RESEARCH ARTICLE

EFFECT OF PLANT GROWTH REGULATORS ON GROWTH PARAMETERS OF SWEET POTATO (*IPOMOEA BATATAS* (L.) LAM.)

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Abstract: A field experiment was carried out during *kharif*2016-17 at Kittur Rani Channamma College of Horticulture, Arabhavi (Karnataka) to study the effect of growth regulators on growth parameters of sweet potato [*Ipomoea batatas* (L.) Lam.]. The results revealed that the spraying of GA_3 @ 100 ppm (T_3) showed significantly highest Vine length (125.50 cm), Petiole length (26.83 cm) and Significantly highest leaf area (87.43 cm^2) was recorded with the combination of GA_3 100 ppm plus CCC 250 ppm (T_{10}), which was on par with GA_3 at 100 ppm (85.18 cm^2),

Keywords: Sweet potato, Plant growth regulators, Growth parameters

INTRODUCTION

Sweet potato [*Ipomoea batatas* (L.) Lam.] is an important tuber crop belonging to the family Convolvulaceae. It is an important starchy vegetablecrop in tropics and sub tropics. It is mainly grown as oneof the supplementary food crops to meet the requirementsof carbohydrates and also to provide raw materials formanufacture of starch, alcohol, lactic acid, vinegar etc. The nutrition of sweet potato in human diet is quite appreciable since, it provides high quantity of starch, substantial amount of vitamins (A, B and C) (Hung *et al.* 1999), minerals and trace elements compared to cereals. It would be a good substitute for rice and wheat (Thakur, 1975). It also contains considerable amount of beta-carotene (5.40 to 20.00 mg/100g) and sugar content. In India sweet potato is grown utilizing the-monsoon rains during *Kharif* (June-July) and with supplemented irrigation during Rabi (October-November).In India, sweet potato is being cultivated in almost all the states with an area of 111 ha, with a production of 1450 metric tonnes and productivity of 10.4 MT/ha (Anonymous, 2015). India accounts for about 68% of the total production of South Asia followed by 27% in Bangladesh and about 5% in Sri Lanka. In India, Sweet potato is cultivated mainly in Odisha, Uttar Pradesh, West Bengal, Bihar, Karnataka, Andhra Pradesh, Tamil Nadu and Kerala.

The role of plant growth substances in the physiology of plant is one of the most interesting chapters in the science. The plant growth substances are organic compounds, other than nutrients which in small concentration influence the physiological processes of plants. They have been used for various beneficial effects such as promoting plant growth, increasing number of flowers, fruit size and inducing early and uniform fruit ripening.GA_3 has a major effect on growth and development activating the entire metabolic activities of many crops. $GA_3$is one of the important growth regulators that stimulate vegetative growth (Singh and Rajodia, 2001), yield (Khan *et al.*, 2002) and sugar content (Babu, 2000). Cycocel (CCC) a new quartemary ammonium growth retardant is the most effective. It interferes with many of the metabolic activities. Reduction of plant height with subsequent increase in branching and yield by the application of CCC was reported by Devi (2002). Increase in chlorophyll content (Volkova, 1985), yield (Amutha and Rajendran, 2001), (Shrivastava*et al.*, 2001) was also reported due to CCC application.

MATERIALS AND METHODS

The field experiment was conducted at the Kittur Rani Channamma College of Horticulture, Arabhavi, Gokak Taluk, Belgaum district of Karnataka state during the *Kharif -2016*. Arabhavi is situated in northern dry zone of Karnataka state at 16^0 13' 39.6" north latitude, 74^0 50' 13.5" east longitude and at an altitude of 612.03 m above the mean sea level.Arabhavi, which lies in Zone-3 of Region-2 of agro-climatic zones of Karnataka, is considered to have the benefit of both South-West and North-East monsoons. The average rainfall of this area is about 530 mm, distributed over a period of five to six months (May-October) with peak (226.10 mm) during September. The area receives water from Ghataprabha Left Bank Canal from mid-July to mid-March. During the experimental period, the mean minimum temperature varied from 11.80^0 C (December 2016) to 23^0 C (August 2016), whereas the mean maximum temperature varied from 26.10^0 C (December 2016).

