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Effect of pinching and growth regulators on growth, herbage yield, essential oil content and oil yield of patchouli (*Pogostemon patchouli* Pellet.)

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ABSTRACT

An experiment was conducted to study the effect of growth regulators on plant growth, herbage yield, essential oil content and oil yield in patchouli (*Pogostemon patchouli* Pellet.) variety Cim-shreshta, at University of Agricultural Sciences (UAS), GKVK, Bangalore, during 2011-12. Results indicated that fresh and shade-dried herbage and essential oil yield was influenced significantly by growth regulators. It is concluded that pinching at 45 days after transplanting, followed by foliar application of benzyl adenine (300ppm), and, subsequent sprays at each harvest was more effective in increasing the yield compared to Control.

Key words: Patchouli, pinching, cycocel, benzyl adenine, growth regulators

INTRODUCTION

Patchouli (*Pogostemon patchouli* Pellet.), a member of Lamiaceae, is the source of commercial patchouli oil. It is native to the Philippines and is now cultivated on a commercial scale in Indonesia, Malaysia, China, Brazil and India. Among these countries, Indonesia leads, with oil production of 600 tonnes, accounting for 80% of world production (Jadhav *et al*, 2002).

Oil of patchouli is obtained by steam distillation of shade-dried herbage. The oil has a strong fixative property and is known to improve tenacity. The oil has mainly a woody note. It is generally blended with other essential oils, and is used in beverages, candy making and meat products. Blended with sandalwood oil, it gives one of the finest *attars*, widely used for scenting soaps, perfumes, body lotions, after-shave lotions, detergents, cosmetics, tobacco and incense sticks (Angadi and Vasantha Kumar, 1995).

In view of the market potential of patchouli, a study was undertaken to widen the knowledge base on use of plant growth regulators (PGRs) on patchouli cultivation. PGRs are considered as the new generation agrochemicals after fertilizers, pesticides and herbicides. The role of PGRs in modifying canopy structure and optimizing yield attributes has proven by earlier researchers. Patchouli, being an aromatic crop, contains essential oil in its leaves and stem. It is possible to increase both herbage and oil yield by exogenous application of plant growth regulators. With this background, a field study was conducted to ascertain the effect of growth regulators on growth, herbage yield, essential oil content and oil yield in patchouli.

MATERIAL AND METHODS

The field experiment was conducted at Sanjeevani Vatika, Medicinal and Aromatic Plants Section, Department of Horticulture, University of Agricultural Sciences, GKVK, Bangalore, during 2011- 2012 on a plot with sandy loam soil of uniform fertility status. Treatments included (T_1) Control, (T_2) pinching without spraying, (T_3) pinching + Cycocel (CCC) 2000ppm, (T_4) pinching + CCC 2500ppm, (T_5) pinching + CCC 3000ppm, (T_6) pinching + BA 200ppm, (T_7) pinching + BA 300ppm and (T_8) pinching + BA 350ppm. These eight treatments were tested in Randomized Complete Block Design, with three replications. Forty five day old rooted cuttings were transplanted in the main field in the third week of July, at a spacing of 45cmx45cm. Recommended dose of NPK (150:50:50kg ha^{-1}) was applied, full dose of P and K, along with one sixth of N was applied before planting, and, the remaining N was top-dressed in five splits at bimonthly intervals. Earthing-up was done immediately after fertilizer application. The plots received irrigation. Pinching operation was carried out 45 days after transplant to the main field. On the same day, growth regulators were sprayed in treatment plots while water was

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sprayed in the Control plot. The remaining two sprays (second and third sprays) were applied after the first and second harvests, respectively.

The first harvest was done after 135 days of planting; the second and third harvests were done at 75 days' interval after the first harvest. Observations on various growth parameters were recorded at harvest. Harvested branches, along with leaves, were dried under shade for seven days. Shade-dried leaves were than hydro-distilled, using Clevenger's apparatus, to estimate essential oil content.

RESULTS AND DISCUSSION

Growth attributes of patchouli

Effects of pinching and application of growth regulators on patchouli growth and yield are presented in Tables 1 and 2. Control plants (T_1) recorded significantly higher plant height (78.71cm) compared to pinched plants during the first harvest. However, plant height was maximum in plants treated with pinching + BA 300ppm in subsequent harvests, as BA continued to increase cell activity. Similar results were obtained by (Rajashekar, 2010) in rose. In general, plants were taller in the first harvest compared to the second and third. This could be due to the longer harvest interval (135 days) and favourable weather conditions prevalant.

Plant height decreased in all the treatments compared to Control. Maximum reduction was noticed in the treatment of pinching + CCC @ 3000ppm. Similar results were obtained by Bhat *et al*, (1989) in *davana* and Vasundhara *et al* (1992) in *marjoram*. Reduction in plant height appears to be due to slowing down of rate of cell division and reduction in cell elongation. It has been suggested that Cycocel has anti-gibberllin effect which prevents excessive vegetative growth, increases chlorophyll synthesis and root development, stimulates photosynthetic activity, prevents lodging and increases yield (Moore, 1980).

The treatment on pinching + BA @ 300ppm (T_7) recorded significantly higher number of branches, number of leaves and higher plant spread compared to Control (T_1) in all three harvests (Table 1). Similar effect (axillary bud development and further growth due to application of kinetin or BA) was reported by Geeta and Hippalgaonkar (1993), Bhaskar *et al* (1997) and Farooqi *et al* (1993) in patchouli and *davana*.

Increase in number of branches and leaves may have been due to the fact that cytokinins have the ability to induce growth of secondary and tertiary branches and of reducing senescence in plants, resulting in increased leaf retention. Increased plant spread could be due to an increased number of branches and number of leaves per plant.

