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Studies on the varietal response to different plant growth regulators for root tuber yield and yield parameters of sweet potato (*Ipomoea batatas* L.) under agro-climate condition of Chhattisgarh plains

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Abstract

The present investigation entitled "Studies on response of Sweet Potato [*Ipomoea batatas* (L.) Lam.] varieties to different plant growth regulators for vegetative growth, tuber yield and quality characters under agro-climate condition of Chhattisgarh plains" was conducted in the Horticultural Research-cum-Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) in the summer season during the year 2017-18 and 2018-19. Pooled data of 2 years revealed that, V_1- Indira Nandini X P4- CCC-1000 ppm recorded significantly maximum root tuber yield parameters like number of root tubers per plant, root tuber girth (cm), root tuber yield per plant (g), root tuber yield / plot (kg), total root tuber yield (q/ha), number of marketable tuber per plot, number of unmarketable tuber per plot, weight of marketable tuber yield per plot (kg), weight of unmarketable tuber yield per plot (kg), dry weight of root tuber per plant (g), during both years (2018-19 and 2019-20) and on the basis of mean data.

Keywords: Sweet potato (*Ipomoea batatas* L.), varieties, Plant growth ragulators, yield and yield parameters

Introduction

Sweet potato is an important tuber crop grown in more than 100 countries as a source of starch, protein and carotene (Woolfe 1992) [32]. Among the root and tuber crops grown in the world, sweet potato ranks second after cassava.

Sweet potato [*Ipomoea batatas* (L.) Lam.] is locally known as *Shakarkand* which belong to the Morning glory family (convolvulaceae) with chromosome number of 2n (6x) = 90. It is herbaceous perennial vine cultivated as annual. It is an important starchy vegetable crop in tropics and sub tropics. It is mainly grown as one of the supplementary food crops to meet the requirements of carbohydrates and also to provide raw materials for manufacture 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) [12], minerals and trace elements compared to cereals. It would be a good substitute for rice and wheat (Thakur, 1975) [29]. It also contains considerable amount of beta-carotene (5.40 to 20.00 mg/100g) and sugar content.

Sweet potato tubers are consumed usually after boiling, baking and frying and may also be candied as 'Puree'. Tubers are utilized for canning, dehydration and flour manufacturing and also as an important source of starch, glucose, pectin and sugar hence used in syrup and industrial alcohol preparation. Sweet potato 'vine tips' are used as leafy vegetable in China, Japan and Korea (Dhankhar, 2001) [8].

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.

Recently, the response of plant growth regulators in increasing the growth and yield has been recognized in many vegetable crops (Muthoo *et al.* 1987, Singh and Yadav 1987, Singh *et al.* 1989, Singh *et al.* 1990) [17, 25, 28, 27].

Plant growth regulating substances have been reported to exert favourable effect on physiological and other biochemical activities of crop plants. The role of GA_3 in enhancing growth and productivity of crops have been established in many crops and it stimulates vegetative growth (Singh and Rajodia 2001 and Bora 2002) [26, 5], chlorophyll content (Chakrabortty 2001, and Khan *et al.* 2002) [6, 14] and sugar content (Babu 2000) [3]. Cycocel (CCC) a growth retardant interferes with many metabolic activities including yield (Shrivastava *et al.* 2001) [23]. Foliar application of growth regulators is reported to improve growth, tuber yield and quality of sweet potato (Seema Sarkar, 2008) [21]. Alar (B-995 or SADH) is another important growth retardant which retard the growth of plants. The inhibition of growth by alar application was reported by Devi (2002) [7] and Bora (2002) [5]. Yadav and Sreenath (1975) [35] reported that alar on foliar application to cowpea plant reduced plant height significantly, but increased the number of leaves and seed yield. Ethrel, releases ethylene inside the plant tissue, which has been widely used in controlling vegetative growth, flowering and yield of many crop plants. (Wickremasinghe *et al.* 1974, and Tiwari *et al.* 2003) [30]. With this background, "Studies on response of Sweet Potato [*Ipomoea batatas* (L.) Lam.] varieties to different plant growth regulators for vegetative growth, tuber yield and quality characters under agro-climate condition of Chhattisgarh plains" was conducted in the Horticultural Research-cum-Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) in the summer season during the year 2017-18 and 2018-19,

Materials and Methods

The present investigation entitled "Studies on response of Sweet Potato [*Ipomoea batatas* (L.) Lam.] varieties to different plant growth regulators for vegetative growth, tuber yield and quality characters under agro-climate condition of Chhattisgarh plains" was conducted in the Horticultural Research-cum-Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) in the summer season during the year 2017-18 and 2018-19.

