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Effect of pinching and foliar application of nitrogen on morphological attributes in stevia (*Stevia rebaudiana* B.) under hill zone of Karnataka

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Abstract
A field experiment was conducted on effect of pinching and foliar application of nitrogen on morphological attributes instevia (*Stevia rebaudiana* B.) at College of Horticulture, Mudigere during 2019-20. The experiment was laid out in factorial randomized block design. The experiment comprised of two factors, factor A comprised of three pinching levels and factor B comprised of four nitrogen levels. Pinching and foliar application of nitrogen significantly affected growth of stevia. Results revealed that, pinched plants noted minimum plant height compared to no pinching. pinching at 30 days after planting along with foliar application of two per cent urea noted significantly maximum number of branches (26.00/plant), number of leaves (379.00/plant), fresh weight of leaves (95.60 g/plant) and dry weight of leaves (48.68 g/plant).

Keywords: Pinching, apical dominance, foliar, steviol glycosides

Introduction
Stevia (*Stevia rebaudiana* B.) is a perennial herb belongs to the family Asteraceae. Stevia is said to be natural zero calorie bio sweetener used as sugar substitute and as flavouring agent. The plant is native of South America (Paraguay) and contains steviol glycosides mainly stevioside and rebaudioside which are 300 times sweeter than canesugar (Mehta *et al*., 2012) [7]. Stevia has many health benefits especially for those who suffering from diabetes, blood pressure, obesity and cardiovascular diseases (Suresh *et al*., 2018) [15]. In stevia, flowering is a continuous process and this is not essential as this crop is known for its leaves. Pinching is an important cultural operation that helps in increasing the number of branches which in turn maximizes the leaf yield through the release of apical dominance. Foliar application of nitrogen helps in production of more number of leaves and plants remains in vegetative phase. So far very limited research has been done on this aspect. Therefore the present investigation entitled "Effect of pinching and foliar application of nitrogen on morphological attributes in stevia (*Stevia rebaudiana* B.) Under hill zone of Karnataka" was carried out.

Material and Methods
The present investigation was undertaken at College of Horticulture, Mudigere in Chikamagaluru district of Karnataka, India during 2019-2020. The experiment was laid out in factorial randomized block design with twelve treatments in three replications, considering pinching (M_1- control; M_2- Pinching at 30 DAP; M_3- Pinching at 40 DAP) as first factor and foliar application of nitrogen (S_1- control; S_2- 1 % urea; S_3- 2 % urea; S_4- 3 % urea;) as second factor.
The experimental plot was ploughed two to three times and brought to fine tilth. At the time of planting, basal dose of fertilizers (60:30:45NPK kg/ha) along with FYM (10 t/ha) was applied. Rooted cuttings are treated with bavistin (2 g/l) for 30 minutes and planted in raised bed with a spacing of 45 cm × 20 cm during the month of November 2019. Plant started flowering after 20 days of planting. Pinching treatment was imposed after 30 and 40 days of planting (DAP). Apical portion of the shoot with flowers and leaves were pinched off (5 cm oftip portion). Pinching was carried out during early morning and evening hours. Urea concentration of one, two and three per cent was considered for the study. One per cent urea was prepared by dissolving 10 gof urea in one litre of water. Similarly urea concentration of two and three per cent were prepared and sprayed after fifteen days of each pinching treatment. Observations were taken at 120 and 180 days after planting (DAP). Harvesting was done by cutting the plant at 10 cm above the ground level to facilitate the regeneration for second crop. First harvest was done at 90 DAP and second harvest was done at 180 DAP.

Result and Discussion
Pinching and foliar application of nitrogen had significantly influenced the morphological attributes *viz*, plant height, plant spread, and number of branches, number of leaves, fresh and dry weight of leaf. Results were found significant at 180 DAP. However it was found non-significant at 120 DAP because, the plants were just 30 days old after the first harvest. So, in the initial day's growth performance of all the plants were found similar.

