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Effect of potassium on growth and yield of patchouli [*Pogostemon cablin* (Blanco) Benth.]

M Singh

Central Institute of Medicinal and Aromatic Plants (CSIR)
Research Centre, Allalasandra, GKVK Post, Bengaluru-560 065, Karnataka.
E-mail: munnusingh10@gmail.com

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Abstract

A field experiment was conducted for two years to study the influence of amount and method of potassium (K) application on growth, herbage yield, oil yield and potassium uptake of patchouli in a semi-arid tropical climate. The results revealed that application of 41.5 kg K ha^{-1} produced significantly higher plant height, plant spread, herbage and oil yield over control (no fertilizer). The increase in herbage yield, oil yield and K uptake was 118.8%, 52.8% and 18.8% higher, respectively over control. Application of potassium in two splits (½ basal + ½ after 60 days) also significantly increased plant height, plant spread, and increased the herbage yield, oil yield and K uptake by 32.2%, 37.9% and 33.2%, respectively over basal application. Oil content was not influenced by amount and method of K application.

Keywords: oil content, oil yield, patchouli, *Pogostemon cablin*, potassium

Introduction

Patchouli [*Pogostemon cablin* (Blanco) Benth.] oil is one of the important natural essential oils used to give a base and lasting character to fragrance in perfumery industry. Patchouli, is native to Philippines, grows wild in Malaysia, Indonesia and Singapore. Increasing demand of patchouli oil had led to systematic cultivation of crop in Indonesia, China, Brazil, Malaysia, Seychelles and West Indies. Indonesia is the major producer of patchouli oil in the world (1100 t $year^{-1}$), contributing more than 91.7% of the total world production (Lawrence 2009). Currently, India is producing 20 t $year^{-1}$ of patchouli oil and most of its domestic requirement is met by importing patchouli oil (about 100 t worth of Rs. 9.0 crores annually). Studies on the performance of patchouli in a semi-arid tropical climate are limited (Puttanna *et al.* 2005). It has been shown that application of N fertilizers increased the productivity of patchouli (Bhaskar 1995; Singh 1999). Very meager or no information is available on its K requirement, method of application and its effects. Therefore, the present experiments were conducted to investigate the effect of amount and method of K application on growth, herbage yield, oil yield and K uptake of patchouli grown in semi-arid tropical condition.

Materials and methods

An experiment was conducted during 2005–

2008 at Bengaluru. Seven treatment combinations consisting of two levels of K (41.5 and 83.0 kg K ha^{-1}) and three methods of application (T_1–full basal(100%); T_2–½ basal (50%) + ½ after 60 days of planting (DAP) and T_3–$^1/_3$ basal (33.3%) + $^1/_3$ after 60 DAP and $^1/_3$ after 120 DAP along with a control (no fertilizer) were arranged in a randomized block design with three replications. Patchouli cv. CIM-Shreshtha was planted on 15 June 2005 and 30 May 2007 in plots at a spacing of 45 cm × 45 cm accommodating 45,000 plants ha^{-1}. Each plot occupied 12.96 m^2. Full dose of P (17.5 kg ha^{-1}) to all treatments and N at the rate of 200 kg ha^{-1} in four equal splits at two monthly intervals in the form of urea and K as muriate of potash were applied as per the treatments. Weekly irrigation was applied depending on climatic conditions. Two harvests per year were taken up during the first year (November 2005 and March 2006) and second year (October 2007 and February 2008). The plants were harvested 20 cm above ground level. At each harvest, the fresh herbage yield was estimated and essential oil content were determined by hydro-distillation using Clevenger apparatus as described by Langenau (1948). The total essential oil yield was calculated by multiplying the percentage oil content and air dried herbage yield. Whole plant samples of above ground level were collected, dried to constant weight (70°C), powdered to pass through a 0.2 mm sieve, digested and analyzed for K by flame photometry (Jackson 1958). After carrying out Bartlett's test for homogeneity of variance, the two years data were pooled. Data were subjected to analysis of variance and estimation of the significance of difference between means was at $P<0.05$.

Results and discussion

Plant height and plant canopy were influenced by K levels (Table 1). K levels significantly increased plant height from 40.2 cm at control to 63.4 cm at 41.5 kg K ha^{-1} and plant canopy from 0.30 m^2 to 0.45 m^2 at 41.5 kg K ha^{-1}, beyond which no response to K application was seen. The methods of K application also increased the plant height and plant canopy. Application of K in two splits (T_2) [½ basal (50%) + ½ after 60 days of planting (50%)] increased the height and plant canopy compared to 100% basal

Table 1. Influence of amounts and methods of K applications on growth of patchouli (pooled data of 2 years)

Treatment	Plant height (cm)		Plant canopy (m^2 $plant^{-1}$)	
	Harvest number		Harvest number	
	1	2	1	2
K fertilizer (kg ha^{-1})				
D_1 -41.5	63.4	45.0	0.42	0.45
D_2 -83.0	63.0	46.1	0.40	0.45
SEm±	1.2	2.5	0.03	0.03
CD (P<0.05)	N.S.	N.S.	N.S.	N.S.
Method of application				
T_1: full dose (100%)	61.5	46.1	0.38	0.35
T_2: $^1/_2$ basal (50%) + $^1/_2$ after 60 DAP	66.7	52.7	0.46	0.42
T_3: $^1/_3$ basal + $^1/_3$ after 60 DAP + $^1/_3$ after 120 DAP	61.4	47.5	0.47	0.36
SEm±	1.4	3.0	0.04	0.03
CD (P<0.05)	3.1	6.6	0.08	0.07
Control	56.9	40.2	0.32	0.30
SEm±	2.2	4.6	0.04	0.05
CD (P<0.05)	4.8	10.0	0.09	0.11

SEm±=standard error; CD=critical difference; N.S=not significant; DAP=days after planting

application (T_1). Application in 3 splits was on par with basal application.

