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Effect of Varieties, Topping and Plant Growth Retardant on Qualitative characters of Sweet Potato (*Ipomoea batatas* L.) under Agro-climatic condition of Chhattisgarh Plains

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ABSTRACT: A Field Experiment was conducted at Horticulture Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur, during *rabi* 2018-2019 and 2019-2020 by adopting three important factor of crop production Varieties, Topping and Plant growth retardant levels, it seems necessary factors for achieving the higher yield and quality attributes of sweet potato. Sweet potato topping raises the yield and starch content of root tubers. Sweet potato is a vine crop hence it necessitates to strike the balance between vegetative and reproductive phase towards achieving higher root tuber yields. Which may be reduced through vine managed by topping at different stages of plant growth and by use of plant growth retardant. Out of 24 treatment combinations comprised of four level of varieties (Indira Madhur, Indira Nandani, Sree Rethna, Chhattisgarh Sarkarkand Priya), three levels of topping (Control, Topping 30cm from top at 60DAP, Topping 30cm from top at 80DAP) and two levels plant growth retardant (Control, foliar spray of cycocel 500ppm after 60 and 80 DAP). The result shown that V_4 –Chhattisgarh Sarkarkand Priya × T_1 *i.e* Topping 30cm from top at 60 DAP × P_1*i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP recorded significantly, higher qualitative characters like starch recovery in root tuber (%), Total soluble sugar, total sugar in root tuber (%) and protein in root tuber (%).

Keywords: Varieties, topping, plant growth retardant, Sweet potato, Quality.

INTRODUCTION

Sweet potato (*Ipomoea batatas* L.) is popularly known as sarkarkand it originated from Central America belong to family *convolvulaceae*. Approximately 900 different species of Convolvulaceae in 400 genera have been identified around the world. Yen (1974); Austin (1978, 1988) recognized 11 species in the section batatas, which includes sweet potato. The closest relative of the sweet potato appears to be *Ipomoea trifida* that is found wild in Mexico, and *Ipomoea tabascana.* It is hexaploid species with chromosome number 2n = 90. Sweet potato is a dicotyledonous plant with tubers derived from swollen roots. It is an important starchy food crop grown in the world's tropical and sub-tropical regions. It is a perennial herbaceous plant planted as an annual vine. Sweet potato, after rice, wheat, potato, maize and cassava, is the sixth most important food crop Worldwide. Among different vegetables; after cereals and grain legumes, tuber plant are the most important food crops. In tropical, subtropical and temperate areas, it serves as staple food for millions of individuals. These crops are known for their high calorific value and their ability to resist adverse soil and climatic conditions (Saravaiya and Patel 2005). The main feature of tuber crops is that these crops have high production per unit area per unit time and is expected to bridge the food shortages and malnutrition. They are tolerant to drought and can be grown even on undulated and unfertile soil. The crop has the additional advantage that due to rapid soil coverage and good rooting characteristics, it helps to reduce soil erosion. Thus, sweet potato is a particularly valuable crop for poorer farmers. The area under Sweet potato cultivation in India is 134.88 thousand ha with a production of 1638.8 thousand MT and productivity 12.2 MT ha respectively. Odisha is leading state with area 40.80 thousand ha and production 384.51 thousand tonne. It is an important tubers crop in tribal dominant Chhattisgarh state. The underground root as well as leaves of which are consumed as vegetable. The tubers and vine is used as feed for cattle. In Chhattisgarh state, Sweet potato is cultivated in an area 5.57 thousand ha

with production 200.03 thousand MT. Major growing belts in Chhattisgarh are Sarguja, Kondagaon, Balrampur, Korba, Raigarh, Kanker, Bilaspur and Kabirdham districts (Anon., 2017). Shoot pruning, particularly the quality and quantity of Sweet potato tubers, increases tuber formation. The timing of shoot pruning influences the growth of the plant, especially the Sweet potato. The vegetative organs will increase if shoot pruning occurs during the late vegetative phase, whereas if shoot pruning occurs during the late vegetative phase, the development of generative organs may accelerate, while it will be spread to the tubers. If the balance of vegetative and reproductive phases is established, photosynthate accumulation will also be balanced. The plants with medium vegetative growth have more tubers. Sweet potato topping raises the yield and starch content of root tubers (Villareal and Griggs 1982). To identify the best variety suited combination of topping treatments and growth retardant concentration for improving quality attributes.

