves have also been found to possess moth repellent properties and therefore, are used to scent wardrobes and protecting clothes especially woolens from insects damage (Khanuja *et al.* 2004). Currently, India produces about 20 t $year^{-1}$ of patchouli oil and most of its domestic requirement is met by import worth 60 million rupees annually (Varshney 2000). Patchouli is shade loving tropical plant and can be grown successfully in India (Bhaskar 1995; Venugopal *et al.* 2008). The commercial cultivation of patchouli is spreading in the states of Karnataka, Maharashtra, Goa, Gujarat, Assam, Kerala and Chhattisgarh. The crop is sensitive to extremely high and low temperatures, low relative humidity, unequal distribution of rainfall and poor soils that affect biomass production. Earlier investigation has revealed that high herbage and oil yield were obtained in patchouli grown under partial shade (Prakasa Rao *et al.* 1997; Puttanna *et al.* 2005). This investigation was carried out to study the effect of cultivar and fertilizer levels on growth, herbage, oil yield, oil content and oil quality of patchouli grown under shade.

A field experiment was conducted during 2006–2007 at the research farm of the Central Institute of Medicinal and Aromatic Plants, Research Centre, Bengaluru. This area receives a mean

annual rainfall of 890 mm, mostly between June and October. Minimum and maximum temperature fluctuate between 12°C (January) and 37°C (May). Bengaluru is situated at a latitude of 12° 59′ N, 77° 35' E latitude and is 930 m above mean sea level. The soil of the experimental field was red sandy loam with a pH of 6.2. The organic carbon content of the soil was 0.30%. The soil had 190.5 kg N ha^{-1} of alkaline $KMnO_4$–extractable N (Subbaiah & Asija 1956), 10.5 kg P ha^{-1} (0.5 M NaH CO_3-extractable P) (John 1970) and 80.5 kg K_2O ha^{-1} (1M NH_4-acetate extractable) (Jackson 1958). Vermicompost was prepared with lemongrass spent material at the research centre which contained 1.0% N, 0.30% P and 0.60% K. Six treatment combinations consisting of two cultivars (Johore & CIM-shreshtha) and three fertilizer levels [control, recommended NPK (200:50:50 kg ha^{-1})] and vermicompost 10 t ha^{-1} + 50% recommended NPK (100:25:25 kg ha^{-1}) were arranged in a randomized block design with five replications. The shade of 75% was created using nylon agrinet. Fifty day old rooted cuttings were planted in ridges with a spacing of 50 × 50 cm in July, 2006 and each plot size was 6.25 m^2. N was applied in four equal splits in the form of urea, P in the form of single super phosphate at the rate of 17.5 kg ha^{-1} and K in the form of muriate of potash. The fertilizers were applied between pairs of rows of patchouli in 5cm deep furrows before planting and vermicompost was spread in the field and mixed into the soil. The crop was irrigated by ridge and furrow method of irrigation with three cm depth of water once in four days. Weeds were removed manually. The plant height and plant spread were recorded before harvest. Two harvests during the year (January and May 2007) were taken. The crop was harvested 20 cm above ground level and plot wise fresh herbage yields were recorded from an area of 4 m^2. The oil content in the air dried herbage was estimated using Clevenger's apparatus (Clevenger 1928). Total estimated oil yield was calculated by multiplying the percentage of oil content by air dried herbage and expressed in kg ha^{-1}. The essential oil samples at each harvest were analysed for quality by GC on PerkinElmer 8500 gas chromatography fitted with flame ionization detector and an electronic integrator, using a bonded phase fused silica capillary column (BP-1, 25 mm i.d., film thickness, 0.22 µm made by SGE, Australia). Column oven was heated from 120°C (3 min) to 230°C at 5°C min^{-1}. The experimental data was statistically analysed by the variance technique. Estimation of the significance of differences between means was based on a probability of $P< 0.05$ (Cochran & Cox 1957).

