

Effect of varieties and spacings on growth, yield and quality of patchouli (*Pogostemon patchouli* Pellet.)

K M Ramachandra, M Vasundhara, A A Farooqi & K N Srinivasappa

Division of Horticulture
University of Agricultural Sciences
Bangalore - 560 065, Karnataka, India

Received 27 June 2002; Revised 25 November 2002; Accepted 20 June 2003

Abstract

Two varieties of patchouli (*Pogostemon patchouli* Pellet.) were evaluated at different plant densities. The experiment consisted of eight treatments comprising the varieties Johore and Java and four spacings (60 x 60, 60 x 45, 45 x 45 and 45 x 30 cm). The results revealed significant differences in performances of varieties at different spacings. Java variety was more robust and yielded higher dry herbage compared to Johore. However Johore yielded more oil content (2.7%) and higher patchouli alcohol (44.7%) as compared to Java (1.4% & 34.5%, respectively). Among the different spacings, Java recorded higher cumulative dry herbage (4.21 t ha⁻¹) and oil yield (60.65 l ha⁻¹) under 60 x 45 cm spacing, where as 45 x 45 cm spacing was found to be the best for Johore, recording more cumulative dry herbage (3.15 t ha⁻¹) and oil yield (86.52 t ha⁻¹).

Key words: crop yield, yield growth, patchouli, *Pogostemon patchouli*, variety trials.

Introduction

Patchouli (*Pogostemon patchouli* Pellet.) oil is one of the important naturally occurring essential oil used to give a base and lasting character to a fragrance in perfumery industries. The shade dried leaves on steam distillation yield the oil of patchouli. Tenacity of odour is one of the virtues of this oil and hence it is widely used in perfumery industry. There is no synthetic substitute for the oil of patchouli, which further enhances its value. Indonesia produces more than 80% of the total world patchouli oil production estimated to be 550 tonnes per year. Currently India is producing a meagre quantity of patchouli oil and is annually importing about 50 tonnes of pure oil and 100 tonnes of formulated oil. Among several factors, the op-

timum plant density and selection of suitable variety are the most important factors influencing herbage yield as well as essential oil content and oil yield. There is a need to popularise this crop and standardize the agro-techniques and variety for better yield potential and quality as this crop can conveniently be cultivated as a understorey crop in arecanut and coconut gardens.

Materials and methods

A field trial was conducted at the Aromatic Garden, Department of Horticulture, University of Agricultural Sciences, GKVK, Bangalore during 1999-2000. The soil was red sandy loam alfisols, uniform in fertility with available nitrogen (197 kg⁻¹), low in phosphorus (15 kg⁻¹) and medium potash (275 kg⁻¹) content and neutral pH (6.6). The treatments

consisted of two varieties namely Johore and Java with four spacings viz. 60 x 60 cm, 60 x 45 cm, 45 x 45 cm and 45 x 30 cm. Eight treatments were laid out in factorial RCBD design in 4 replications. Sixty day old saplings raised from shoot tip cuttings were planted at different spacings as per the treatment in main field in the last week of July. Recommended dose of 150 : 50 : 50 kg ha⁻¹ of N, P, K was applied. Full dose of phosphorus and potash were applied at the time of planting and nitrogen was applied in split doses (25 kg ha⁻¹ of nitrogen was applied during the time of planting and another 25 kg ha⁻¹ two months after planting). Similarly, nitrogen was applied at each harvest once immediately after harvest and later at two months after harvest. Earthing up was carried out immediately after fertilizer application and the plots were irrigated. First harvest was done after 150 days of planting (January), second harvest was done 240 days of planting (March) and third harvest was done 330 days after planting (June). Observations on vari-

ous growth parameters were made at monthly interval. After harvest the leaves along with the stem (biomass) were dried under shade for seven days. The shade dried leaves were distilled using Clavenger's apparatus to estimate the oil content. Distillation of the bulk material was carried out in a steam distillation unit to calculate the oil yield. Statistical analysis was carried out by using factorial RCBD design.

Results and discussion

Evaluation of varieties

The comparative performance of the varieties Java and Johore of patchouli for their growth and yield parameters are presented in Tables 1 & 2.

The growth characters between the varieties were found to be significantly different. Variety Java recorded taller plants, maximum number of branches, plant spread and leaf area, compared to the variety Johore. Variety Java showed similar significant differ-