MATERIALS AND METHODS

A Field Experiment was conducted at Horticulture Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur situated at latitude 21°16' N, 81°36' E and 289.56 m above mean sea level. The experiment was carried out during *rabi* seasons of 2018-19 and 2019-20. The soil is a predominantly light-textured Clay loam with a pH of 7.12.The organic matter content of the soil ranges between 0.49 to 0.60% at 0 to 20 cm soil depth. The experiment was laid out in Factorial Randomized Block Design with 24 treatment combinations which were replicated three times. The treatments included: four varieties (i) Indira Madhur (ii) Indira Nandani (iii) Sree Rethna (iv) Chhattisgarh Sarkark and Priya, 3 levels of topping (i) Control (No topping) (ii) Topping 30cm from top at 60DAP iii) Topping 30cm from top at 80DAP and 2 levels plant growth retardant treatments (i) Control (P_0), (ii) foliar spray of Cycocel 500ppm after 60 and 80 DAP (P_1). The treatments were randomly allotted in each replication in a total 72 plots of 2 m × 1.8 m size in each accommodating 30 plants. The cutting was planted at 20 cm distance on ridges spaced at 60 cm. The crop was applied @75:50:75 NPK kg/ha in the form of urea, single super phosphate and muriate of potash, respectively. Urea was applied in two split doses, first as basal and second after the 45 days of vine planting in main field as top dressing. Full dose of phosphorus and potassium along with FYM 10 t/ha were applied as basal dose. The vine was turned and lifted during the growth period of 45 and 75 days after planting to prevent rooting from nodes.

RESULTS AND DISCUSSION

Starch recovery in root tubers (%). The data starch recovery in root tubers (%) as influenced by varieties, topping and plant growth retardant are presented in Table 1. The variety Chhattisgarh Sarkarkand Priya (V_4) showed maximum starch recovery of root tuber (7.79 %) followed by V_3- Sree Rethna (7.49 %). Among topping, treatments during the investigation significant maximum starch recovery percent was recorded in T_1 *i.e* topping at 60 DAP (6.99 %) which was found statistically *at par* with treatment T_0*i.e* control. The minimum starch recovery percent was noticed in T_2 *i.e* topping at 80 DAP (6.50 %). These results are supported by the findings of earlier workers reported that topping of sweet potato increased starch content of the roots because it minimized the competition between shoots and roots in drawing photosynthates (Griggs and Villareal 1982). The results indicated that P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP significantly maximum starch recovery of root tuber was recorded (7.26 %). The minimum starch recovery of root tuber was noticed in P_0 *i.e* control (6.20 %). The interactions among varieties, topping and growth retardant treatment showed non-significant impact on starch recovery of root tuber are presented in Table 2. The interactions between $V_4T_1P_1$ *i.e* when topping at 60 DAP and cycocel 500ppm as foliar spray at 60 and 80 DAP produced maximum starch recovery (9.05 %) followed by V_4 T_0 P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP (8.83 %) among different treatment combination. The significant improvement in starch recovery of root tuber under different treatment combinations were noticed over control treatment *i.e.* when no topping and cycocel 500ppm was applied at 60 and 80 DAP foliar spray was done.

Total soluble solids (^{o}Brix). The data on Total soluble solids in tubers as influenced by varieties, topping and plant growth retardant are presented in Table 1.The variety Chhattisgarh Sarkarkand Priya (V_4) showed maximum total soluble solids (12.04 Brix^o) followed by Indira Madhur (V_1) (10.17 Brix^o). However minimum total soluble solids was noticed in Sree Rethna (V_3) (8.96 Brix^0). The higher total soluble solids due to varietal characteristic. Among topping, treatments during the investigation significant maximum total soluble solids in root tuber was recorded in T_2 *i.e* topping at 80 DAP (10.66 Brix^o) followed by T_1 *i.e* topping at 60 DAP. The minimum total soluble solids in root tuber was noticed in T_0 *i.e* control. The results indicated that P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP significantly maximum total soluble solids in root tuber was recorded (10.54 Brix^o). The minimum total soluble solids in root tuber was noticed in P_0 *i.e* control (9.95Brix^o). The interaction between varieties, topping and growth retardant treatments exhibited significant impact on total soluble solids in root tuber are presented in Table 2. The data indicated that maximum values of total soluble solids in root tuber in V_4 –Chhattisgarh Sarkarkand Priya in combination with different topping and plant growth retardant treatments over rest of the counter parts. The interactions between $V_4T_0P_1$ *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP recorded higher total soluble solids in root tuber (12.89Brix^o) which was found statistically *at par* with treatment of same variety. The minimum total soluble solids in root tuber was recorded in V_3 T_0 P_0 *i.e* control (8.64 Brix^o). The higher total soluble solids due to varietal characteristic.

Similar results are recorded that total soluble solids in root tuber of sweet potato by Slosar *et al*. (2019).