There were twenty two treatments involved two varieties *i.e.* V_1- Indira Nandini, V_2- Indira Madhur, eleven Plant growth ragulators concentrations *viz.* P1- GA_3 -300 ppm, P_2 - GA_3 -500 ppm, P_3- CCC-500 ppm, P4 - CCC-1000 ppm, P5- 2,4-D-10 ppm, P_6 2,4-D-15 ppm, P7 - Etherel 100 ppm, P8- Etherel 250 ppm, P9- ALAR 500 ppm, P10- ALAR 1000 ppm, P11- Control, which was carried out in Factorial Randomized Block Design with three replications. The effect of several treatments on growth parameters was analyzed.

Results and Discussion

Yield parameters

The data on the yield parameters *i.e.* number of root tubers per plant, root tuber length (cm), root tuber girth (cm), root tuber yield per plant (g), root tuber yield / plot (kg), total root tuber yield (q/ha), number of marketable tuber per plot, number of unmarketable tuber per plot, weight of marketable tuber yield per plot (kg), weight of unmarketable tuber yield per plot (kg), dry weight of root tuber per plant (g) of sweet potato as influenced by varieties and plant growth regulators are furnished in Tables 1 to 4.

Number of root tubers per plant

The data on number of root tubers per plant of sweet potato as influenced by varieties and plant growth regulators are presented in Table 1.

Between varieties, V_1- Indira Nandini produced significantly maximum number of root tubers per plant (6.37, 6.18and 6.28 respectively). whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum number of root tubers per plant (7.50, 7.51 and 7.51 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3- CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data.

The maximum number of tubers per vine was recorded in CCC 500 ppm might be due to restricted vegetative growth resulted in diversion of photo assimilates for the production of more number of tubers per vine. These results were in accordance with the findings of Abdul Vahab and Mohan Kumaran (1980) [1] in sweet potato and found that CCC 500 ppm increased the number of tubers per vine.

Root tuber length (cm)

The data on root tuber length (cm) of sweet potato as influenced by varieties and plant growth regulators are presented in Table 1.

Between varieties, V_1- Indira Nandini produced significantly maximum root tuber length (cm) (19.42, 20.83 and 20.13 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P2- GA_3 -500 ppm produced significantly maximum root tuber length (cm) (23.00, 23.17and 23.09 cm respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P1- GA_3 -300 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P6- 2,4-D-15 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum root tuber length (cm) was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

The highest tuber length was recorded in GA3 might be due to marked increase in the vine length ultimately more photosynthesis, resulted in greater transfer of assimilates to sink and increased the length of tuber. The similar results were also reported by El-Tohamy *et al.* (2015) [9, 10] in sweet potato and they found that GA3 significantly increased the tuber length.

Root tuber girth (cm)

The data on root tuber girth (cm) of sweet potato as influenced by varieties, plant growth regulators are presented in Table 1. Between varieties, V_1- Indira Nandini produced significantly maximum root tuber girth (cm) (15.56, 17.03 and 16.30 respectively), whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum root tuber girth (cm) (19.33, 19.83and 19.58 cm respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3- CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9-ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum root tuber girth (cm) was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

The maximum tuber diameter was recorded in CCC 1000 ppm might be due to suppress vine growth by inhibition of the endogenous Gibberillic acid biosynthesis resulted increasing photo assimilates allocation to the tuber portion only. Our results are comparable with that of Abdul Vahab and Mohan Kumaran (1980) [1] in sweet potato and they found that CCC 500 and 1000 ppm increased tuber diameter.

Root tuber yield plant^{-1} (g)

The data on root tuber yield plant^{-1} (g) of sweet potato as influenced by varieties, plant growth regulators are presented in Table 2.

Between varieties, V_1- Indira Nandini produced significantly maximum root tuber yield plant^{-1} (g) (315.47, 317.62and 316.55 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum root tuber yield plant^{-1} (g) (334.44, 343.40 and 338.92 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3- CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9-ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum root tuber yield plant^{-1} (g) was recorded in treatment P11-Control in both years (2018-19 and 2019-20) and on the basis of mean data.

The suppressing vegetative growth by cycocel might have resulted in better utilization of nitrogen for the synthesis of carbohydrates and its effective translocation from source to sink resulted in more tuber yield. (Mishra *et al.* 1987) [16].

