

Effect of growth regulators on growth and rhizome production of ginger (*Zingiber officinale* Rosc.) in the hilly region of Darjeeling district

D. K. SENGUPTA, ¹T. K. MAITY AND B. DASGUPTA

All India Networking Project on Betelvine, Directorate of Research,

¹Department of Vegetable Crops, Faculty of Horticulture,

Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741252, Nadia, West Bengal, India

ABSTRACT

A field trial was conducted at the Horticultural Research Station, Bidhan Chandra Krishi Viswavidyalaya, Pedong, Darjeeling, West Bengal for two consecutive years to study the effect of growth regulators on growth and rhizome production of ginger cv. Gorubathan. Growth regulators like Ethrel @ 50,100,150ppm, Cycocel @ 100, 200, 500ppm and GA₃ @ 50,100,150ppm and control (water spray) were sprayed at 90 and 120 days after planting. The results revealed that spraying with GA₃ @ 150 ppm and Ethrel @ 150 ppm showed maximum plant height (103.38 cm.) and maximum number of pseudostem (5.23/clump) respectively. Maximum number of leaves per plant (72.19), maximum leaf length (29.69 cm.) and leaf breadth (2.80 cm.) were recorded in plants treated with Ethrel @ 100 ppm., GA₃ @ 150 ppm and Cycocel @ 200 ppm respectively. The maximum yield (69.86 t/ha) was recorded in the treatment GA₃ @ 150 ppm as compared to 45.60 t/ha in control. From this experiment it can be concluded that the foliar spray of GA₃ 150 ppm is the best for ginger cultivation.

Key words: Growth regulator, ginger and rhizome

Growth regulators are organic compounds other than nutrients and its site of action is different from site of production. In small quantity these promote, inhibit or otherwise modify any physiological process in plants. Jayachadrana and Sethumadhavan (1979) reported that Cycocel 100, 500, 1000 ppm, Ethrel 50,100,200ppm when applied 3 times at 15 days interval, starting from 70 DAP on ginger cv. Rio-de-Janeiro recorded no significant effect on plant height. Only Ethrel at 200 ppm and to a lesser extent cycocel at 1000 ppm showed appreciable effect on tiller production and Ethrel at the same dose also had the largest number of leaves.

Several workers in root and tuber crops reported that tuber formation in potato was stimulated by cytokinin (Smith and Palmer,1970). Eshasi and Leopold (1968) reported that tuber development in begonia was promoted. For altering growth and enhancing yield in many root and tuber crops, Cycocel has been used in *Solanum tuberosum* L. (Chowdhuri *et al.*, 1976) and in *Manihot esculenta* Crantz (Gupta, 1976; Muthu Krishnan *et al.*, 1976). Ethrel has been used in *Ipomoea batata* Lam (Muthu Krishnan *et al.*, 1974; Shanmugam and Srinivasan, 1974) and in *Manihot esculenta* Crantz (Muthu Krishnan., 1976). Very little works have so far been done on ginger in this aspect. Possibility of using

growth regulators in ginger has not been explored systematically and hence the present investigation was undertaken.

MATERIALS AND METHODS

The experiment was laid out in randomized block design with three replications for the two consecutive years. Three-growth regulators viz. Ethrel (50,100 and 150 ppm) cycocel (100,200 and 500 ppm), GA₃ (50,100 and 150 ppm) and control (water spray) were included. The planting material 40 gm were sown on a raised bed of 2m. x 1m. at a spacing 25x20cm. during the month of March. The crop was fertilized at the rate of NPK 60:40:60 kg/ha. Nitrogen fertilizer was given in two equal splits i.e., at the time of planting and 90 days after planting. Phosphate and potassium fertilizers were applied at the time of planting. Mother rhizomes were removed from the plant at 90 days after planting with the help of hand fork. The crop was harvested in the month of November when the leaves are turned yellow and started dry up. Foliar spray of growth regulators at two times was given 90 and 120 days after planting. Other cultural operations were done as per the common package of practices. Mean values of 15 plants in each treatment were used for statistical analysis by the analysis and variance method (Panse and Sukhatme, 1978).

