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Effect of bio regulators on yield parameters of sweet potato (*Ipomoea batatas* L.)

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Abstract
Sweet potato (*Ipomoea batatas* L.) is an important member of the family Convolvulaceae, locally known as “shakarkand”, is commonly planted in flat to slightly rolling open areas. The crop is highly nutritive and an excellent source of carbohydrates, vitamin A, calcium, and phosphorus. Jharkhand is the 7th largest producer of sweet potato only after Orissa, UP, MP, Assam, WB and Bihar. Due to increasing demand of sweet potato, there is a need to increase its yield. Foliar application of growth regulators is reported to improve growth, early flowering, increased flowering and tuber yield. Growth regulators are also reported to improve yield of many horticultural crops those in which the underground part is economically important. Hence, the present investigation has been carried out in the experimental site of AICRP on tuber crops under the department of Horticulture, Faculty of Agriculture, Birsa Agricultural University, Kanke, Ranchi during the Kharif season of 2016. There were fifteen treatments used namely T1-Triacontanol (250 ppm), T2-Triacontanol (500 ppm), T3- Gibberellic Acid (50 ppm), T4 - Gibberellic Acid (100 ppm), T5 - Naphthalene Acetic Acid (25 ppm), T6 - Naphthalene Acetic Acid (25 ppm), T7 – Indole Acetic Acid (25 ppm), T8 - Indole Acetic Acid (50 ppm), T9 - Ethrel (150 ppm), T10 - Ethrel (300 ppm), T11- Maleic hydrazide (50 ppm), T12 - Maleic hydrazide (100 ppm), T13- Salicylic Acid (100 ppm), T14 - Salicylic Acid (200 ppm), T15 - Control (Only water spray). To find out feasibility of increment in growth of sweet potato by means of application of growth regulators on the till date most accepted variety of sweet potato, Sree Bhadra by the growers in the state of Jharkhand. Among the fifteen treatments used GA_3 at 100 ppm was found to record maximum yield parameters in cultivation of sweet potato.

Keywords: Sweet potato, *Ipomoea batatas* L., PGR, Yield parameters

1. Introduction
Sweet potato (*Ipomoea batatas* L.*)* is an important member of the family Convolvulaceae and has been originated in America (Mexico, Central America) and the North Western part of South America. It is an important starchy food crop grown throughout the tropical and sub-tropical countries. It is a warm-season crop and grows best in abundant sunshine, temperatures above 24 °C, sandy loam soil and a well-distributed rainfall of 850-900 mm per annum. It is a nutritive vegetable crop and serves as an excellent source of carbohydrates, vitamin A, calcium, and phosphorus. The plant is a herbaceous perennial vine, bearing alternate heart-shaped or palmately lobed leaves and medium-size sympetalous flowers. The edible tuberous root is long and tapered, with a smooth skin with colour range between yellow, orange, red, brown etc. The main growing states of sweet potato are Bihar, Orissa, Uttar Pradesh, Madhya Pradesh, Maharashtra and Karnataka. Jharkhand is the 7th largest producer of sweet potato.. The increasing demand for sweet potato both for consumption and medicinal purposes increased the need for breeding new cultivars of sweet potato with a high yield and quality for a specific production. Growth and yield of plants are greatly influenced by a wide range of factors, among which plant growth regulators are one. The plant growth substances are organic compounds, other than nutrients which in small concentration influence the physiological processes of plants. Foliar application of growth regulators is reported to improve growth, early flowering, increased flowering and tuber yield. Growth regulators are also reported to improve yield of many horticultural crops those in which the underground part is economically important. Though, agronomical practices for sweet potato has been standardized and there is always demand for enhancing its growth from the growers. Hence, the present investigation has been formulated to find out feasibility of increment in yield of sweet potato by means of applications of growth regulators in the date most accepted variety of sweet potato, Sree Bhadra by the growers in the state of Jharkhand Hence, present study was undertaken with the objectives to evaluate growth and yield of sweet potato with application of different

bioregulators in the context of growth and growth behaviour, yield and yield attributes and economics involved.