It is observed that, CCC 1000 ppm recorded maximum tuber yield per vine might be due to maximum diameter and more number of tubers per vine as compared to rest of the treatments. These findings are in consonance with the reports of Seema sarkar and Sarma (2008) [21] and shedge *et al.* (2008) [22] in sweet potato and they found that CCC 500 ppm recorded the highest tuber yield per vine.

Root tuber yield / plot (kg)

The data on root tuber yield / plot (kg) of sweet potato as influenced by varieties, plant growth regulators are presented in Table 2.

Between varieties, V_1- Indira Nandini produced significantly maximum root tuber yield / plot (kg) (7.87, 7.94 and 7.91 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum root tuber yield / plot (kg) (8.32, 8.59and 8.46 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3- CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9-ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum maximum root tuber yield / plot (kg) was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

The data enunciated on tuber yield per pot revealed that, CCC 1000 ppm recorded the highest value which was due to maximum tuber diameter, higher tuber yield per vine and better mean weight of tuber per vine as compare to rest of the treatments. Similar result was also observed by Shedge *et al.* (2008) [22] in sweet potato and stated that CCC 500 ppm recorded the highest tuber yield per plot.

Root tuber yield (q/ha)

The data on root tuber yield (q/ha) of sweet potato as influenced by varieties, plant growth regulators are presented in Table 2.

Between varieties, V_1- Indira Nandini produced significantly maximum root tuber yield (q/ha) (262.44, 264.68and 263.56 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum root tuber yield (q/ha) (277.45, 286.17 and 281.81 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3- CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9-ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum root tuber yield plant^{-1} (g) was recorded in treatment P11-Control in both years (2018-19 and 2019-20) and on the basis of mean data.

The highest yield might be due to positive influence on yield contributing characters like increased number of root tubers per plant, root tuber girth (cm), root tuber yield plant^{-1} (g), also helpful in increasing the yield. The results are in consonance with the findings of Mishra *et al*. (1987) [16] in sweet potato.

Number of marketable tuber per plot

The data on number of marketable tuber per plot of sweet potato as influenced by varieties, plant growth regulators are presented in Table 3.

Between varieties, V_1- Indira Nandini produced significantly maximum number of marketable tuber per plot (127.33, 123.62and 125.48 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum number of marketable tuber per plot (150.00, 150.11 and 150.06 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3-CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9- ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum number of marketable tuber per plot was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

The significant increase in tuber yield might be attributed due to the higher chlorophyll content, photosynthetic activity, increased assimilation and accumulation of photosynthates from source to sink by foliar application of CCC. These results are in conformity with the findings of Shedge *et al.* (2008) [22] in sweet potato, Baijal *et al.* (1983) [4], Sillu *et al.* (2012) [24] in potato, Padmavathi (1998) [18] in onion and Remison *et al.* (2002) [20] in cassava.

Number of unmarketable tuber per plot

The data on number of unmarketable tuber per plot of sweet potato as influenced by varieties, plant growth regulators are presented in Table 3.

Between varieties, V_1- Indira Nandini produced significantly maximum number of unmarketable tuber per plot (31.81, 30.91and 31.36 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum number of unmarketable tuber per plot (37.50, 37.53and 37.52 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3-CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9- ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum number of unmarketable tuber per plot was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

The number of unmarketable tubers might be due to development of uniform sized, uninfected and medium to large size tubers. The another probable reason might be attributed due to the higher chlorophyll content, photosynthetic activity, increased assimilation and accumulation of photosynthates from source to sink by foliar application of GA3 and CCC. These results are in conformity with the findings of Abdul and Kumaran (1980) [1], Shedge *et al.* (2008) [22] in sweet potato and Patel *et al.* (2010) [19] in onion.

Weight of marketable tuber yield / plot (kg)

The data on weight of marketable tuber yield / plot (kg) of sweet potato as influenced by varieties, plant growth regulators are presented in Table 3.

Between varieties, V_1- Indira Nandini produced significantly maximum weight of marketable tuber yield / plot (kg) (7.40, 7.41 and 7.40 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum weight of marketable tuber yield / plot (kg) (7.88, 7.99 and 7.84 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3-CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9- ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum weight of marketable tuber yield / plot (kg) was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

The increase in marketable tuber weight was due to uniform and uninfected tubers. The increase in weight of tuber and yield might be due to accumulation of carbohydrates owing to greater photosynthesis. CCC application manifests in increased yield of crops was reported by Indira *et al.* (1984) [13], Arora *et al.* (1985) [2] and Srivastava *et al.* (2001). These results are in conformity with the findings of Abdul and Kumaran (1980) [1], Shedge *et al.* (2008) [22], Tohamy *et al.* (2015) [9, 10] in sweet potato, Maurya and Lal (1987) [15] in carrot.