Moisture content (%). The data on moisture content (%) in tubers as influenced by varieties, topping and plant growth retardant are presented in Table 1. The variety Indira Nandani (V_2) showed maximum moisture content (78.54%) followed by Indira Madhur (V_1) (70.67%). However minimum moisture content was noticed in Chhattisgarh Sarkarkand Priya (V_4) (64.65%). Among Topping, treatments T_1 *i.e* topping at 60 DAP obtained higher moisture content in root tuber (72.09 %) in comparison to rest of the treatments and while the lower moisture content was noted under treatment T_2 *i.e* topping at 80 DAP (69.11 %). As regards, plant growth retardant, perusal of data indicated that treatment P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP recorded significantly maximum moisture content of root tuber (72.89%) as compare to control treatment (P_0). The interactions among varieties, topping and growth retardant treatments exhibited non-significant impact on moisture content during are presented in Table 2. The interactions of data between $V_2T_0P_1$ *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP produced maximum moisture content (86.21 %) followed by V_2T_1 P_1 *i.e* when topping at 60 DAP and Cycocel 500ppm as foliar spray at 60 and 80 DAP among different treatments. Similar results are recorded that moisture content in the Sweet potato varieties by Rose and Vasanthakaalam (2011); Kamal *et al*. (2013).

Protein in root tubers (%). The data protein in root tubers (%) as influenced by varieties, topping and plant growth retardant are presented in Table 1. The variety Chhattisgarh Sarkarkand Priya (V_4) showed maximum of protein content in root tubers (3.95 %) followed by Indira Madhur (V_1) (3.47%). However protein content in root tuber was noticed in Indira Nandini (V_2) (2.68 %). Among topping, treatments during the investigation significant maximum protein content was recorded in T_1*i.e* topping at 60 DAP (3.45 %) followed by T_0 *i.e* control. The minimum protein content was noticed in T_2*i.e* topping at 80 DAP (3.05 %). As regards, plant growth retardant, perusal of data indicated that treatment P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP recorded significantly maximum protein content in root tuber (3.52 %) as compare to control treatment (P_0). The interaction between varieties, topping and growth retardant treatments exhibited non-significant impact on protein content in root tuber are presented in Table 2. The data indicated that maximum values of protein content in root tubers in V_4 – Chhattisgarh Sarkarkand Priya in combination with different topping and plant growth retardant treatments over rest of the combinations. The interaction among $V_4T_0P_1$*i.e* when cycocel 500ppm was applied at 60 and 80 DAP as foliar spray (4.67 %) followed by V_4 T_1 P_1 *i.e* when topping at 60 DAP and cycocel 500ppm as foliar spray at 60 and 80 DAP. The minimum protein content in root tubers was recorded in V_2 T_0 P_0 *i.e* when no topping and without cycocel 500ppm as foliar spray at 60 and 80 DAP. The increment in protein content due to plant growth retardant. Similar results are observed by Rodrigues *et al*. (2016); Samy *et al.* (2014); Kamal *et al*. (2013).

Vitamin 'C' in root tuber (mg/100 g). The data vitamin 'C' in root tuber as influenced by varieties, topping and plant growth retardant are presented in Table 1. The variety Sree Rethna (V_3) showed maximum of vitamin 'C' content in root tubers (26.49 mg 100 g^{-1}) followed by Indira Nandani (V_2) (18.00 mg 100 g^{-1}). However minimum value of vitamin 'C' content in root tubers was noticed in Chhattisgarh Sarkarkand Priya (V_4) (11.23 mg 100 g^{-1}) .Topping among, T_0 *i.e* control (No topping) obtained higher vitamin 'C' content in root tuber (.43 mg 100 g^{-1}) followed by T_2 *i.e* topping at 80 DAP while the lower vitamin 'C' content in root tuber was noted under treatment T_1*i.e* topping at 60 DAP (17.88mg 100 g^{-1}). As regards, plant growth retardant, perusal of data indicated that treatment P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP recorded significantly maximum vitamin 'C' content in root tuber (18.59mg 100 g^{-1}) as compare to control treatment (P_0). The interactions among varieties, topping and growth retardant treatments exhibited non-significant impact on vitamin 'C' content are presented in Table 2. The interactions between V_3T_0 P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP produced maximum vitamin 'C' content (28.32mg 100 g^{-1}) followed by V_3T_1 P_1 *i.e* when topping at 60 DAP and cycocel 500ppm as foliar spray at 60 and 80 DAP among different treatments. The significant improvement in ascorbic acid content due varieties, topping and plant growth retardant may be attributed to combine effect of treatments. Similar observation was documented by Mitra (2012); Yildirim *et al.* (2011).

