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Effect of plant growth hormones on growth, tuber character and forskolin content of patherchur (*Coleus forskohlii* (Willd) Briq).

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Abstract
This study was conducted at A field experiment was carried out in the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during *Kharif* 2015-16). A field experiment consisting of Plant Growth Hormones MH (100 and 150 ppm), Cycocel (500 and 1000 ppm), NAA (50 and 100 ppm), GA3 (150 and 200 ppm) and and water spray as control to study the impact of plant growth Hormones on plant height, No. of branches, Number of tuber/plant, Lengh of tubers (cm) Diameter of tuber (cm). Fresh weight of tuber (g/plant) Dry weight of tuber (g/plant) and Forskolin Content (%)of *Coleus forskohlii* (Willd) Briq. 1000 ppm concentration of cycocel determined a decrease of the plant hight, incraes number of branches, number of tuber/plant, lengh of tubers (cm), Diameter of tuber (cm), fresh and dry weight of tuber (g/plant) and Forskolin Content (%).

Keywords: Forskolin, medicinal plant, Cycocel, GA_3 spray, ppm, HPLC

Introduction
Coleus forskohlii (Willd) Briq. [syn. *C. barbatus* (Andr.) Benth] is a plant in Indian origin (Valdes *et al.*, 1987) [5] belonging to mint family Lamiaceae and grow perennially over tropical and sub tropical region of India, Pakistan, Sri Lanka, East Africa and Brazil. In India the crop is being commercially grow in large area in Madhya Pradesh, Maharashtra, Kerala, Karnataka and Tamil Nadu (Lakshmanan *et al.*, 2013). The root portion of the plant has been traditionally used for medicinal purposed and contains an active constituent, forskolin. The crop has a great potential in future due to respected increase in demand for forskolin widely used in glaucoma, cardiac problem and also used in treatment of certain type of cancer (Shah *et al.*, 1980) [4]. To specific PGRs are used to modify crop growth rate and growth pattern during the various stages of development, from germination through harvest and post harvest preservation. Growth hormone chemicals that have positive influences on major medicinal plant can be of value. The final test, however is that harvested yields must be increase or medicinal quality enhanced in order for growth hormones to be profitable. The synthetic growth regulators chemicals are being extremely important and valuable for manipulating the growth and yield of medicinal plants. Their effect varies with plant species, variety concentration used, and frequency of application and various other factors which influence the uptake and translocation of chemicals (Singh *et al*., 1990). The present study was conducted with an objective of finding out the effect of growth hormones on the growth and yield of medicinal plant of Patherchur.

2. Materials and Methods
This study was conducted at A field experiment was carried out in the research farm of RAK College of Agriculture, Sehore (Madhya Pradesh) during *Kharif* 2016). There were eight treatments MH (100 and 150 ppm), Cycocel (500 and 1000 ppm), NAA (50 and 100 ppm), GA3 (150 and 200 ppm) and the water being the control. This study was done on the base of randomized complete block design. The treatment was replicated 3 times. The plant growth regulators were sprayed in three stages viz cutting stage, vegetative stages and reproductive stage. The local coleus variety cutting were transplanted in main field. The whole plot was divided into 3 block each representing the replication. Each block was then divided into unit plot of 3 x 3 m size. Seedlings were transplanted at 60 x 30 cm spacing. The experiment plot fertilized with urea, single super phosphate and murate of potash at the rate of NPK 40 kg, 60 kg and 50 kg ha^{-1} respectively. Nitrogen was applied at two equal splits, one at the time of transplanting and another as top dressing at 30 day after sowing. All the operations done regularly during growing season.

Different plant growth parameter and physiological observations were recorded on five randomly selected plants from every treatment on 60 days, 120 days and 180 days after transplanting. Obsevations and mesurments were made on plant height, No. of branches, Number of tuber/plant, Lengh of tubers (cm) Diameter of tuber (cm). Fresh weight of tuber (g/plant) Dry weight of tuber (g/plant). The Forskolin Content was estimated by HPLC analysis in tuber samples separately using replicated pooled samples of crop. Finally mean data of the all characters were computed for statistical analysis as per standard procedure given by (Panse and Sukhtme 1989) [1].