Materials and methods

The present investigation "Effect of Bioregulators on growth of Sweet potato (*Ipomoea batatas* L.) was conducted in the experimental site of AICRP on tuber crops under the department of Horticulture, Faculty of Agriculture, Birsa Agricultural University, Kanke, Ranchi during the *Kharif* season of 2016. There were fifteen treatments used namelyT_1-Triacontanol (250 ppm), T_2-Triacontanol (500 ppm), T_3-Gibberellic Acid (50 ppm), T_4 - Gibberellic Acid (100 ppm), T_5 - Naphthalene Acetic Acid (25 ppm), T_6 - Naphthalene Acetic Acid (25 ppm), T_7 – Indole Acetic Acid (25 ppm),T_8 - Indole Acetic Acid (50 ppm), T_9 - Ethrel (150 ppm), T_{10} - Ethrel (300 ppm), T_{11}- Maleic hydrazide (50 ppm), T12 - Maleic hydrazide (100 ppm), T_{13}- Salicylic Acid (100 ppm), T14 - Salicylic Acid (200 ppm), T_{15} - Control (Only water spray) which was carried out in randomised block design with three replications.

Result and discussion

The data presented in table 1 shows that maximum tuber length and breadth of sweet potato was observed in T_4 [GA_3 (100 ppm)] (14.27 cm and 2.95 cm) followed by treatment T_3 [GA_3 (50 ppm)] (12.80 cm and 2.68 cm) in comparison to other treatments including control (only water spray). The increase in length & breadth of tuber might be due to increase in meristematic activity of the apical tissue on GA_3 application. Also GA_3 was involved in increasing photosynthetic activity, efficient translocation and utilization of photosynthates causing rapid cell division, cell elongation and cell differentiation at growing region of the plant leaves leading to stimulation of growth. Similar findings were observed by Kumar *et al.*(2011), Sitapara *et al.*(2011), Rohamare *et al.*(2013), Chaudhary *et al.* (2013), Thapa *et al.*(2014), Chaurasiya *et al.*(2014), Netam and Sharma (2014) and Kumar *et al.*(2014).

The data presented in table 2 shows that maximum girth of tuber and average number of tuber per plant were observed in T_4 [GA_3 (100 ppm)] (9.27 cm & 5.87 respectively) followed by treatment T_3 [GA_3 (50 ppm)] (8.42 cm & 4.98) in comparison to other treatments including control (only water spray).The possible reason for Increased in the Girth of tuber is due to crucial role of GA_3 in cell enlargement and cell division, increase in the intercellular space in peripheral cells of the tuber and higher translocation of photo-assimilates & mineral nutrients from vegetative parts towards the developing tube that are extremely active metabolic sink. The results were similar to the trend found by Chowdhury *et al.* (2009) and Thapa *et al.* (2014). The increase in number of tuber might be due to enhanced photosynthetic activities and efficiency and rapid metabolic processes thereby increase in photosynthates pool and energy which along with increased cell division and elongation processes resulted to force the plant to produce more number of branches. Similar findings with respect to number of branches were also reported by Singh (2010).

The data presented in table 3 shows that maximum yield/plant (kg) and yield/ha (tonnes) of sweet potato was observed in T_4 [GA_3 (100 ppm)] (0.325 kg and 27.10 tonnes) followed by treatment T_3 [GA_3 (50 ppm)] (0.321 kg and 26.76 tonnes) in comparison to other treatments including control (only water spray). The increase in the yield probably due to the stimulatory effect of the GA_3 which prolonged the stomatal openings and induces the large no. of reproductive sinks leading to the greater activity of RuBP enzyme resulting in higher photosynthetic rates with greater translocation and accumulation of metabolites in the sink. The results of yield of tubers are in consonance to that of Perveen *et al.* (2014), Thapa *et al.* (2014) and Khan *et al.* (2014).