Application of 41.5 kg K ha^{-1} produced significantly higher herbage and oil yields compared to control (no fertilizer) and was on par with 83.0 kg K ha^{-1} (Table 2). Total herbage and oil yield increased by 118.8% and 52.83%, respectively with the application of 41.5 kg K ha^{-1} compared to control (no K) which may be due to low K status of the soil (75.5 kg ha^{-1}). Patchouli yields in treatments that received K in two splits (T_2) [½ basal + ½ after 60 DAP] were higher than the treatment that received entire dose as basal (T_1); The treatment T_2 (½ basal + ½ after 60 DAP) increased herbage and oil yield by 33.2% and 37.9%, respectively compared to basal application (T_1). Split method of application would have reduced the loss of K through leaching, resulting in higher utilization by the crop. Similar results were reported in Java citronella (Singh *et al.* 1990) and in sugarcane (Tiwari *et al*. 1998). The different amounts and methods of K application caused no significant changes in K content of plant tissue (data not presented). Hence, the uptake of K followed the pattern of herbage yield. The crop removed significantly higher amount of K with the application of 41.5 kg ha^{-1} compared with control. Total uptake of K increased by 118.8% with the application of 41.5 kg K ha^{-1} compared with control and T_2 method of application increased uptake by 33.2% over basal application (T_1). Among the methods of K application, T_2 removed higher K than T_1 and T_3 (Table 2).

Oil content and oil composition (data not given) were not influenced by content and methods of K application (Table 2). The quality of essential oil with 54.7-44.5% patchouli alcohol, 4.0-5.0% α-δ-patchoulene, 12.7-8.7% α-bulnesene and 8.9-6.1% α-guaiene was found to be good and readily accepted in the market. It is concluded that to get optimum herbage and oil yield of patchouli in red sandy loam soil of semi-arid tropical climate of Bengaluru, fertilization with 41.5 kg K ha^{-1} in two splits

Table 2. Influence of amounts of K and methods of K application on herbage, oil yield, oil content and K uptake of patchouli (pooled data of 2 years)

Treatment	Herbage yield (t ha^{-1}) Harvest number			Oil yield (kg ha^{-1}) Harvest number			Oil content (%) Harvest number		Total uptake (kg ha^{-1})
	1	2	Total	1	2	Total	1	2	
K fertilizer (kg ha^{-1})									
D_1 - 41.5	4.99	4.77	9.76	28.3	28.4	56.7	2.18	2.29	34.25
D_2 - 83.0	4.85	4.85	9.70	27.0	29.5	56.5	2.14	2.34	34.22
SEm±	0.26	0.32	0.58	2.7	1.8	3.3	0.05	0.06	2.04
CD (P<0.05)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Method of application									
T_1: full dose (100%)	4.30	4.30	8.70	24.7	25.4	50.1	2.21	2.27	30.54
T_2: ½ basal + ½ after 60 DAP	5.96	5.63	11.59	32.5	36.6	69.1	2.10	2.43	40.68
T_3: $^1/_3$ basal + $^1/_3$ after 60 DAP + $^1/_3$ after 120 DAP	4.51	4.50	9.01	25.6	26.4	52.0	2.18	2.26	31.63
SEm±	0.32	0.39	0.71	3.3	2.1	4.0	0.06	0.07	2.49
CD (P<0.05)	0.70	0.85	1.54	7.3	4.7	8.8	N.S.	N.S.	5.41
Control	3.15	3.31	4.46	17.9	19.2	37.1	2.18	2.23	15.65
SEm±	0.50	0.56	1.08	5.1	3.3	6.2	0.09	0.11	3.79
CD (P<0.05)	1.08	1.21	2.35	11.1	7.1	13.4	N.S.	N.S.	8.25

SEm±=standard error; CD=critical difference; N.S.=not significant; DAP=Day after planting

(½ at basal and ½ at 60 DAP) is recommended. Potassium uptake also increased with split application. Oil content was not influenced by amount and method of K 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. Indian Perf. 39: 35–8.

Jackson M L 1958 Soil Chemical Analysis, Constable, London, UK, p.498.

Langenau E E 1948 The examination and analysis of essential oils, synthesis and isolates. In: Essential Oils, Vol. I (Guenther E, Ed.) Van Nostrand, Princeton, N.J., USA.

Lawrence B M 2009 A preliminary report on the world production of some selected essential oils and countries. Perf. Flav. 34: 38–44.

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 K, Choudhury A, Subramanyam K, Chatterjee B N & Singh D V 1990 Influence of amount and methods of potassium application on yield and quality of citronella Java (*Cymbopogon winterianus*). J. Agril. Sci. Cambridge 115: 247–52.

Singh M 1999 Effect of irrigation and nitrogen levels on herbage and oil yield of patchouli (*Pogostemon patchouli*) on alfisols. J. Med. Arom. Pl. Sci. 21: 689–691.

Tiwari R J, Jain R C & Nema G K 1998 Response of sugarcane to levels and time of application of potassium. J. Indian Soc. Soil Sci. 46: 319–321.