Weight of unmarketable tuber yield / plot (kg)

The data on weight of unmarketable tuber yield / plot (kg)of sweet potato as influenced by varieties, plant growth regulators are presented in Table 4.

Between varieties, V_1- Indira Nandini produced significantly maximum weight of unmarketable tuber yield / plot (kg) (0.517, 0.533 and 0.525 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum weight of unmarketable tuber yield / plot (kg) (0.612, 0.655 and 0.634 cm respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3-CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9- ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum weight of unmarketable tuber yield / plot (kg) was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

It might be due to development of some small irregular and over size tubers. These results are in conformity with the findings of Abdul and Kumaran (1980) [1], Shedge *et al.* (2008) [22] in sweet potato, Patel *et al.* (2010) [19] in onion.

Dry weight of root tuber plant-1 (g)

The data on dry weight of root tuber plant-1 (g) of sweet potato as influenced by varieties, plant growth regulators are presented in Table 4.

Between varieties, V_1- Indira Nandini produced significantly maximum dry weight of root tuber plant-1 (g) (90.52, 93.02 and 91.77 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum dry weight of root tuber plant-1 (g) (104.00, 106.50 and 105.25 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data.

However, it was *at par* treatment P3- CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9-ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum dry weight of root tuber plant-1 (g) was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

Dry matter percentage of tuber

The data on dry matter percentage of tuber of sweet potato as influenced by varieties, plant growth regulators are presented in Table 4.

Between varieties, V_1- Indira Nandini produced significantly maximum dry matter percentage of tuber (28.54, 29.13 and 28.84 respectively) whereas the minimum in V_2 - Indira Madhur in both years (2018-19 and 2019-20) and on the basis of mean data.

As regards to plant growth regulators, treatment P4- CCC-1000 ppm produced significantly maximum dry matter percentage of tuber (30.95, 30.84 and 30.90 respectively) in both years (2018-19 and 2019-20) and on the basis of mean data. However, it was *at par* treatment P3- CCC-500 ppm in both years (2018-19 and 2019-20) and on the basis of mean data. Further, it was *at par* to treatment P10- ALAR 1000 ppm, P9- ALAR 500 ppm plant growth regulators in both years (2018-19 and 2019-20) and on the basis of mean data. The minimum dry matter percentage of tuber was recorded in treatment P11- Control in both years (2018-19 and 2019-20) and on the basis of mean data.

It indicated that bioregulators have the capacity to alter source-sink relationship to a greater extent. Similar results were found by Remison *et al.* (2002) [20].

In general, growth regulators are better uptake and utilization of nutrients along with water which may in turn increase the dry matter of the root. These results obtained in the present study were in conforming with the findings of Baijal *et al.* (1983) [4] and Ashok *et al.* (2012) in potato, Remison *et al.* (2002) [20] in cassava, Seema sarkar (2008) [21] in sweet potato, Emongor (2007) in cowpea, Nawalagatti *et al.* (2009) in french bean and Lendve *et al.* (2010) in cabbage.

Table 1: Effect of varieties, plant growth regulators on number of root tubers plant^{-1}, root tuber length (cm), root tuber girth (cm) of sweet potato

