

Effect of organic and inorganic fertilizers on growth, yield and nutrient uptake of patchouli [*Pogostemon cablin* (Blanco) Benth.] in a semi-arid tropical climate

Munnu Singh

Central Institute of Medicinal and Aromatic Plants
(Council of Scientific & Industrial Research)
Research Centre, Allalandsandra, GKVK P.O., Bangalore-560 065, India.
E-mail: munnusingh10@yahoo.co.in

Received 05 September 2009; Revised 13 October 2010; Accepted 14 January 2011

Abstract

A field experiment was conducted for two years at Bangalore, to study the influence of organic (vermicompost) and inorganic fertilizers (NPK) on growth, yield and nutrient uptake of patchouli (*Pogostemon cablin*) in a semi-arid tropical climate. The results revealed that application of vermicompost (5 t ha⁻¹) + 50% NPK (100 : 25 : 25 kg ha⁻¹) produced significantly higher herbage and oil yield (13.98 t ha⁻¹ and 83.4 kg ha⁻¹), respectively, which was on par with recommended dose of NPK (200 : 50 : 50 kg ha⁻¹). Application of vermicompost (5 t ha⁻¹) + 50% NPK (100 : 25 : 25 kg ha⁻¹) increased the nitrogen, phosphorus and potassium uptake, respectively, which was at par with recommended dose of NPK (200 : 50 : 50 kg ha⁻¹). Oil content was not influenced by organic and inorganic fertilizers.

Keywords: inorganic fertilizer, nutrient uptake, patchouli, *Pogostemon cablin*, vermicompost, yield.

Studies on the performance of patchouli [*Pogostemon cablin* (Blanco) Benth.] in a semi-arid tropical climate are limited (Bhaskar 1995; Singh 1999; Singh *et al.* 2002; Puttanna *et al.* 2005). Inorganic fertilizers together with organic manures are now commonly used to maintain optimum soil fertility and to attain desired levels of yield. Hence, a field experiment was conducted to study the influence of organic and inorganic fertilizers on growth, yield and nutrient uptake of patchouli in a semi-arid tropical climate.

The field experiment was conducted for two years during 2003-05 at Central Institute of Medicinal and Aromatic Plants, Research

Centre, Bangalore. The experimental soil is classified as alfisol (red sandy loam) with pH 6.2, available nitrogen (N) 210 kg ha⁻¹, phosphorus (P) 22.5 kg ha⁻¹ and potassium (K) 105 kg ha⁻¹ in 0-15 cm soil profile. Vermicompost contained 1.9% N, 0.3% P and 0.7% K. The experiment was laid out in a randomized block design with five treatment combinations replicated six times. T₁ : Control (no fertilizer); T₂ : Vermicompost (10 t ha⁻¹); T₃ : Recommended dose of NPK (200 : 50 : 50 kg ha⁻¹); T₄ : Vermicompost (5 t ha⁻¹) + 50% NPK (100 : 25 : 25 kg ha⁻¹) and T₅ : Vermicompost (7.5 t ha⁻¹) + 33% NPK (67 : 17 : 17 kg ha⁻¹). Fifty day old rooted patchouli

cuttings (cv. Johore) were planted at a spacing of 45 cm x 45 cm on 25 December 2003 and 30 December 2004, accommodating 45,000 plants ha⁻¹. The individual plot size was maintained as 12.96 m². Entire quantity of organic manure (vermicompost) and full dose of P₂O₅ and K₂O in the form of single superphosphate and muriate of potash were applied as basal at the time of planting. Nitrogen was applied in four equal splits at 60 days interval in the form of urea. Weeds were removed by hand and the crop was irrigated once in four days depending on climatic conditions. The crop was harvested twice (14 July 2004 and 30 October 2004; 30 July 2005 and 10 November 2005) during both the years. Data on plant height, plant canopy, fresh weight, leaf stem ratio (L/S ratio), root fresh weight, were recorded at the time of harvest and moisture was determined by drying samples at 80°C in an oven. Dry matter yields were calculated from fresh herb yields and moisture content in them. The dried samples were utilized for determination of N, P and K. Oil content in air dried biomass was estimated by hydro-distillation method using Clevenger's apparatus (Clevenger 1928). Oil yield was computed by multiplying oil content with that of herbage yield. Nitrogen in plant samples were determined by the indophenol-blue method (Novozamsky *et al.* 1974). Phosphorus was determined as described by John (1970) and K by flame photometric method described by Jackson (1958). Uptake values were calculated from dry matter yields

and concentration of nutrient in them. After carrying out Bartlett's test for homogeneity of variance, the two years data were pooled and statistically analysed. Estimation of significance of differences between means was based on probability of P < 0.05 (Cochran & Cox 1957).

Yield attributes and yield

Application of organic and inorganic fertilizers and their combination significantly influenced the yield attributes of patchouli. Vermicompost (5 t ha⁻¹) + 50% NPK (100 : 25 : 25 kg ha⁻¹) increased the plant height significantly which was on par with recommended dose of NPK (200 : 50 : 50 kg ha⁻¹) and a similar pattern was noticed in case of fresh root weight. Plant weight was significantly higher in recommended dose of NPK (200 : 50 : 50 kg ha⁻¹) compared with other treatments. Leaf/stem ratio was not influenced by organic and inorganic fertilizers (Table 1).