The experiment was laid out in Randomized block design and replicated thrice.Vine cuttings of 15-20 cm length were planted at a spacing of 60 x 30 cmand 5-7 cm depth. Standard recommended cultural practices were followed during the entire crop grown period.The experiment consisted of different PGR concentrations (GA_3 @ 25, 50 and 100 ppm, CCC @ 100, 250 and 300 ppm and IBA @ 100 and 200 ppm and control). In each treatment, the plants were

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sprayed twice at 45 and 60 days after transplanting. The data on vegetative growth parameters were recorded and analyzed statistically.The experimental data collected on various growth, yield and quality aspects were subjected to Fisher's method of analysis of variance (ANOVA) as per methods outlined by Panse and Sukhatme (1967). The critical difference (CD) was calculated wherever the 'F' test was found significant. The data were analyzed and presented with the level of significance at 5 per cent.

RESULTS AND DISCUSSION

Fresh vine length

It is evident from the data that the vine length was significantly influenced by growth regulators and the treatments differed significantly among themselves at various growth stages except at 30 DAP and presented in Table -1.

Among different treatments, GA_3 at 100 ppm (T_3) was recorded highest vine length (125.50 cm), which was on par with combination of GA_3 at 100 ppm plus CCC at 250 ppm (T_{10}) (119.00 cm), combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (116.17 cm) and IBA at 200 ppm (T_8) (108.33 cm), whereas minimum vine length (73.17 cm) was observed in control (T_{11}) at 60 DAP. Vine length noticed at 90 DAP ranged from 113.10 to 169.83 cm.Significantly highest vine length (169.83 cm) was recorded in GA_3 at 100 ppm (T_3), which was on par with GA_3at 100 ppm plus CCC at 250 ppm (T_{10}) (154.95 cm) andcombination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (146.75 cm). In control (T_{11}) the lowest vine length (113.10 cm) was observed.

The trend observed in respect of vine length at harvest (120 DAP) of crop was similarto those observed at earlier stages. Significantly highest vine length (221.72 cm) was recorded in GA_3 at 100 ppm (T_3),which was on par with combination of GA_3at 100 ppm plus CCC at 250 ppm (T_{10}) (213.52 cm) and combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (205.48 cm), whereas minimum vine length (158.09 cm) was observed in control. The increase in vine lengthby GA_3 treatment may be due cell division. GA_3 has been found to increase the cell wall plasticity and also thus creating water diffusion pressure deficit, which result in water uptake, thereby causing cell elongation followed by cell division as suggested by Randhawa (1971). However, the response to GA_3 in terms of cell division and cell elongation depends up on nature of tissues and the balance of the different kinds of growth substances. Similar responses of GA_3 were earlier reported by Tohamy*et al.* (2015) in sweet potato, Natesh *et al*. (2005) in chilli, Sengupta *et al.* (2008) in ginger.

Petiole length (cm)

Significantly higher petiole length (26.83 cm)was recorded in GA_3 at 100 ppm (T_3), which was on par with treatment combination of GA_3at 100 ppm plus CCC at 250 ppm (23.86 cm) (T_{10}), combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (23.41 cm). The minimum petiole length (18.25 cm) was observed incontrol (T_{11}).