Plant height: No pinching (M_1) recorded the maximum plant height (22.12 cm and 66.01 cm) and M_3 (pinching at 40 DAP) recorded minimum height (20.67 cm and 53.42 cm) at 120 and

180 days after planting respectively (Table 1). With respect to foliar application of nitrogen minimum plant height (56.00 cm) and maximum plant height (60.78 cm) was recorded under S_1 (control) and S_3 (2 % urea) respectively at 180 DAP. In the interactions, the treatment combination T_3 (M_1S_3) registered maximum plant height of 22.87 cm and 68.48 cm at 120 and 180 DAP respectively. While T_9 (M_3S_1) recorded the lowest plant height of 50.84 cm at 180 DAP. Apical dominance and massive impact of nitrogen spray could be attributed to the higher plant height, which promoted vigorous growth of the stevia. Whereas, plants remained considerably dwarf in the case of pinching treatments compared to no pinching, which may be due to the elimination of the apical portion that resulted in reduced plant height. Similar results were noted by Kumar *et al.* (2014) [5] in stevia, Sehrawat*et al*. (2003) [10] in marigold, Gnyandev (2006) [1] in China aster and Maharnor *et al.* (2011) [11] in marigold.

Plant spread: At 180 DAP,M_2(pinching at 30 DAP) recorded significantly maximum plant spread (38.93 cm) at N-S direction whereas, pinching at 40 DAP (M_2) recorded maximum plant spread (35.19 cm) at E-W direction and found to be on par with M_2 (34.84 cm). Lowest plant spread at both the direction (31.97 cm at N-S and 29.38 cmat E-W direction) was recorded under no pinching (M_1). Foliar application of urea (2 %) recorded maximum plant spread (38.46 cm at N-S and 34.58 cm at E-W direction (Table 1). However lowest values for plant spread of 33.14 cm and 30.92 cm was noticed in control (S_1) at N-S and E-W direction. Interaction effect was found non-significant at 120 and 180 days after plantingin both the directions. Wider plant spread under pinching may be attributed to movement of photosynthates to leaf axils which ultimately boost the production of lateral branches. This induces more branches per plant thus, encourages wider plant spread. Nitrogen favours cell division and expansion, which resulted into robust nature of plant by the development of more branches.These findings are comply with Singh *et al.* (2015) [12] in marigold, Salve *et al.* (2016) [9] in chrysanthemum, Sowmya *et al.* (2017) [13] in fenugreek and Khan *et al.* (2018) [4] in marigold.

Table 1: Effect of pinching and foliar application of nitrogen on plant height and plant spread of stevia (*Stevia rebaudiana*)

Treatments	Plant height (cm)		Plant spread (cm)	
	120 DAP (30 DAFH)	180 DAP (second harvest)	N-S (180 DAP)	E-W (180 DAP)
Pinching (M)				
M_1- No pinching	22.12	66.01	31.97	29.38
M_2-Pinching at 30 DAP	21.13	55.02	38.93	34.84
M_3-Pinching at 40 DAP	20.67	53.42	36.51	35.19
SE (m) ±	0.90	0.41	0.38	0.42
CD at 5 %	NS	1.19	1.12	1.24
Nitrogen foliar spray (S)				
S_1- RDF (control)	20.84	56.00	33.14	30.92
S_2- 1 % urea spray	21.26	58.75	36.39	33.49
S_3- 2 % urea spray	21.44	60.78	38.46	34.58
S_4- 3 % urea spray	21.66	57.06	35.22	33.57
SE (m) ±	1.04	0.47	0.44	0.49
CD at 5 %	NS	1.38	1.30	1.43
Interaction effect (pinching x nitrogen foliar spray)				
T_1- M_1S_1	22.07	64.80	29.60	27.23
T_2- M_1S_2	21.85	67.69	31.19	29.35
T_3- M_1S_3	22.87	68.48	34.56	30.04
T_4- M_1S_4	21.68	63.07	32.53	30.91
T_5- M_2S_1	20.49	52.36	36.65	32.47
T_6- M_2S_2	21.17	55.05	40.81	34.30
T_7- M_2S_3	20.36	58.48	41.38	37.33
T_8- M_2S_4	22.48	54.18	36.89	35.25
T_9- M_3S_1	19.96	50.84	33.18	33.05
T_{10}- M_3S_2	20.77	53.52	37.16	36.81
T_{11}- M_3S_3	21.10	55.39	39.45	36.37
T_{12}- M_3S_4	20.83	53.92	36.24	34.54
SE (m) ±	1.80	0.81	0.77	0.84
CD at 5 %	NS	2.39	NS	NS