Plant height and plant spread were influenced by cultivar and fertilizer levels (Table 1). Cultivar CIM-Shreshtha had significantly higher plant height and plant spread compared with cultivar Johore. Application of recommended NPK (200:50:50 kg ha^{-1}) produced significantly higher plant height and plant spread over control and was on par with vermicompost 10 tha^{-1} + 50% recommended NPK (100:25:25 kg ha^{-1}). Similar results was reported by Singh *et al.* (2002) and Singh (2011) in patchouli. Total herbage and oil yield were markedly influenced by cultivar and fertilizer levels (Table 1). Significantly higher total herbage yield of 10.34 t ha^{-1} was obtained with cultivar CIM-Shreshtha compared with cultivar Johore (8.0 t ha^{-1}) which may be due to better plant growth. A similar pattern was noted in the case of oil yield. Recommended NPK (200:50:50 kg ha^{-1}) produced significantly higher herbage yield of 11.62 tha^{-1} and oil yield of 61.75 kg ha^{-1} compared with control and was on par with vermicompost 10 tha^{-1} + 50% recommended NPK (100:25:25 kg ha^{-1}) which indicated that 50% inorganic fertilizer requirement can be supplemented through vermicompost without affecting the productivity (Singh 2011). Cultivar CIM-Shreshtha had greater oil content compared with cultivar Johore in both harvests (Table 1). Control gave better oil content than recommended fertilizers which may be due to more stem portion than leaves. Patchouli leaves contained more oil than stem and patchouli alcohol was not influenced by cultivar or fertilizer levels.

The study showed that patchouli cultivar CIM-Shreshtha produced better oil yield than

Table 1. Influence of cultivar and fertilizer levels on growth, herbage yield, oil yield, oil content and oil quality of patchouli

Treatment	Plant height (cm)		Plant spread (m^2 $plant^{-1}$)		Herbage yield (t ha^{-1})			Oil yield (kg ha^{-1})			Oil Content (%)		Patchouli alcohol (%)	
	Harvest No.		Harvest No.		Harvest No.			Harvest No.			Harvest No.		Harvest No.	
	First	Second	First	Second	First	Second	Total	First	Second	Total	First	Second	First	Second
Cultivar														
Johore	62.5	60.8	0.42	0.57	2.72	5.28	8.00	12.65	27.07	39.72	2.18	2.43	40.95	41.13
CIM-shrestha	74.3	64.6	0.57	0.66	4.02	6.32	10.34	24.89	32.02	56.91	2.57	2.49	42.65	40.38
SEm±	2.3	1.4	0.04	0.02	0.23	0.51	0.75	1.19	3.04	3.76	0.06	0.09	0.90	0.94
CD (P<0.05)	4.8	2.9	0.08	0.04	0.49	1.10	1.56	2.48	N.S.	7.84	0.12	N.S.	N.S	N.S
Fertilizer level														
F1	56.3	56.6	0.33	0.58	1.51	3.94	5.45	9.34	18.64	27.98	2.61	2.38	41.21	42.22
F2	73.8	65.9	0.60	0.64	4.76	6.86	11.62	25.79	35.66	61.75	2.22	2.53	41.56	42.08
F3	73.5	65.5	0.55	0.64	3.83	6.64	10.47	21.18	34.03	55.21	2.31	2.47	42.59	40.96
SEm±	2.8	1.7	0.05	0.02	0.28	0.64	0.91	1.46	3.73	4.60	0.07	0.10	1.12	1.15
CD (P<0.05)	5.9	3.5	0.10	0.05	0.59	1.34	1.91	3.04	7.78	9.61	0.15	N.S.	N.S.	N.S.

F_1=Control (no fertilizers); F_2=Recommended NPK kg ha^{-1} (200:50:50); F_3=Vermicompost 10 t ha^{-1} + 50% recommended NPK kg ha^{-1} (100:25:25); SE=Standard error; CD=Critical difference; NS=Not significant

cultivar Johore under shaded condition. Vermicompost 10 tha^{-1} + 50% recommended NPK (100:25:25 kg ha^{-1}) produced optimum herbage and oil yield compared with control which indicated that 50% inorganic fertilizer requirement can be supplemented through vermicompost. Oil quality was not influenced by cultivar and fertilizer levels.

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