Petiole length recorded at 90 DAP ranged from 21.12 to 29.86 cm.Significantly highest petiole length (29.86 cm) was recorded in GA_3 at 100 ppm (T_3), which was on par with treatment combination of GA_3 at 100 ppm plus CCC at 250 ppm (T_{10}) (27.98 cm),combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (26.92 cm). In control (T_{11}) the lowest petiole length (21.12 cm) was observed. The trend observed in respect of petiole length at harvest (120 DAP) of crop was similarto those observed at earlier stages.Significantly highest petiole length (31.99 cm) was recorded in GA_3 at 100 ppm (T_3), which was on par with combination of GA_3 at 100 ppm plus CCC at 250 ppm (T_{10}) (29.54 cm) and whereas minimum petiole length (24.38 cm) was observed in control (T_{11}). The promotion of growth either in terms of increase the petiole length due to GA_3 has been thought to be by increasing plasticity of the cell wall followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation. These osmotic driven responses under the influence of gibberellins might have attributed to increase in photosynthetic activity, accelerated translocation and efficiency of utilizing photosynthetic products, thus resulting in increased cell elongation and rapid cell division in the growing portion (Sargent, 1965).These results are in conformity with the findings of Singh and Choudhary (1989) in watermelon and Rao*et al.* (2017) in sweet potato (Table 2).

Leaf area (cm^2)

Significantly higher leaf area (77.20 cm^2)was recorded with combination of GA_3 at 100 ppm plus CCC at 250 ppm (T_{10}), which was on par with single treatment of GA_3at 100 ppm (73.50 cm^2), combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) (71.15 cm^2) and IBA at 200 ppm (T_8) (68.30 cm^2). The minimum leaf area (61.42 cm^2) was resulted incontrol (T_{11}) at 60 DAP. Significantly highest leaf area (87.43 cm^2) was recorded with the combination of GA_3 100 ppm plus CCC 250 ppm (T_{10}), which was on par with GA_3at 100 ppm (85.18 cm^2), combination of GA_3 at 50 ppm plus IBA at 200 ppm (T_9) and GA_3 at 50 ppm (T_2). In control (T_{11}) the lowest leaf area (69.15 cm^2) was observed at 90 DAP.

The trend observed in respect of leaf area at harvest (120 DAP) of crop was similarto those observed at earlier stages. Combination of growth regulators GA_3at 100 ppm plus CCC at 250 ppm (T_{10}), recorded significantly highest leaf area (98.48 cm^2), followed by GA_3@ 100 ppm (T_3) (93.60 cm^2),whereas minimum leaf area (78.11 cm^2) was observed in control.

The promotion of growth either in terms of increase the leaf area due to GA_3 has been thought to be by increasing plasticity of the cell wall followed by hydrolysis of starch to sugars which lowers the water potential of cell, resulting in the entry of water into the cell causing elongation.These results are in conformity with the findings of Singh and Choudhary (1989) in watermelon, Emongor (2007) and Chatterjee and Choudhuri (2012) in cowpea.

The highest diameters of fresh tubers (7.42 cm) was recorded in combination of GA_3 at 100 ppm plus CCC @ 250 ppm(T_{10}), which was on par with single treatment of CCC at 300 ppm (T_6) (7.27 cm).Whereas the lowest diameters of fresh tubers (3.78 cm) was reported in control (T_{11}).Similar response of CCC increase the girth of root tuber was earlier reported by Abdul and Kumaran (1980),Tohamy*et al.*(2015),Shee (1983)in sweet potato, Mohamed and Anbu (1996) in radish and Jirali*et al.* (2008) in ginger.

Table 1. Vine length (cm) of sweet potato at different stages of growth as influenced by different plant growth regulators