3. Results and Discussions

3.1 Plant height (cm): The plant height per plant at 60, 120 and 180 days of the crop is presented in (Table- 1). The effect of different concentration of plant growth hormones was significant for all growth stages except 60 days of crop on plant height. The plant height increases with the advancement in growth stage and reaching highest value at harvest in all treatment. The maximum plant height was recorded with treated GA3 @200ppm (61.27) at 120 days. Closely followed by NAA @ 100 ppm (60.40) and GA3 @150 ppm (60.08) which were at par and plant height per plant was lowest in control (57.18) as compare to treated with plant growth hormones Cycocel 1000 ppm (46.33) and Cycocel @ 500 ppm (49.76). At 180 day maximum plant height was recorded with treated GA3 @200ppm (65.71) closely followed by NAA @ 100 ppm (65.02) and GA3 @150 ppm (64.51) which were at par and plant height per plant was lowest in control (64.16) as compare to treated with plant growth hormones Cycocel 1000 ppm (49.31) and Cycocel @ 500 ppm (51.84).Similar results reported on the same medicinal plant by R. Swamy (2006) [2] and J. C. Mathad (2005).

Table 1: Effect of Plant Growth Hormones on Growth Patherchur (*Coleus forskohlii* (Willd) Briq).

Symbol	Treatment	Plant height (cm)			No. of Branches		
		60 DAT	120 DAT	180 DAT	60 DAT	120 DAT	180 DAT
T_1	MH100PPM	42.74	52.18	53.89	13.67	45.33	46.44
T_2	MH150PPM	42.33	51.43	52.59	14.33	52.89	53.78
T_3	CCC500PPM	42.87	49.76	51.84	15.67	69.00	70.33
T_4	CCC1000	42.94	46.33	49.31	14.00	71.22	72.44
T_5	NAA50PPM	43.98	57.56	64.38	14.00	33.56	34.44
T_6	NAA100PPM	43.99	60.40	65.02	11.67	33.78	35.89
T_7	GA3150PPM	44.54	60.08	64.51	14.00	34.33	36.56
T_8	GA3200PPM	44.79	61.27	65.71	15.67	32.00	33.11
T_9	CONTROL	43.03	57.18	64.16	13.67	34.78	35.00
	SE (m) ±	1.68	1.60	2.28	1.50	2.37	2.23
	C D at 5%	NS	4.92	7.02	NS	7.29	6.86

3.2 Number of branches/plant: The number of branches per plant at 60, 120 and 180 days of the crop is presented in (Table- 1).The impact of different concentration of plant growth hormones was significant except 60 days of crop on number of branches per plant. The number of branches per plant maximum found was in the Cycocel @ 1000 ppm (72.44) as compare to Cycocel @ 500 ppm (70.33) at 120 days of crop. Closely followed by MH @ 150 ppm (53.78), MH 100 ppm (46.44), MH @ 150 ppm (53.78), MH 100 ppm (46.44) which were at par and lowest no. of branches found was GA3 200 ppm (32.00). Inhibitory effect of Cycocel on plant height, at the same time with stumulation of of the emergence of the lateral shoots Sunil kumar G. S. (2005) [3]. At 180 day maximum no. of branches observed with treated Cycocel @ 1000 ppm (72.44) as compare to Cycocel @ 500 ppm (70.33) at 120 days of crop. Closely followed by MH @ 150 ppm (53.78), MH 100 ppm (46.44), MH @ 150 ppm (53.78), MH 100 ppm (46.44) which were at par and lowest no. of branches found was GA3 200 ppm (32.00).

3.3 Diameter of tuber (cm): The data on diameter of tuber as influenced by various plant growth hormones at different concentration have been presented in (table -2). The impact of different concentration of plant growth hormones was significant. At 180 days diameter of tuber (cm) maximum found crop was treated with Cycocel @ 1000 ppm (1.978) as compare to Cycocel @ 500 ppm (1.804) at 180 days of crop. Closely followed by MH @ 150 ppm (1.756), MH 100 ppm (1.660), MH @ 150 ppm (1.756), MH 100 ppm (1.660) which were at par and lowest no. of branches found was NAA 50 ppm (1.373).