Yield parameters in patchouli

The application of pinching + BA @ 300ppm (T_7) registered significantly higher fresh herbage yield (12.13, 10.81 and 9.77t/ha), dry herbage yield (2.52, 2.36 and 2.0t/ha) and oil yield (47.19, 43.70 and 36.44 kg/ha) compared to control in all three harvests, respectively. Higher herbage and oil yield with application of PGRs may be due to enhanced yield-contributing factors, viz., plant height, number of leaves, number of branches and plant spread. Benzyl adenine (BA) is known to modify growth of plants, as, it promotes cell division, morphogenesis, lateral bud development and delays senescence, leading to enhanced leaf expansion which cause maintenance of more number of green leaves.

This clearly shows that BA can induce robust growth, resulting in increased herb yield compared to other treatments under identical growing conditions. These

Table 1. Effect of growth regulators on growth parameters at three harvests in patchouli

Treatment	Plant height (cm)			No. of branches plant^{-1}			No. of leaves plant^{-1}			Plant spread (cm^2)		
	H_1	H_2	H_3	H_1	H_2	H_3	H_1	H_2	H_3	H_1	H_2	H_3
T_1	78.71	56.86	55.97	23.45	24.52	20.48	385.49	367.75	331.83	42.11	39.71	36.31
T_2	74.04	55.75	55.63	29.49	26.86	22.53	437.95	396.88	354.16	47.02	42.85	39.68
T_3	71.10	54.33	51.70	33.22	31.72	30.47	519.44	487.75	452.11	59.78	56.20	52.74
T_4	69.98	53.74	50.91	32.09	30.33	29.39	498.59	475.05	435.25	58.61	53.85	50.48
T_5	69.11	52.31	49.44	30.26	29.60	27.92	490.54	466.01	413.87	56.82	51.48	48.61
T_6	73.91	56.50	55.84	34.95	32.74	31.19	540.65	491.65	462.75	61.37	58.40	53.61
T_7	77.35	60.84	59.58	39.14	35.86	34.33	578.70	535.54	493.04	64.72	62.75	57.25
T_8	76.52	58.30	58.30	36.52	34.28	31.78	553.21	507.39	474.21	62.92	60.03	55.38
F-Test	*	*	*	*	*	*	*	*	*	*	*	*
S.Em ±	1.40	1.05	1.14	1.43	1.20	1.16	10.35	9.53	10.14	1.19	1.52	1.26
CD *(P=0.05)*	4.26	3.17	3.45	4.32	3.63	3.52	31.40	28.91	30.75	3.61	4.60	3.83

Table 2. Effect of growth regulators on yield parameters at three harvests in patchouli

Treatment	Fresh herbage yield(t ha^{-1})			Pooled	Dry herbage yield (t ha^{-1})			Pooled	Oil content (%)			Oil yield (kg ha^{-1})			Pooled
	H_1	H_2	H_3		H_1	H_2	H_3		H_1	H_2	H_3	H_1	H_2	H_3	
T_1	7.19	7.02	6.42	18.38	1.59	1.54	1.37	4.01	1.83	1.80	1.77	29.35	27.65	24.28	81.28
T_2	8.34	7.30	6.47	22.11	1.81	1.70	1.39	4.90	1.83	1.81	1.77	33.08	30.81	24.58	88.48
T_3	10.37	9.82	8.67	28.86	2.08	2.03	1.76	5.87	1.87	1.83	1.80	38.90	37.14	31.64	107.69
T_4	9.88	9.44	8.45	27.76	1.92	1.92	1.73	5.57	1.85	1.83	1.77	35.51	35.28	30.56	101.35
T_5	9.60	8.83	8.18	26.61	1.87	1.87	1.65	5.38	1.83	1.80	1.78	34.35	33.41	29.35	97.11
T_6	11.14	10.15	9.27	30.56	2.28	2.14	1.90	6.32	1.83	1.83	1.80	41.94	39.23	34.14	115.31
T_7	12.13	10.81	9.77	32.70	2.52	2.36	2.00	6.89	1.87	1.85	1.82	47.19	43.70	36.44	127.33
T_8	11.69	10.42	9.55	31.66	2.39	2.25	1.97	6.61	1.85	1.81	1.80	44.39	40.90	35.54	120.83
F-Test	*	*	*	*	*	*	*	*	NS	NS	NS	*	*	*	*
S.Em ±	0.34	0.30	0.35	0.91	0.12	0.10	0.07	0.21	0.05	0.04	0.04	2.65	1.85	1.44	4.31
CD *(P=0.05)*	1.04	0.92	1.05	2.77	0.35	0.31	0.22	0.62	-	-	-	8.05	5.61	4.35	13.08

* Significant at 5% level

T_1 : Control
T_2 : Pinching without spraying
T_3 : Pinching + CCC 2000ppm
T_4 : Pinching + CCC 2500ppm
T_5 : Pinching + CCC 3000ppm
T_6 : Pinching + BA 200ppm
T_7 : Pinching + BA 300ppm
T_8 : Pinching + BA 350ppm

H_1- first harvest, H_2- second harvest, H_3- third harvest

findings are in line with results of Geeta and Hippalgaonkar (1993) also in patchouli who obtained higher fresh herbage yield per plant with 0.5x10^{-4}M kinetin and Farooqi *et al* (2003) in *Mentha arvensis* and Farooqi *et al* (1993) in *davana*.

Oil content (% v/w) did not vary substantially among treatments. However, CCC @ 2000ppm and BA 300ppm showed higher values (1.87%) at first harvest; but, during the second and third harvests, BA at 300ppm showed maximum oil content (1.85 and 1.82%, respectively). This may be because of overall increase in leaf biomass under the same treatment.

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