RDF: Recommended dose of fertilizer
DAP: Days after planting
DAFH: Days after first harvest
NS: Non significant

Number of branches and leaves: Number of branches andleaves significantly varied due to pinching and foliar application of nitrogen (Table 2). More number of branches (22.50/plant) and leaves (352.33/plant) was produced under M_2 (pinching at 30 DAP) and minimum were recorded under control. With respect to foliar application of nitrogen S_3 (2 % urea) accounted higher number of branches (22.56) and leaves per plant (336.11). While in the interaction effect, treatment 7 noted higher number of branches (26.00) and leaves per plant (379.00). Production of more number of branches and leaves might be due to pinching of apical portion stimulates vegetative lateral development by accumulation of cytokinin in the lateral buds and increases the

branches number which directly helps in production of more number of leaves (Mohammad and Naz, 2006) [8]. Similarly nitrogen is an essential element which required for photosynthesis, cell division, cell elongation and protein synthesis there by increased the vegetative growth of the plant in terms of production of more number of branches and leaves. The results are in conformity with the findings of Zaman *et al*. (2015) [16] in stevia, Sudarshan (2004) [14] in fenugreek and Jawarkar *et al*. (2018) [3] in methi.

Table 2: Effect of pinching and foliar application of nitrogen on number of branches and number of leaves per plant in stevia (*Stevia rebaudiana*)

Treatments	Number of branches per plant		Number of leaves per plant	
	120 DAP (30 DAFH)	180 DAP (second harvest)	120 DAP (30 DAFH)	180 DAP (second harvest)
Pinching (M)				
M_1- No pinching	5.50	15.83	85.58	240.25
M_2-Pinching at 30 DAP	5.92	22.50	88.17	352.33
M_3-Pinching at 40 DAP	5.71	21.83	87.00	349.75
SE (m) ±	0.31	0.43	0.84	3.12
CD at 5 %	NS	1.27	NS	9.15
Nitrogen foliar spray (S)				
S_1- RDF (control)	5.67	18.00	86.56	291.33
S_2- 1 % urea spray	5.72	20.67	86.44	314.22
S_3- 2 % urea spray	5.78	22.56	87.44	336.11
S_4- 3 % urea spray	5.67	19.00	87.22	314.78
SE (m) ±	0.36	0.50	0.97	3.60
CD at 5 %	NS	1.47	NS	10.57
Interaction effect (pinching x nitrogen foliar spray)				
T_1- M_1S_1	5.00	14.33	84.67	225.00
T_2- M_1S_2	5.33	16.33	86.33	241.33
T_3- M_1S_3	5.67	17.33	85.33	256.67
T_4- M_1S_4	6.00	15.33	86.00	238.00
T_5- M_2S_1	5.67	21.33	88.33	318.33
T_6- M_2S_2	6.00	23.33	87.00	340.00
T_7- M_2S_3	6.33	26.00	89.33	379.00
T_8- M_2S_4	5.67	19.33	88.00	372.00
T_9- M_3S_1	6.33	18.33	86.67	330.67
T_{10}- M_3S_2	5.83	22.33	86.00	361.33
T_{11}- M_3S_3	5.33	24.33	87.67	372.67
T_{12}- M_3S_4	5.33	22.33	87.67	334.33
SE (m) ±	0.62	0.87	1.69	6.24
CD at 5 %	NS	2.55	NS	18.30