3.4 Fresh weight of tuber (g/plant): The data on fresh weight of tuber as influenced by various plant growth hormones at different concentration have been presented in (table -2). The impact of different concentration of plant growth hormones was significant. At 180 days Fresh weight of tuber (g/plant) maximum found crop was treated with Cycocel @ 1000 ppm (263.67) as compare to Cycocel @ 500 ppm (257.67) at 180 days of crop. Closely followed by MH @ 150 ppm (252.78), MH 100 ppm (247.11), MH @ 150 ppm (252.78), MH 100 ppm (247.11) which were at par and lowest no. of branches found was GA3 150 ppm (232.44).

3.5 Dry weight of tuber (g/plant): The data on dry weight of tuber as influenced by various plant growth hormones at different concentration have been presented in (table -2). The impact of different concentration of plant growth hormones was significant. Fresh weight of tuber (g/plant) maximum found crop was treated with Cycocel @ 1000 ppm (43.11) as compare to MH @ 150 ppm (41.89) at 180 days of crop. Closely followed by Cycocel 500 ppm (40.56), MH 100 ppm (39.89), Cycocel 500 ppm (40.56), MH 100 ppm (39.89), which were at par and lowest dry weight of tuber (g/plant) found was GA3 150 ppm (35.89).

Table 2: Effect of Plant Growth Hormones on Tuber Character and Forskolin Content of Patherchur (*Coleus forskohlii* (Willd) Briq).

Symbol	Treatment	Number of tuber/plant	Lengh of tubers (cm)	Diameter of tuber (cm)	Fresh weight of tuber (g/plant)	Dry weight of tuber (g/plant)	*Forskolin Content of tuber (%w/w)
T_1	MH100PPM	24.44	23.99	1.660	247.11	39.89	0.50
T_2	MH150PPM	25.89	25.50	1.756	252.78	41.89	0.56
T_3	CCC500PPM	28.11	26.53	1.804	257.67	40.56	0.62
T_4	CCC1000 PPM	30.56	27.89	1.978	263.67	43.11	0.70
T_5	NAA50PPM	18.22	21.86	1.373	232.44	36.00	0.44
T_6	NAA100PPM	17.33	21.64	1.496	235.89	36.00	0.46
T_7	GA3150PPM	16.89	20.53	1.513	232.44	35.89	0.47
T_8	GA3200PPM	19.22	21.25	1.534	234.78	37.44	0.51
T_9	CONTROL	23.33	22.41	1.576	242.00	40.00	0.51
	SE (m) ±	3.13	1.91	0.235	5.73	2.77	
	C D at 5%	9.64	5.90	0.723	17.64	8.53	

* The replicated pooled samples of leaf were used for estimation of alkaloid and hence, could not be analyzed statistically and only mean values have been presented

3.6 Forskolin Content of tuber (% w/w)

Plant Growth hormones treatments caused for higher Forskolin content in tuber presented in (Table- 2). Plant Growth hormones applied with Cycocel 1000 ppm (0.70 % w/w) and Cycocel 500 ppm (0.62 % w/w) registered maximum leaf Forskolin as compare to treated with MH @ 150 ppm (0.56% w/w), MH @ 100 ppm (0.50% w/w) and GA3 150 ppm (1.78 w/w) respectively. Forskolin content was lowest in NAA 50 ppm (0.44). Similar results reported on the same medicinal plant by R. Swamy (2006) [2].

4. Conclusion

The crop has a great potential in future due to respected increase in demand for forskolin widely used in glaucoma, cardiac problem and also used in treatment of certain type of cancer (Shah *et al.*, 1980, Murugan *et al.*, 2015) [4]. To specific PGRs are used to modify crop growth rate and growth pattern during the various stages of development, from germination through harvest and post harvest preservation. Growth hormone chemicals that have positive influences on major medicinal plant can be of value.

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6. References

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