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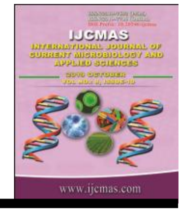

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Effect of Bioregulators on Growth, Tuber Yield and Quality of Sweet Potato (*Ipomoea batatas* (L) Lam.) Under Hill Zone of Karnataka, India

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A B S T R A C T

A field experiment was carried out during *Rabi* 2018-19 at College of Horticulture, Mudigere, University of Agricultural and Horticultural Sciences, Shivamogga (Karnataka) to study the influence of bioregulators on growth, tuber yield and quality parameters of sweet potato. The experiment consisted of thirteen treatments such as two concentrations of bioregulators sprayed at three frequencies (first, second and third spray at 30, 60 and 90 days after planting) and untreated control. Each treatment was replicated thrice in randomized complete block design (RCBD). The results showed that GA_3 at 200 ppm (T_2) recorded significantly maximum values for parameters such as vine length (176.00 cm), number of auxillary branches (5.73), number of leaves per plant (391.33), vine internodal length (6.03 cm) and vine girth (17.80 mm). Even maximum tuber yield per plant (835.83 g), tuber yield per plot (30.09 kg), tuber yield per hectare (46.44 t) and maximum total sugars (2.25 %) were noticed in T_2 (GA_3 at 200 ppm) in Sweet potato.

Introduction

Sweet potato [*Ipomoea batatas* (L.) Lam] is such a vegetable which makes one-self to remember of its sweetness and eye attractive colored tubers, popularly called by name sakarkand in India. It is an extremely versatile and delicious dicotyledonous tuber crop belonging to the family Convolvulaceae. The crop stands one among the oldest vegetables known to mankind and has been originated in South America. The nutrition of sweet potato in human diet is quite appreciable as it provides high quantity of starch, substantial amount of vitamins, 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. Statistical data obtained shows that in sweet potato India covers an area of 0.13 million ha producing 1.63 million tonnes of tubers with the productivity of 12.2 metric tonnes per ha (Anon., 2017). A wide industrial application of sweet potato starch is incredible, it includes sweeteners, citric acid, noodle production, beverage, industrial alcohol, ethanol, fuel, and derived products as maltose. Leaves are immense source of protein for feeding pigs, goats, and chickens and for improving ruminant urea utilization. It is also a promising crop for future as a renewable energy source.

In modern vegetable industry new insights have been developed to achieve sufficient and sustainable productivity with quality. One among such approaches is the use of "bioregulators". Bioregulators are the organic compounds, other than nutrients which in small concentration influence the physiological processes of plants and have contributed a great deal to the yield and productivity by modifying and controlling the growth behaviour of many crop plants. Therefore the present study was under taken to know the effect of bioregulators on morphology, tuber yield and quality of sweet potato (*Ipomoea batatas* (L) Lam.) under hill zone of Karnataka.

Materials and Methods

The experiment was carried out in the experimental block of the College of Horticulture, Mudigere, Chickmagalore district of Karnataka state during *Rabi* 2018-19. Mudigere is located at an altitude of 982 m above mean sea level (AMSL) in the (Zone-9 and Region-V) of Karnataka. Depicts 13^0 25' North latitude and 75^0 25' East longitude epitomizing part of biologically rich and biogeographically unique Western Ghats. The total rain fall received during the year is 2420.00 mm which was distributed over a period of six to eight months (May-December) with the peak period of rainfall during June – September. Here 27.78°C is the average maximum temperature recorded and the minimum of 19.41°C has been noticed in this region with mean relative humidity of 82.96 per cent. The experiment was laid out in open field with a randomized complete block design (RCBD) by replicating thrice. The treatments in each replication were allotted randomly according to definite laws of probability. Vine cuttings were planted at a spacing of 60 × 30 cm following ridges and furrow method. The experiment consist of different bioregulators concentrations *viz*. T_1- GA_3 at 100 ppm, T_2- GA_3 at 200 ppm, T_3- CCC at 250 ppm, T_4- CCC at 500 ppm, T_5- Triacontanol at 250 ppm, T_6- Triacontanol at 500 ppm, T_7-Biozyme at 0.3 %, T_8- Biozyme at 0.4 %, T_9- Biovita at 0.3 %, T_{10}-Biovita at 0.4 %, T_{11}-Cytozyme at 0.3 %, T_{12}- Cytozyme at 0.4 % and T_{13}- Water spray. In each treatment, plants were sprayed thrice at 30, 60 and 90 days after planting. Observations were recorded systematically at monthly interval and analyzed as per the standard procedure.

Results and Discussion

Growth parameters

The data pertaining to growth parameters as influenced by bioregulators are presented in Table 1.