Table 1. Effect of varieties and spacings on growth parameters of patchouli

Treatment	Plant height (cm)			No. of branches plant ⁻¹			Plant spread (cm ²)			Leaf area (cm ²)		
	I	II	III	I	II	III	I	II	III	I	II	III
<i>Variety</i>												
V ₁ Johore	91.80	71.13	76.60	29.90	26.79	28.06	61.20	50.84	44.56	4138.5	3734.5	3734.5
V ₂ Java	104.09	88.73	81.82	53.10	35.00	32.80	84.52	73.69	66.93	5460.4	5054.8	5151.3
F test	S	S	S	S	S	S	S	S	S	S	S	S
SEm ±	2.30	1.08	1.59	0.03	0.42	0.56	1.71	0.96	1.36	1.28	2.26	1.71
CD at 5%	7.00	3.19	4.70	0.09	1.24	1.67	5.04	2.82	4.01	3.70	6.65	5.05
<i>Spacing (cm)</i>												
S ₁ 60 x 60	90.70	84.00	71.70	37.1	26.85	25.18	67.5	56.90	56.37	5945.0	5533.7	5586.3
S ₂ 60 x 45	102.60	83.20	87.40	43.8	33.57	33.60	81.5	68.70	60.37	5309.7	4899.5	4992.2
S ₃ 45 x 45	104.35	88.50	85.17	45.8	33.57	33.00	80.3	66.67	60.00	4382.2	3978.2	4081.3
S ₄ 45 x 30	94.13	75.82	66.02	39.3	23.70	29.87	62.1	56.70	46.25	3560.8	3167.2	3262.8
F test	S	S	S	S	S	S	S	S	S	S	S	S
SEm ±	3.3	1.5	2.26	0.47	0.6	0.8	2.40	1.35	1.92	1.81	3.19	2.43
CD at 5%	9.9	4.5	6.65	0.13	1.7	2.3	7.13	3.99	5.60	5.35	9.40	7.14

I = First harvest; II = Second harvest; III = Third harvest

Table 2. Effect of varieties and spacings on herb yield, oil content and oil yield of patchouli

Treatments	Dry weight of herb (t ha ⁻¹)				Oil content (%)				Oil yield (l ha ⁻¹)			
	I	II	III	C	I	II	III	C	I	II	III	C
<i>Variety</i>												
V ₁ Johore	1.40	0.62	0.78	2.80	2.40	2.94	2.85	2.73	35.32	18.90	21.0	74.98
V ₂ Java	1.53	0.83	1.18	3.53	1.51	1.61	1.18	1.43	23.42	13.15	14.98	51.54
F test	S	S	S	S	S	S	S	S	S	S	S	S
SEm ±	0.002	0.0014	0.0016	0.034	0.06	0.1	0.08	-	0.01	0.0013	0.01	0.008
CD at 5%	0.005	0.0042	0.005	0.1	1.17	0.29	0.24	-	0.03	0.004	0.03	0.023
<i>Spacing (cm)</i>												
S ₁ 60 x 60	1.25	0.47	2.41	1.80	2.21	2.06	2.02	23.09	11.15	13.14	13.14	47.36
S ₂ 60 x 45	1.50	0.85	3.45	2.11	2.15	1.93	2.06	30.14	17.15	19.28	19.28	66.57
S ₃ 45 x 45	1.54	0.74	3.34	2.10	2.32	1.91	2.11	32.13	17.65	20.29	19.25	69.02
S ₄ 45 x 30	1.58	0.86	3.46	1.96	2.42	2.17	2.18	32.13	18.15	0.043	20.29	70.57
F test	S	S	S	S	NS	NS	NS	S	S	S	S	S
SE ±	0.003	0.002	0.02	0.048	0.08	0.14	0.11	-	0.014	0.002	0.015	0.012
CD at 5%	0.007	0.006	0.007	0.141	NS	NS	NS	-	0.042	0.006	0.043	0.033

I = First harvest; II = Second harvest; III = Third harvest; C = Cumulative yield

ences compared to Johore in the second and third harvests (Bhaskar 1996). The variety Java recorded significantly higher cumulative dry herb yield compared to Johore. However, the oil content and oil yield was significantly higher in variety Johore as compared to variety Java. Similar observations were made by Rao *et al.* (1988), Sarma *et al.* (1993), Kothari *et al.* (1996), Muniram & Sushil Kumar (1999).

Effect of different plant densities

Different plant densities showed significant differences in growth parameters. The spacing of 60 x 45 cm recorded taller plants, more number of branches per plant and plant spread and was *on par* with 45 x 45 cm spacing and significantly superior over 60 x 60 cm and 45 x 30 cm spacings (Table 1). However, with respect to leaf area, spacing of 60 x 60 cm recorded better value, which may be due to better utilization of sunlight and nutrients resulting in large leaf area and there by better photosynthesis. This was also observed by Bhaskar (1996), Pareek & Sethi

(1985) and Ram *et al.* (1998).

The spacing of 45 x 30 cm recorded higher dry herbage weight and oil yield (Table 2). It was *on par* with the spacing of 45 x 45 cm. It may be because of more number of plants per unit area. The higher herbage yield was attributed by many growth parameters like plant height, number of branches, plant spread and leaf area. The present results endorse the views expressed by Vishwanathan *et al.* (1993). Spacings did not play any significant role in the enhancing of oil content.

Interaction effect between varieties and spacings

The interaction effect between varieties and spacings was found to be significant. The variety Johore performed better under 45 x 45 cm spacing with respect to plant height, number of branches per plant and plant spread, cumulative (from all three harvests) yield of dry herb and oil yield (Table 3). Similar observations were reported by Singh (1996) and Bhaskar (1996) in patchouli earlier also.