The increase in herbage yield and oil yields in organic and inorganic fertilizers treated plants over control plants ranged between 28.5% to 171.0% and 23.3% to 89.9%, respectively (Table 2). Among the five treatments, recommended dose of NPK (200 : 50 : 50 kg ha⁻¹) resulted in highest herbage yield (14.85 t ha⁻¹) and oil yield (84.9 kg ha⁻¹) which was on par with vermicompost 5 t ha⁻¹ + 50% NPK (100 : 25 : 25 kg ha⁻¹). Vermicompost, when applied alone did not

Table 1. Effect of organic and inorganic fertilizers on growth of patchouli (pooled data of 2 years)

Treatment	Plant height (cm)	Plant canopy (m ² plant ⁻¹)	Plant weight (g plant ⁻¹)	Leaf/stem ratio	Root weight (g plant ⁻¹)
T ₁	31.9	0.095	126.7	1.52	18.0
T ₂	31.3	0.118	162.0	1.69	24.7
T ₃	36.6	0.175	334.2	1.31	34.2
T ₄	36.9	0.171	260.8	1.41	34.5
T ₅	35.7	0.165	252.5	1.42	30.3
C D (P=0.05)	2.4	0.030	66.6	NS	9.5

T₁ = Control (no fertilizer), T₂ = Vermicompost (10 t ha⁻¹), T₃ = Recommended dose of NPK (200 : 50 : 50 kg ha⁻¹), T₄ = Vermicompost (5 t ha⁻¹) + 50% NPK (100 : 25 : 25 kg ha⁻¹), T₅ = Vermicompost (7.5 t ha⁻¹) + 33% NPK (67 : 17 : 17 kg ha⁻¹)

significantly differ from control in respect of herbage and oil yields.

Nutrient uptake

Uptake of major nutrients by the crop was significantly influenced by the treatments (Table 2). Highest N uptake was obtained in recommended dose of NPK (200 : 50 : 50 kg ha⁻¹) which was on par with vermicompost (5 t ha⁻¹) + 50% NPK (100 : 25 : 50 kg ha⁻¹); similar trend was observed with respect to P and K uptake by the plants. The higher uptake of NPK under different combinations was due to the combined influence of higher nutrient concentration (data not presented) and yield in these treatments.

Oil content

Oil content was not influenced by organic and inorganic fertilizers (Table 2) as reported earlier by Singh & Rao (2009).

The study indicated that in order to get optimum oil yield from patchouli crop under semi-arid tropical conditions, vermicompost (5 t ha⁻¹) + NPK (100 : 25 : 250 kg ha⁻¹) may be applied which indicated that 50% N P K requirement can be supplemented through organic manure (vermicompost) without loss of yield.

Acknowledgement

The author is grateful to the Director, Central Institute of Medicinal and Aromatic Plants,

Lucknow, and Scientist-in-charge of the Centre and Mr. S Ramesh, Ex-Technical Officer for analysis of oil samples and Mr. Kundan Narayan Wasnik for analysis of plant samples.

References

- Bhaskar S 1995 Growth, herbage and oil yields of patchouli (*Pogostemon patchouli*) as influenced by cultivars and nitrogen fertilization. Indian Perf. 39: 35-38.
- Clevenger J F 1928 Apparatus for the determination of volatile oil. J. American Pharma. Assoc. 17: 346-348.
- Cochran W G & Cox G M 1957 Experimental Designs, John Wiley and Sons Inc., New York.
- Jackson M L 1958 Soil Chemical Analysis, Constable, London.
- John M K 1970 Colorimetric determination of phosphorus in soil and plant materials with ascorbic acid. Soil Sci. 190: 214-220.
- Novozamsky I, Van Ech R, Van Schouwenburg J & Walinga I 1974 Total nitrogen determination in plant material by means of indophenol-blue method. Netherlands J. Agric. Sci. 22: 3-5.
- Puttanna K, Prakasa Rao E V S, Ganesha Rao R S, Gopinath C T Ramesh S 2005 Effect of shade and nitrogen on herb yield and longevity of patchouli (*Pogostemon cablin*). J. Med. Arom. Pl. Sci. 25: 297-300.
- Singh M 1999 Effect of irrigation and nitrogen levels on herbage and oil yield of

Table 2. Effect of organic and inorganic fertilizers on herbage, oil yield, oil content and nutrient uptake of patchouli (pooled data of 2 years)

Treatment	Herbage yield (t ha ⁻¹)	Oil yield (kg ha ⁻¹)	Oil content (%)	Nitrogen uptake (kg ha ⁻¹)	Phosphorus uptake (kg ha ⁻¹)	Potassium uptake (kg ha ⁻¹)
T ₁	5.48	44.7	3.12	28.50	2.85	22.80
T ₂	7.04	55.1	3.03	36.66	36.66	29.29
T ₃	14.85	84.9	3.08	81.08	7.72	61.78
T ₄	13.98	83.4	3.14	78.15	7.27	58.15
T ₅	11.94	66.5	3.12	62.08	6.21	49.67
C D (P=0.05)	2.22	14.5	NS	11.54	1.15	9.24

T₁ = Control (no fertilizer), T₂ = Vermicompost (10 t ha⁻¹), T₃ = Recommended dose of NPK (200 : 50 : 50 kg ha⁻¹), T₄ = Vermicompost (5 t ha⁻¹) + 50% NPK (100 : 25 : 25 kg ha⁻¹), T₅ = Vermicompost (7.5 t ha⁻¹) + 33% NPK (67 : 17 : 17 kg ha⁻¹)

- patchouli (*Pogostemon patchouli*) on alfisols. J. Med. Arom. Pl. Sci. 21: 689-691.
- Singh M, Sharma S & 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. Ind. Crops Prod. 16: 101-107.
- Singh M & 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. Ind. Crops Prod. 29: 229-234.