Treatment		Number of root tubers plant^{-1}			Root tuber length (cm)			Root tuber girth (cm)		
		2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean
Varieties										
V_1	Indira Nandini	6.37	6.18	6.28	19.42	20.83	20.13	15.56	17.03	16.30
V_2	Indira Madhur	5.05	4.99	5.02	18.48	19.48	18.98	14.88	14.36	14.62
SE m±		0.10	0.05	0.08	0.27	0.22	0.25	0.31	0.24	0.28
CD (P=0.05)		0.29	0.15	0.22	0.76	0.63	0.70	0.88	0.69	0.79
Plant growth ragulators										
P1	GA_3 -300 ppm	5.17	4.93	5.05	21.40	22.17	21.79	13.50	15.17	14.34
P2	GA_3 -500 ppm	5.58	5.47	5.53	23.00	23.17	23.09	14.33	15.50	14.92
P3	CCC-500 ppm	7.19	7.13	7.16	18.92	20.33	19.63	18.33	17.50	17.92
P4	CCC-1000 ppm	7.50	7.51	7.51	17.92	19.87	18.90	19.33	19.83	19.58
P5	2,4-D-10 ppm	3.92	3.69	3.81	20.75	21.00	20.88	12.17	12.83	12.50
P6	2,4-D-15 ppm	4.50	4.29	4.40	21.08	21.58	21.33	13.08	14.50	13.79
P7	Etherel 100 ppm	5.85	5.70	5.78	16.50	17.83	17.17	15.33	16.00	15.67
P8	Etherel 250 ppm	6.27	5.97	6.12	17.33	19.50	18.42	15.58	16.45	16.02
P9	ALAR 500 ppm	6.58	6.63	6.61	18.50	20.00	19.25	16.33	16.67	16.50
P10	ALAR 1000 ppm	6.92	6.94	6.93	17.55	19.72	18.64	17.50	16.83	17.17
P11	Control	3.33	3.20	3.27	15.50	16.50	16.00	11.92	11.37	11.65
SE m±		0.24	0.12	0.18	0.63	0.52	0.58	0.72	0.57	0.65
CD (P=0.05)		0.67	0.36	0.52	1.79	1.48	1.64	2.06	1.62	1.84

Table 2: Effect of varieties, plant growth regulators on root tuber yield plant^{-1} (g), root tuber yield plot^{-1} (kg), root tuber yield (q/ha) of sweet potato

Treatment		Root tuber yield plant^{-1} (g)			Root tuber yield plot^{-1} (kg)			Root tuber yield (q/ha)		
		2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean
Varieties										
V_1	Indira Nandini	315.47	317.62	316.55	7.87	7.94	7.91	262.44	264.68	263.56
V_2	Indira Madhur	238.19	235.30	236.75	5.95	5.88	5.92	198.32	196.08	197.20
SE m±		1.53	1.55	1.54	0.04	0.06	0.05	0.08	0.07	0.08
CD (P=0.05)		4.41	4.43	4.42	0.11	0.17	0.14	0.24	0.21	0.23
Plant growth ragulators										
P1	GA_3 -300 ppm	249.97	248.67	249.32	6.25	6.22	6.24	208.30	207.22	207.76
P2	GA_3 -500 ppm	254.33	251.33	252.83	6.35	6.28	6.32	211.66	209.44	210.55
P3	CCC-500 ppm	328.93	330.67	329.80	8.22	8.27	8.25	273.83	275.55	274.69
P4	CCC-1000 ppm	334.44	343.40	338.92	8.32	8.59	8.46	277.45	286.17	281.81
P5	2,4-D-10 ppm	237.13	231.53	234.33	5.90	5.79	5.85	196.78	192.94	194.86
P6	2,4-D-15 ppm	239.10	245.47	242.29	5.98	6.14	6.06	199.25	204.55	201.90
P7	Etherel 100 ppm	271.83	265.40	268.62	6.77	6.64	6.71	225.69	221.17	223.43
P8	Etherel 250 ppm	295.27	292.33	293.80	7.38	7.31	7.35	246.05	243.61	244.83
P9	ALAR 500 ppm	313.20	315.33	314.27	7.83	7.88	7.86	261.00	262.78	261.89
P10	ALAR 1000 ppm	325.35	325.11	325.23	8.13	8.13	8.13	271.12	270.93	271.03
P11	Control	195.60	191.80	193.70	4.89	4.80	4.85	163.00	159.83	161.42
SE m±		3.62	3.64	3.63	0.09	0.14	0.12	0.20	0.17	0.19
CD (P=0.05)		10.35	10.38	10.37	0.25	0.41	0.33	0.56	0.50	0.53

Table 3: Effect of varieties, plant growth regulators on number of marketable tuber yield plot^{-1}, number of unmarketable tuber yield plot^{-1}, weight of marketable tuber yield plot^{-1} (kg) of sweet potato