RESULTS AND DISCUSSION

Height of the plant

The results (Table-1) showed that maximum plant height was recorded when the plants treated with GA₃ 150ppm and it is statistically at par with the treatment when the plants treated with GA₃ 50ppm and GA₃ 100 ppm during the year 1992 and it is statistically superior to all the treatments during the year 1993 and pooled analysis of two years. The minimum plant height was recorded when the plants were treated with Ethrel 150ppm and it is statistically at par with all the treatments except when the plants treated with GA₃ 50ppm, GA₃ 100 ppm and GA₃ 150 ppm during the year 1992 and when the plants treated with Ethrel 100ppm, Ethrel 150ppm and control treatment during the year 1993 at 5% level of significance. Pooled analysis of above two years revealed that the minimum plant height was recorded in plants treated with Ethrel 50 ppm and it is at par with the plants treated with Ethrel 100 ppm, Ethrel 150 ppm, Cycocel 100 ppm. and control.

Number of pseudostems per clump

The maximum number of pseudostems per clump were recorded when plants treated with Ethrel 50 ppm and it is at par with the plants treated with Ethrel 100 ppm, Ethrel 150 ppm and Cycocel 500 ppm during both the year and pooled data. The minimum number of pseudostem per clump was recorded when the plants treated with GA₃ 150 ppm during 1st year and pooled data of two years and it is at par when the plants treated with GA₃ 100 ppm. During the 2nd year the minimum number of pseudostem per clump was recorded when the plants treated with GA₃ 100 ppm and it is at par with the plants treated with GA₃ 50 ppm and 150 ppm at 5% level of significance (Table -1).

Number of leaves per clump

The results showed that in the 1st year and pooled data of two years, the maximum number of leaves per clump was recorded when the plants treated with Ethrel 100 ppm and it is statistically at par with all the treatments except when the plants treated with Cycocel 100 ppm, GA₃ 50 ppm, GA₃ 100 ppm and GA₃ 150 ppm during 1st year and statistically at par with the treatments Ethrel Cycocel 500 ppm in pooled data. In the second year, the maximum number of leaves per clump was recorded when the plants treated with Ethrel 150 ppm and it is at par with Ethrel 100 ppm and Cycocel 500 ppm. The minimum number of leaves per clump were recorded when the plants treated with GA₃ 150

ppm and it is at par with when the plants treated with GA₃ 50 ppm and GA₃ 100 ppm at 5% level of significance in 1st year. In 2nd year and pooled data, the minimum number of leaves per clump was recorded when the plants treated with GA₃ 100 ppm and it is at par with the plants treated with GA₃ 50 ppm and GA₃ 150 ppm. (Table-1).

Leaf length

The results showed that in 2nd year and in pooled data, maximum leaf length was recorded when the plants treated with GA₃ 150 ppm and it is statistically at par with the treatment when the plants treated with GA₃ 100 ppm. In 1st year, maximum leaf length was recorded when the plants treated with GA₃ 100 ppm and it is statistically at par with the treatment when the plants treated with GA₃ 150 ppm. The minimum leaf length was recorded when the plants treated with Ethrel 150 ppm in 1st year and in pooled data. And it is at par with the treatment when the plants treated with Ethrel 50 ppm and 100 ppm. In the second year, minimum leaf length was recorded in control treatment and it is inferior to all the treatments. (Table-2).

Leaf breadth

The results (Table -2) showed that in the first year and in pooled data, maximum leaf breadth was recorded when the plants treated with Cycocel 200 ppm and minimum leaf breadth was recorded when the plants treated with GA₃ 150 ppm but the treatment differences were not statistically significant. In 2nd year, the maximum leaf breadth was recorded when the plants treated with GA₃ 50 ppm and minimum leaf breadth was recorded when the plants treated with Ethrel 50 ppm and 150 ppm but the treatment differences were not statistically significant.