Vine length (cm)

The vine length differed significantly among the different levels of bioregulators. Foliar application of GA_3 @ 200 ppm evinced maximum vine length (176.00 cm) and minimum vine length (111.33 cm) was noticed in treatment receiving CCC at 500 ppm. This might be due to increased cell division and cell elongation resulting in more number of cells and in size of cells which ultimately increases the vine length. These results were in accordance with that of Behera *et al.*, (2018), Hejjegar *et al.*, (2018), Rajak (2018) in sweet potato.

Number of axillary branches

Significantly more number of axillary branches of sweet potato was observed with GA_3 at 200 ppm (5.73) while control recorded less number of axillary branches (4.07). The possible reason is due the application of GA_3 which enhances the lateral buds and vegetative growth which in turn increases the number of axillary branches per plant. These results are in line with findings of Rao *et al.,* (2017) in sweet potato, Abbas (2011) in carrot, Mahesh and Sen (2005) in okra.

Number of leaves per plant

Number of leaves per plant varied significantly among the different levels of treatments and GA_3 at 200 ppm showed significantly more number of leaves per plant (391.33) while control recorded minimum number of leaves per plant (262.00). The increase in number of leaves might be due to enhanced photosynthetic activities and rapid metabolic processes within the plant thereby increase in photosynthates pool and energy along with increased cell division and elongation processes resulted to force the plant to produce more number of branches and leaves. Similar findings with respect to number of leaves were also reported by Rajak (2018) in sweet potato.

Vine internodal length (cm)

Foliar application of bioregulators showed significant influence on vine internodal length during the experimental period. The vine internodal length was significantly maximum (6.03 cm) in plants sprayed with GA_3 @ 200 ppm and minimum vine internodal length was found in CCC at 500 ppm (4.72 cm). Application of GA_3 played an important role in enhancing the mean length of internode on main vine due to cell elongation and cell division. These results are in a parallel with the results of Barani *et al.,* (2013), Rao *et al.,* (2017), Rajak (2018) in sweet potato.

Table.1 Effect of bioregulators on sweet potato for morphological characteristics

Treatments	Vine length (cm)	Number of axillary branches	Number of leaves per plant	Vine internodal length (cm)	Vine girth (mm)
T_1 - GA_3 @ 100 ppm	160.77	5.40	362.67	5.91	16.20
T_2 - GA_3 @ 200 ppm	176.00	5.73	391.33	6.03	17.80
T_3 - CCC @ 250 ppm	117.07	4.13	280.00	4.82	13.07
T_4 - CCC @ 500 ppm	111.33	4.20	285.33	4.72	13.13
T_5 - Triacontanol @ 250 ppm	153.87	5.07	351.33	5.82	15.23
T_6 - Triacontanol @ 500 ppm	158.23	5.07	354.00	5.85	15.68
T_7 - Biozyme @ 0.3 %	149.60	4.73	320.00	5.67	15.26
T_8 - Biozyme @ 0.4 %	151.60	4.93	340.67	5.73	15.43
T_9 - Biovita @ 0.3 %	141.83	4.53	309.33	5.17	13.87
T_{10} - Biovita @ 0.4 %	146.70	4.67	312.00	5.55	14.58
T_{11} - Cytozyme @ 0.3 %	147.13	4.80	316.00	5.62	15.32
T_{12} - Cytozyme @ 0.4 %	151.20	4.80	333.33	5.70	15.39
T_{13} - Control (Water spray)	124.67	4.07	262.00	4.87	12.56
S.Em ±	8.01	0.27	16.48	0.25	0.81
C.D @ 5 %	23.39	0.79	48.10	0.73	2.38

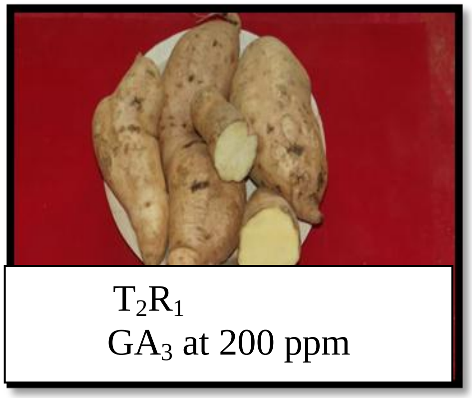
Table.2 Effect of bioregulators on sweet potato for tuber yield parameters