Sl. No.	Treatments	Vine length (cm)			
		30 DAP	**60 DAP**	**90 DAP**	**120 DAP**
1.	T_1- GA_3 @ 25 ppm	51.12	92.17	127.29	173.33
2.	T_2- GA_3 @ 50 ppm	50.02	100.51	138.02	187.47
3.	T_3- GA_3 @ 100 ppm	50.42	125.50	169.83	221.72
4.	T_4- CCC @ 200 ppm	49.00	106.83	145.24	191.86
5.	T_5- CCC @ 250 ppm	48.45	95.67	132.17	183.75
6.	T_6- CCC @ 300 ppm	47.30	90.83	126.08	174.40
7.	T_7- IBA @ 100 ppm	51.31	93.73	131.38	175.83
8.	T_8- IBA @ 200 ppm	47.28	108.33	143.67	185.09
9.	T_9- Combination of GA_3 @ 50 ppm + IBA @ 200 ppm	50.11	116.17	146.75	205.48
10.	T_{10}- Combination of GA_3 @ 100 ppm + CCC @ 250 ppm	47.20	119.00	154.95	213.52
11.	T_{11}- Control	54.35	73.17	113.10	158.09
	S.Em±	**2.90**	**7.43**	**8.80**	**8.58**
	C. D. at 5%	**N.S**	**21.94**	**25.97**	**25.31**
	C.V	**10.11**	**12.63**	**10.97**	**7.89**

DAP = Days after planting

Table 2. Petiole length (cm) of sweet potato at different stages of growth as influenced by different plant growth regulators

Sl. No.	Treatments	Petiole length (cm)			
		30 DAP	**60 DAP**	**90 DAP**	**120 DAP**
1.	T_1- GA_3 @ 25 ppm	12.67	19.62	25.19	27.42
2.	T_2- GA_3 @ 50 ppm	12.49	22.97	26.08	27.87
3.	T_3- GA_3 @ 100 ppm	13.23	26.83	29.86	31.99
4.	T_4- CCC @ 200 ppm	12.88	22.53	25.82	27.76

5.	T_5- CCC @ 250 ppm	13.11	20.85	25.26	27.49
6.	T_6- CCC @ 300 ppm	12.45	19.34	22.87	25.70
7.	T_7- IBA @ 100 ppm	14.12	20.09	24.00	25.79
8.	T_8- IBA @ 200 ppm	13.55	21.51	26.01	26.23
9.	T_9- Combination of GA_3 @ 50 ppm + IBA @ 200 ppm	12.26	23.41	26.92	28.24
10.	T_{10}- Combination of GA_3 @ 100 ppm + CCC @ 250 ppm	13.60	23.86	27.98	29.54
11.	T_{11}- Control	12.60	18.25	21.12	24.38
	S.Em±	**1.03**	**1.38**	**1.52**	**1.25**
	C. D. at 5%	**N.S**	**4.09**	**4.50**	**3.70**
	C.V.	**13.82**	**11.05**	**10.34**	**7.91**

DAP = Days after planting

Table 3. Leaf area (cm^2) of sweet potato at different stages of growth as influenced by different plant growth regulators

Sl. No.	Treatments	Leaf area (cm^2)			
		30 DAP	**60 DAP**	**90 DAP**	**120 DAP**
1.	T_1- GA_3 @ 25 ppm	47.90	64.15	75.03	83.32
2.	T_2- GA_3 @ 50 ppm	45.12	67.08	78.17	85.10
3.	T_3- GA_3 @ 100 ppm	52.73	73.50	85.18	93.60
4.	T_4- CCC @ 200 ppm	55.30	67.32	76.52	84.02
5.	T_5- CCC @ 250 ppm	47.51	65.88	74.25	83.18
6.	T_6- CCC @ 300 ppm	52.19	64.13	72.16	80.34
7.	T_7- IBA @ 100 ppm	48.17	65.49	72.53	80.26
8.	T_8- IBA @ 200 ppm	45.36	68.30	75.14	82.95
9.	T_9- Combination of GA_3 @ 50 ppm + IBA @ 200 ppm	52.14	71.15	81.72	90.55
10.	T_{10}- Combination of GA_3 @ 100 ppm + CCC @ 250 ppm	47.57	77.20	87.43	98.48
11.	T_{11}- Control	48.07	61.42	69.15	78.11
	S.Em±	**3.51**	**2.96**	**3.54**	**4.02**
	C. D. at 5%	**N.S**	**8.75**	**10.45**	**11.87**
	C. V	**12.35**	**7.58**	**7.97**	**8.15**

DAP: Days after planting

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