Table 1: Effect of Bioregulators on Length & Breadth of tuber (cm) of sweet potato

Treatments	Length of tuber (cm)	Breadth of tuber (cm)
T_1-Triacontanol (250 ppm)	11.93	2.34
T_2-Triacontanol (500 ppm)	12.45	2.60
T_3- Gibberellic Acid (50 ppm)	12.80	2.68
T_4 - Gibberellic Acid (100 ppm)	14.27	2.95
T_5 - Naphthalene Acetic Acid (25 ppm)	11.68	2.30
T_6 - Naphthalene Acetic Acid (25 ppm)	12.16	2.45
T_7 – Indole Acetic Acid (25 ppm)	11.15	2.08
T_8 - Indole Acetic Acid (50 ppm)	10.93	2.04
T_9 - Ethrel (150 ppm)	10.77	1.97
T_{10} - Ethrel (300 ppm)	9.80	1.70
T_{11}- Maleic hydrazide (50 ppm)	10.24	1.76
T_{12} - Maleic hydrazide (100 ppm)	10.65	1.88
T_{13}- Salicylic Acid (100 ppm)	11.40	2.14
T_{14} - Salicylic Acid (200 ppm)	11.53	2.22
T_{15} - Control (Only water spray)	9.19	1.49
SEm ±	0.77	0.23
CD (5%)	2.23	0.47
CV (5%)	11.71	13.08

Table 2: Effect of Bioregulators on Girth of tuber (cm) & Average no. of tuber of sweet potato

Treatments	Girth of tuber (cm)	Average no. of tuber
T_1-Triacontanol (250 ppm)	7.35	4.13
T_2-Triacontanol (500 ppm)	8.17	4.60
T_3- Gibberellic Acid (50 ppm)	8.43	4.98
T_4 - Gibberellic Acid (100 ppm)	9.27	5.87
T_5 - Naphthalene Acetic Acid (25 ppm)	7.23	4.67
T_6 - Naphthalene Acetic Acid (25 ppm)	7.68	4.27
T_7 – Indole Acetic Acid (25 ppm)	6.53	4.25
T_8 - Indole Acetic Acid (50 ppm)	6.42	4.00
T_9 - Ethrel (150 ppm)	6.20	3.73
T_{10} - Ethrel (300 ppm)	5.35	3.27
T_{11}- Maleic hydrazide (50 ppm)	5.51	3.47
T_{12} - Maleic hydrazide (100 ppm)	5.91	3.60
T_{13}- Salicylic Acid (100 ppm)	6.71	4.40
T_{14} - Salicylic Acid (200 ppm)	6.97	4.50
T_{15} - Control (Only water spray)	4.67	2.87
SEm ±	0.51	0.31
CD (5%)	1.49	0.91
CV (5%)	13.06	13.01

Table 3: Effect of Bioregulators on Yield per plant (kg) & Yield per hectare (t) of sweet potato

Treatments	Yield /plant (kg)	Yield/ ha (tonnes)
T_1-Triacontanol (250 ppm)	0.252	21.01
T_2-Triacontanol (500 ppm)	0.31252	25.97
T_3- Gibberellic Acid (50 ppm)	0.321	26.76
T_4 - Gibberellic Acid (100 ppm)	0.325	27.10
T_5 - Naphthalene Acetic Acid (25 ppm)	0.248	20.67
T_6 - Naphthalene Acetic Acid (25 ppm)	0.301	25.11
T_7 – Indole Acetic Acid (25 ppm)	0.242	20.15
T_8 - Indole Acetic Acid (50 ppm)	0.240	19.98
T_9 - Ethrel (150 ppm)	0.236	19.64
T_{10} - Ethrel (300 ppm)	0.230	19.13
T_{11}- Maleic hydrazide (50 ppm)	0.232	19.30
T_{12} - Maleic hydrazide (100 ppm)	0.234	20.47
T_{13}- Salicylic Acid (100 ppm)	0.244	20.32
T_{14} - Salicylic Acid (200 ppm)	0.246	20.50
T_{15} - Control (Only water spray)	0.205	17.09
SEm ±	0.02	1.63
CD (5%)	0.06	4.72
CV (5%)	13.13	13.16

Conclusion

Thus, on the basis of results obtained in one year investigation (2016-17), it can be concluded that foliar spray of bio-regulators increase the Yield and Yield attributes. The present investigation revealed that the effective concentration of undertaken bio-regulators can be used to improve the yield of sweet potato especially treatment with GA_3 @ 100 ppm & GA_3 @ 50 ppm. Considering these parameters, it is inferred that GA_3 at 100 ppm can be administered with a view for getting maximum net returns in cultivation of sweet potato.

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