RDF: Recommended dose of fertilizer
DAP: Days after planting
DAFH: Days after first harvest
NS: Non significant

Fresh and dry weight of leaves: Pinching had significantly influenced the fresh and dry weight of leaves per plant and it was maximum (91.19 g and 44.33 g) in M_2 (pinching at 30 DAP) at 180 DAP (Table 3). M_2 was found on par (90.76 g) with M_3 (pinching at 40 DAP) for fresh weight of leaves. Lowest fresh and dry weight of leaves per plant of 65.48 g and 27.58 g was recorded under no pinching (M_1) at 180 DAP. Foliar application of urea (2 %) noted higher fresh and dry weight of leaves and the minimum was noted under control. Treatment combination of M_2S_3 (treatment 7) registered higher fresh (95.50 g) and dry weight of leaves (48.68 g) at 180 DAP. The increase in fresh and dry weight of leaves might be due to the development of more number of branches and consequently more leaves per plant that might have produced and translocated more photosynthates by efficient utilization of nitrogen.These results were found similar with findings of Kumar *et al*. (2014) [5], Ignacio and Salazar (2018) [2] in Steviaand Sharangi *et al*. (2011) [11] in coriander.

Table 3: Effect of pinching and foliar application of nitrogen on fresh and dry weight of leaves in stevia (*Stevia rebaudiana*)

Treatments	Fresh weight of leaves per plant (g)		Dry weight of leaves per plant (g)	
	120 DAP (30 DAFH)	180 DAP (second harvest)	120 DAP (30 DAFH)	180 DAP (second harvest)
Pinching (M)				
M_1- No pinching	11.60	65.48	5.20	27.58
M_2-Pinching at 30 DAP	12.86	91.19	5.69	44.33
M_3-Pinching at 40 DAP	12.31	90.76	5.98	42.31
SE (m) ±	0.43	0.82	0.27	0.38
CD at 5 %	NS	2.41	NS	1.12
Nitrogen foliar spray (S)				

S_1- RDF (control)	11.49	76.62	5.27	36.47
S_2- 1 % urea spray	12.04	81.77	5.64	37.43
S_3- 2 % urea spray	13.38	86.45	6.02	41.03
S_4- 3 % urea spray	12.10	84.98	5.55	37.36
SE (m) ±	0.50	0.95	0.31	0.44
CD at 5 %	NS	2.78	NS	1.29
Interaction effect (pinching x nitrogen foliar spray)				
T_1- M_1S_1	10.92	55.85	4.69	23.79
T_2- M_1S_2	11.19	65.25	5.11	27.27
T_3- M_1S_3	12.95	69.12	5.52	29.68
T_4- M_1S_4	11.33	71.69	5.46	29.58
T_5- M_2S_1	11.14	84.82	5.29	43.33
T_6- M_2S_2	12.65	89.72	5.55	40.96
T_7- M_2S_3	13.61	95.60	6.79	48.68
T_8- M_2S_4	11.84	92.67	5.13	44.34
T_9- M_3S_1	12.41	89.19	5.83	42.28
T_{10}- M_3S_2	12.28	90.36	6.26	44.07
T_{11}- M_3S_3	13.59	94.62	5.76	44.72
T_{12}- M_3S_4	13.14	90.57	6.06	38.15
SE (m) ±	0.86	1.64	0.53	0.76
CD at 5 %	NS	4.82	NS	2.24

RDF: Recommended dose of fertilizer
DAP: Days after planting
DAFH: Days after first harvest
NS: Non significant

Conclusion

The results of study inferred that, pinching and foliar application of nitrogen (urea) had positive effect on plant growth and development compared to control. Pinching at 30 days after planting along with foliar application of two per cent urea recorded better plant performance and produced more number of leaves and higher leaf weight per plant.

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