Treatment		Number of marketable tuber plot^{-1}			Number of unmarketable tuber plot^{-1}			Weight of marketable tuber yield plot^{-1} (kg)		
		2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean
Varieties										
V_1	Indira Nandini	127.33	123.62	125.48	31.81	30.91	31.36	7.40	7.41	7.39
V_2	Indira Madhur	101.05	99.87	100.46	25.26	24.97	25.12	5.55	5.44	5.50
SE m±		0.07	0.08	0.08	0.10	0.19	0.15	0.06	0.07	0.07
CD (P=0.05)		0.21	0.23	0.22	0.30	0.53	0.42	0.17	0.21	0.19
Plant growth ragulators										
P1	GA_3 -300 ppm	103.33	98.56	100.95	25.72	24.64	25.18	5.67	5.59	5.63
P2	GA_3 -500 ppm	111.67	109.44	110.56	27.92	27.36	27.64	6.03	5.91	5.97
P3	CCC-500 ppm	143.80	142.53	143.17	35.95	35.63	35.79	7.77	7.77	7.77
P4	CCC-1000 ppm	150.00	150.11	150.06	37.50	37.53	37.52	7.88	7.98	7.84
P5	2,4-D-10 ppm	78.33	73.89	76.11	19.58	18.47	19.03	5.47	5.29	5.38
P6	2,4-D-15 ppm	90.00	85.89	87.95	22.50	21.47	21.99	5.56	5.61	5.59
P7	Etherel 100 ppm	117.00	114.07	115.54	29.25	28.52	28.89	6.30	6.16	6.23
P8	Etherel 250 ppm	125.33	119.33	122.33	31.33	29.83	30.58	6.94	6.88	6.91
P9	ALAR 500 ppm	131.67	132.56	132.12	32.92	33.14	33.03	7.43	7.46	7.45
P10	ALAR 1000 ppm	138.33	138.89	138.61	34.58	34.72	34.65	7.63	7.60	7.62
P11	Control	66.67	63.91	65.29	16.67	15.98	16.33	4.58	4.44	4.51
SE m±		0.17	0.19	0.18	0.24	0.44	0.34	0.14	0.17	0.16
CD (P=0.05)		0.50	0.55	0.53	0.69	1.24	0.97	0.39	0.48	0.44

Table 4: Effect of varieties, plant growth regulators on weight of unmarketable tuber yield plot^{-1} (kg), dry weight of root tuber plant^{-1} (g), dry matter percentage of tuber of sweet potato

Treatment		weight of unmarketable tuber yield plot^{-1} (kg)			dry weight of root tuber plant^{-1} (g)			Dry matter percentage of tuber		
		2018-19	2019-20	Mean	2018-19	2019-20	Mean	2018-19	2019-20	Mean
Varieties										
V_1	Indira Nandini	0.517	0.533	0.525	90.52	93.02	91.77	28.54	29.13	28.84
V_2	Indira Madhur	0.412	0.443	0.428	65.55	63.48	64.52	27.23	26.67	26.95
SE m±		0.01	0.01	0.01	0.08	0.02	0.05	0.08	0.09	0.09
CD (P=0.05)		0.03	0.04	0.04	0.22	0.05	0.14	0.24	0.26	0.25
Plant growth ragulators										
P1	GA_3 -300 ppm	0.575	0.599	0.587	68.00	68.50	68.25	27.12	27.40	27.26
P2	GA_3 -500 ppm	0.342	0.369	0.356	70.50	70.00	70.25	27.62	27.70	27.66
P3	CCC-500 ppm	0.466	0.486	0.476	98.00	98.00	98.00	29.75	29.54	29.65
P4	CCC-1000 ppm	0.612	0.655	0.634	104.00	106.50	105.25	30.95	30.84	30.90
P5	2,4-D-10 ppm	0.476	0.499	0.488	62.50	60.90	61.70	26.13	25.96	26.05
P6	2,4-D-15 ppm	0.478	0.499	0.489	64.00	66.25	65.13	26.63	26.71	26.67
P7	Etherel 100 ppm	0.456	0.480	0.468	75.00	75.00	75.00	27.54	28.14	27.84
P8	Etherel 250 ppm	0.423	0.435	0.429	82.33	82.33	82.33	27.80	27.96	27.88
P9	ALAR 500 ppm	0.427	0.455	0.441	88.50	89.50	89.00	28.23	28.26	28.25
P10	ALAR 1000 ppm	0.504	0.520	0.512	94.50	94.00	94.25	29.05	28.83	28.94
P11	Control	0.350	0.369	0.360	51.00	49.75	50.38	25.88	25.59	25.74
SE m±		0.03	0.03	0.03	0.18	0.04	0.11	0.20	0.22	0.21
CD (P=0.05)		0.08	0.10	0.09	0.51	0.12	0.32	0.56	0.62	0.59

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