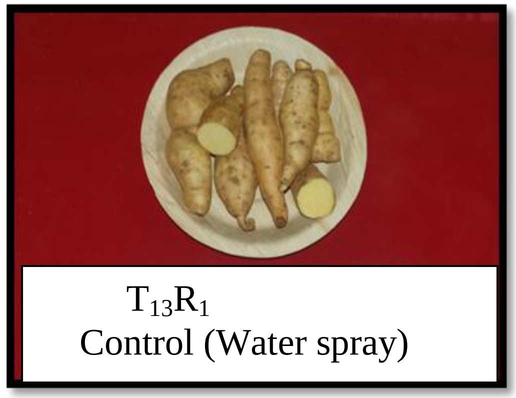
Treatments	Yield per plant(g)	Yield per plot (kg)	Yield per hectare (Tonnes)
T_1 - GA_3 @ 100 ppm	795.17	28.63	44.18
T_2 - GA_3 @ 200 ppm	835.83	30.09	46.44
T_3 - CCC @ 250 ppm	732.50	26.37	40.69
T_4 - CCC @ 500 ppm	782.17	28.16	43.45
T_5 - Triacontanol @ 250 ppm	759.63	27.35	42.20
T_6 - Triacontanol @ 500 ppm	793.27	28.56	44.07
T_7 - Biozyme @ 0.3 %	699.50	25.18	38.86
T_8 - Biozyme @ 0.4 %	703.93	25.34	39.11
T_9 - Biovita @ 0.3 %	683.27	24.60	37.96
T_{10} - Biovita @ 0.4 %	684.50	24.64	38.03
T_{11} - Cytozyme @ 0.3 %	697.90	25.12	38.77
T_{12} - Cytozyme @ 0.4 %	701.97	25.27	39.00
T_{13} - Control (Water spray)	595.07	21.42	33.06
S.Em ±	42.93	1.54	2.38
C.D @ 5 %	125.33	4.51	6.96

Table.3 Effect of bioregulators on sweet potato for quality parameter

Treatments	Total sugar content (%)
T_1 - GA_3 @ 100 ppm	2.22
T_2 - GA_3 @ 200 ppm	2.25
T_3 - CCC @ 250 ppm	1.95
T_4 - CCC @ 500 ppm	1.98
T_5 - Triacontanol @ 250 ppm	2.02
T_6 - Triacontanol @ 500 ppm	2.09
T_7 - Biozyme @ 0.3 %	1.87
T_8 - Biozyme @ 0.4 %	1.89
T_9 - Biovita @ 0.3 %	1.83
T_{10} - Biovita @ 0.4 %	1.85
T_{11} - Cytozyme @ 0.3 %	1.90
T_{12} - Cytozyme @ 0.4 %	1.94
T_{13} - Control (Water spray)	1.73
S.Em ±	0.03
C.D @ 5 %	0.10

Plate.1 Performance of GA_3 at 200 ppm over the control on tuber yield





Vine girth (mm)

Among different levels of bioregulators, GA_3 @ 200 ppm had a significant influence on vine girth. The maximum vine girth (17.80 mm) was noticed in treatment with GA_3 @ 200 ppm, whereas minimum (12.56 mm) vine girth was observed in control. The possible reason for increased girth of stem is due foliar application of GA_3 which increased the meristematic activity of lateral meristem resulting in the rapid cell division and cell elongation in cambium region led to the increase in the girth of stem. These results are in line to the findings of Rajak (2018) in sweet potato and Tapidya *et al.*, (2018) in chilli.

Tuber yield and quality characters

The data regarding tuber yield and quality characters as influenced by bioregulators are furnished in Table 2, 3 and plate 1respectively.

Tuber yield per plant (g), per plot (kg) and per hectare (t)

The maximum tuber yield per plant (835.83 g), tuber yield per plot (30.09 kg) and tuber yield per hectare (46.44 t) was recorded with GA_3 at 200 ppm while control showed minimum tuber yield per plant (595.07 g), tuber yield per plot (21.42 kg) and tuber yield per hectare (33.06 t).Increase in the yield attributes is probably due to the stimulatory effect of the GA_3 which prolonged the stomatal openings and induces the large number of reproductive sinks leading to the greater activity of RuBP enzyme resulting in higher photosynthetic rate with greater translocation and accumulation of metabolites in the sink. The results of yield of tubers are in consonance to that of Rao *et al.,* (2017) and Rajak (2017) in sweet potato and Kim *et al.*, (2005) in Chinese yam.

Total sugars

Bioregulators had significant influence on total sugar content of sweet potato and significantly maximum total sugar content (2.25 %) was recorded with the application of GA_3 at 200 ppm and minimum content of total sugar percentage (1.73 %) was recorded in control. Exogenous application of GA_3 probably stimulated the activity of *amylase* enzyme which caused hydrolysis of starch. Then the starch readily converted into sucrose and thus the amount of total sugar content increased. The results pertaining to total sugar was similar as that of Rao *et al.*, (2017) and Rajak (2017) in sweet potato and Geetha *et al.*, (2014) in bittergourd.

Based on the results obtained, it can be concluded that, among various bioregulators GA_3 at 200 ppm has resulted in maximum morphological, tuber yield and quality characteristics of sweet potato compared to other treatments.

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