Yield

The results showed that in both the years and in pooled data of two years, maximum plant yield (kg/plant) was recorded when the plants treated with GA₃ 150 ppm and it is at per with when the plants treated with Cycocel 100 ppm, GA₃ 50 ppm and 100 ppm in 1st year 1992 and statistically superior to all the treatment in 2nd year and statistically at par with GA₃ 100 ppm in pooled data. The minimum yield of plant was recorded in control treatment all through. (Table-2)

Projected yield

Maximum yield (t/ha) was recorded when the plants treated with GA₃ 150 ppm during both in the year 1992, 1993 and in pooled data of two years and

Table1. Effect of growth regulators on the plant height, number of pseudostem per clump and number of leaves per clump.

Treatments	Plant height (cm.)			No. of pseudostem per clump			No. of leaves per clump		
	1st. yr.	2nd yr.	Pooled	1st. yr.	2nd yr.	Pooled	1st. yr.	2nd yr.	Pooled
Ethrel 50 ppm	79.62	70.02	74.82	4.81	5.01	4.91	67.85	70.98	69.41
Ethrel 100 ppm	78.24	75.48	76.86	4.77	5.48	5.12	67.99	76.39	72.19
Ethrel 150 ppm	78.07	72.57	75.32	4.72	5.75	5.23	62.60	80.19	71.39
Cycocel 100 ppm	83.52	77.16	80.34	3.93	4.95	4.44	55.59	70.06	62.82
Cycocel 200 ppm	83.64	80.67	82.15	4.23	4.38	4.30	62.39	64.15	63.27
Cycocel 500 ppm	84.62	78.27	81.44	4.48	5.46	4.97	63.03	77.49	70.26
GA ₃ 50 ppm	92.07	86.91	89.49	3.52	3.33	3.42	52.04	49.86	50.95
GA ₃ 100 ppm	100.38	94.62	97.50	3.13	3.23	3.18	47.24	48.42	47.83
GA ₃ 150 ppm	101.04	105.72	103.38	2.99	3.33	3.16	45.14	53.48	49.31
Control	78.92	75.68	77.30	4.28	4.44	4.36	60.54	62.77	61.65
SEm (±)	3.380	2.322	1.882	0.200	0.187	0.130	3.252	3.298	2.757
LSD (P=0.05)	10.041	6.898	5.591	0.594	0.555	0.386	9.661	9.797	8.190

Table 2. Effect of growth regulators on the leaf length, leaf breadth and plant yield.

Treatments	Leaf length (cm.)			Leaf breadth (cm.)			Yield per plant (kg.)			Projected yield (t/ha)		
	1st yr.	2nd yr.	Pooled	1st yr.	2nd yr.	Pooled	1st yr.	2nd yr.	Pooled	1st yr.	2nd yr.	Pooled
Ethrel 50 ppm	26.89	26.79	26.84	2.65	2.65	2.65	0.282	0.300	0.291	56.46	60.06	58.26
Ethrel 100 ppm	26.52	25.93	26.22	2.67	2.67	2.67	0.267	0.259	0.263	53.40	51.93	52.66
Ethrel 150 ppm	26.09	25.73	25.91	2.63	2.65	2.64	0.270	0.313	0.291	54.13	62.60	58.36
Cycocel 100 ppm	27.56	27.43	27.49	2.77	2.78	2.77	0.303	0.315	0.309	60.73	63.00	61.86
Cycocel 200 ppm	27.71	27.46	27.58	2.84	2.76	2.80	0.295	0.284	0.289	59.06	56.93	57.99
Cycocel 500 ppm	27.94	27.66	27.80	2.68	2.70	2.69	0.299	0.297	0.298	59.93	59.46	59.69
GA ₃ 50 ppm	27.68	27.89	27.78	2.70	2.79	2.74	0.303	0.313	0.308	60.66	62.73	61.69
GA ₃ 100 ppm	29.76	29.57	29.66	2.79	2.75	2.77	0.317	0.338	0.327	63.40	67.60	65.50
GA ₃ 150 ppm	28.79	30.60	29.69	2.62	2.70	2.66	0.323	0.375	0.349	64.73	75.00	69.86
Control	27.77	25.63	26.70	2.72	2.75	2.73	0.225	0.231	0.228	45.00	46.20	45.60
SEm (±)	0.392	0.529	0.398	0.051	0.054	0.040	0.008	0.011	0.008	2.067	2.476	1.927
LSD (P=0.05)	1.164	1.571	1.182	NS	NS	NS	0.023	0.032	0.023	6.140	7.355	5.724

it is at par with all the treatments except when the plants treated with Ethrel 50ppm, 100ppm and 150 ppm and control treatment in 1st year and statistically superior to all the treatment in 2nd year and statistically at par with GA₃ 100 ppm in pooled data. The minimum yield was recorded in control treatment and it is inferior to all the treatments in 1st year and in pooled data of two years and statistically at par with the treatment Ethrel 100ppm (Table-2).