The variety Java performed better under 60

Table 3. Interaction effect of varieties and spacings on growth and yield parameters of patchouli

Treatment	Plant height (cm)			No. of branches plant ⁻¹			Plant spread (cm ²)			Dry weight of herb (t ha ⁻¹)			Oil content (%)			Oil yield (l ha ⁻¹)		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
V ₁ S ₁	81.10	82.60	78.70	26.17	23.20	23.00	55.18	47.11	45.75	1.17	0.48	0.63	2.28	2.40	2.95	28.08	15.15	16.17
V ₁ S ₂	85.90	70.10	77.45	27.22	23.95	26.75	57.20	50.20	45.25	1.33	0.60	0.76	2.69	2.55	2.82	34.08	18.15	20.27
V ₁ S ₃	109.9	89.30	89.90	41.25	34.45	32.25	76.10	62.45	51.50	1.57	0.71	0.87	3.15	2.60	2.95	40.08	22.15	24.29
V ₁ S ₄	90.30	66.40	60.27	25.25	25.56	27.25	56.40	43.60	35.75	1.53	0.70	0.86	3.09	2.42	3.05	39.07	21.15	23.27
V ₂ S ₁	100.30	85.80	77.50	48.15	30.50	27.37	79.90	66.73	67.00	1.34	0.46	0.74	2.54	1.35	1.47	18.10	8.15	10.11
V ₂ S ₂	119.30	96.40	97.50	60.50	43.20	40.50	105.82	87.20	75.50	1.67	1.10	1.44	4.21	1.60	1.47	26.20	16.15	18.30
V ₂ S ₃	98.80	87.50	80.40	50.42	32.70	30.82	84.50	70.90	68.50	1.51	0.78	1.16	3.54	1.60	1.70	24.17	13.15	14.21
V ₂ S ₄	97.95	85.25	71.77	53.40	33.00	32.50	67.85	69.99	56.75	1.63	1.00	1.36	3.83	1.50	1.80	25.20	15.15	19.30
F-test	S	S	S	S	S	S	S	S	NS	S	S	S	NS	NS	NS	S	S	S
SEm±	4.7	2.17	3.19	0.06	0.84	1.13	3.4	10.09	5.60	0.004	0.003	0.0031	0.068	0.12	0.20	0.02	0.003	0.02
CD @ 5%	6.7	6.39	9.4	0.19	2.4	3.34	10.09	5.60	-	0.01	0.009	0.009	0.199	-	-	0.059	0.008	0.006

V₁ - Johore; V₂ - Java; S₁ - 60 x 60 cm spacing; S₂ - 60 x 45 cm spacing; S₃ - 45 x 45 cm spacing; S₄ - 45 x 30 cm spacing.

I = First harvest; II = Second harvest; III = Third harvest; C = Cumulative yield.

x 45 cm spacing, recording higher values for plant height, number of branches per plant, plant spread, cumulative yield of dry herb and oil yield. This may be due to the fact that, variety Java was vigorous in growth and requiring more space to produce the required leaf area for production of secondary metabolites and yield, whereas, Johore is comparatively less vigorous and for this, a spacing of 45 x 45 cm seems to be ideal for optimum growth and yield.

References

- Bhaskar S 1996 Growth, herbage and oil yield of patchouli in relation to spacing and nitrogen fertilization. South Indian Hort. 44 (1 & 2) : 57-58.
- Kothari S K, Singh V P & Singh U B 1996 The effect of row spacing and nitrogen fertilization on the growth and oil yield composition of Japanese mint. J. Med. Arom. Pl. Sci. 18 (1) : 17-21.
- Muni Ram & Sushil Kumar 1999 Optimization of interplant space and harvesting time for high essential oil yield in different varieties of mint (*Mentha arvensis*). J. Med. Arom. Pl. Sci. 21 (1) : 38-45.
- Pareek S K & Sethi K L 1985 Response to irrigation and fertilizer in coriander. Indian Perfumer 29: 225-228.
- Ram P, Patra N K, Singh H B, Singh H P, Muni Ram, Birendra Kumar & Sushil Kumar 1998 Effect of planting dates and spacing on oil yield and major yield component of *Tagetes minuta*. J. Med. Arom. Pl. Sci. 29 (3) : 742-745.
- Rao E V S P, Singh M & Rao R S 1988 Nitrogen and spacing studies in Java citronella (*Cymbopogon winterianus* Jowitl.). Indian J. Agron 34 (4) : 455-57.
- Sarma T C, Sarma P C & Bordoloi D N 1993 Response of Jorlab L2-An improved strain of lemon grass to population density and nitrogen levels. Indian Perfumer 27 (2) : 171-177.
- Singh M 1996 Effect of irrigation and plant spacing on herb, oil yield of patchouli under semi-arid tropical condition. J. Med. Arom. Pl. Sci. 18 (3) : 487-488.
- Vishwanathan T V, Raghunath B R, Radhakrishnan V V, Prasannakumari K T & Sosamma Cheriyan 1993 Patchouli - A potential essential oil yielding crop for coconut garden. Indian Perfumer 37 (2) : 12-13.