The results revealed that application of GA₃ showed maximum plant height, leaf length and yield, Cycocel increased the leaf breadth and ethrel produced maximum pseudostem and leaves per plant. Furutani and Nagao (1986) reported increase in rhizome yield with the application of daminozide and decreased with GA₃ and ethephon. In the present investigation, the authors did not tried daminozide and ethephon as growth regulators. Jayachadrana

and Sethumadhavan (1979) reported that Cycocel 100, 500, 1000 ppm, Ethrel 50, 100, 200 ppm when applied 3 times at 15 days interval starting 70 DAP on ginger Cv. Rio-de-Janeiro recorded no significant effect on plant height. Only Ethrel at 200 ppm and to a lesser extent cycocel at 1000 ppm showed appreciable effect on tiller production and Ethrel at the same dose also had the largest number of leaves. For altering growth and enhancing yield in many root and tuber crops, Cycocel has been used in *Solanum tuberosum* L. (Chowdhuri *et al.*, 1976) and in *Manihot esculenta* Crantz (Gupta, 1976; Muthu Krishnan *et al.*, 1976). Ethrel has been used in *Ipomoea batata* Lam (Muthu Krishnan *et al.*, 1974; Shanmugam and Srinivasan, 1974) and in *Manihot Esculenta* crantz (Muthu Krishnan., 1976).

REFERENCES

- Choudhuri, R. S., Choudhuri P. K. R. and Veeraraghavan, P.A. 1976. Response of potato crop to treatment with ascorbic acid and Cycocel . *Indian. J. Plant. Physiol.* **19**: 15-19.
- Esashi, Y. and Leopold, A. C 1968. Regulation of tuber development in *Begonia evansiana* by cytokinin. In Wightman and Setterfield. pp. 923-41.
- Furutani, S. C. and Nagao, M. A. 1986. Influence of laminozide, gibberellic acid and ethephon on flowering, shoot growth and yield of ginger. *Hort. Sci.* **21**: 428-29.
- Gupta, D. K. D 1976. Effect of Cycocel on crop plants in sierra Leone. 2. cassava (*Manihot esculenta*). *Exp. Agric.* **21**. 321-28.
- Jayachandran, B. K. and Sethumadhavan, P. 1979. Vegetative growth of ginger (*Zingiber officinale* R) as influenced by Cycocel, Ethrel and Kinetin, *Agril. Res. J. Kerala* **17** : 67-70.
- Muthukrishnan, C. R., Thambura, S., Shanmugam, A. and Shanmugavelu, K. G. 1976. Effect of certain growth regulators on tapioca (*Manihot esculenta* Crantz) and sweet potato (*Ipomoea batatas* (L) Lam) *J. Root Crops.* **2** : 52-56.
- Muthukrishnan, C. R., Shanmugam, A. and Thamburaj, S. 1974. Effect of Soil and Foliar application of Ethrel on sweet potato (*Ipomoea batatas* Lamb.S). *Indian Hort.* **22** : 1-5.
- Panase, V. G. and Sukhatme, P. V. 1978. *Statistical Method for Agricultural Workers*. Indian Council of Agricultural Research, New Delhi.
- Shanmugam, A. and Srinivasan, C. 1974. Influence of ethephon on the growth and yield of sweet potato (*Ipomoea batatas* Lam). *Hort. Res.* **13** : 143-45.
- Smith, O. E. and Palmer, C. E. 1970. Cytokinin induced tuber formation in stolons of *Solanum tuberosum*. *Physiol. Plantarum.* **23** : 599-606.