Total sugar content in root tuber (%). The data on total sugar content in root tuber as influenced by varieties, topping and plant growth retardant treatments are presented in Table 1. The variety Chhattisgarh Sarkarkand Priya (V_4) showed maximum of total sugar content in root tuber (4.97 %) followed by Indira Madhur (V_1) (3.47%). However protein content in root tuber was noticed in Indira Nandini (V_2) (2.68 %). Among topping, treatments during the investigation significant maximum total sugar content was recorded in T_1 *i.e* topping at 60 DAP (4.24 %) followed by T_2 *i.e* topping at 80 DAP. The minimum total sugar content was noticed in T_0 *i.e* control (No topping) (3.49 %). As regards, plant growth retardant, perusal of data indicated that treatment P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP recorded Significantly maximum sugar content in root tuber (4.18 %) as compare to control treatment (P_0). The interaction between varieties, topping and growth retardant treatments exhibited non-significant impact on protein content in root tuber are presented in Table 2. The data indicated that maximum values of protein content in root tubersin V_4 – Chhattisgarh Sarkarkand Priya in combination with different topping and plant growth retardant treatments over rest of the combinations. The interaction among V_4T_0 P_1 *i.e* when cycocel 500ppm was applied at 60 and 80 DAP as foliar spray (4.67 %) followed by V_4 T_1 P_1 *i.e* when topping at 60 DAP and

cycocel 500ppm as foliar spray at 60 and 80 DAP. The minimum protein content in root tubers was recorded in V_2 T_0 P_0 *i.e* when no topping and without cycocel 500ppm as foliar spray at 60 and 80 DAP. The improvement in total sugar content may be due to combine effect of varieties, topping and plant growth retardant treatments. Similar results are obtained by Lai *et al*. (2014); Kamal *et al*. (2013); Rose and Vasanthakaalam (2011); Suraji *et al.* (2013).

Table 1: Effect of varieties, topping and plant growth retardant on quality characters of sweet potato.

Treatments		Starch recovery of root tuber (%)	Total soluble solids (%)	Moisture content (%)	Vitamin 'C' content in root tuber (mg/100 g)	Protein content in root tuber (%)	Total sugar %
	Varieties						
V_1	**Indira Madhur**	5.59	10.17	70.67	17.01	3.47	4.47
V_2	**Indira Nandani**	6.05	9.82	78.54	18.00	2.68	2.57
V_3	**Sree Rethna**	7.49	8.96	66.65	26.49	2.80	3.05
V_4	**Chhattisgarh Sarkarkand Priya**	7.79	12.04	64.65	11.23	3.95	4.97
SE m±		0.07	0.15	1.13	0.20	0.07	0.07
CD (P=0.05)		0.19	0.43	3.22	0.56	0.21	0.20
Topping							
T_0	**Control**	6.17	9.84	69.18	18.43	3.18	3.49
T_1	**60 days**	6.99	10.24	72.09	17.81	3.45	4.24
T_2	**80 days**	6.50	10.66	69.11	18.28	3.05	3.57
SE m±		0.06	0.13	0.98	0.20	0.06	0.06
CD (P=0.05)		0.16	0.37	NS	NS	0.18	0.17
PGR (CCC)							
P_0	**Control**	6.20	9.95	67.36	17.77	2.93	3.35
P_1	**500ppm**	7.26	10.54	72.89	18.59	3.52	4.18
SE m±		0.05	0.11	0.80	0.14	0.05	0.05
CD (P=0.05)		0.13	0.30	2.28	0.40	0.15	0.14

Varieties- V_1-Indira Madhur, V_2-Indira Nandani, V_3-Sree Rethna, V_4-Chhattisgarh Sarkarkand Priya, T_0-No topping (control), T_1-topping at 60 DAP,T_2-topping at 80 DAP, P_0-control, P_1-whencycocel 500ppm was applied at 60 and 80 DAP as foliar spray, DAP- Days after planting

Table 2: Interaction effect of varieties, topping and plant growth retardant on qualitative characters of sweet potato.

Treatment	Starch recovery of root tuber (%)	Total soluble solids (%)	Moisture content (%)	Vitamin 'C' content in root tuber (mg/100 g)	Protein content in root tuber (%)	Total sugar %
$V_1T_0P_0$	5.21	9.48	68.53	16.81	2.84	3.55
$V_1T_0P_1$	5.83	10.00	69.83	17.65	4.37	5.04
V_1T_1P0	5.48	9.67	68.62	16.66	3.03	4.21
$V_1T_1P_1$	6.00	9.97	79.22	17.08	4.48	5.49
$V_1T_2P_0$	5.35	9.76	68.57	16.82	2.98	4.00
$V_1T_2P_1$	5.66	10.07	69.23	17.07	3.12	4.51
$V_2T_0P_0$	5.61	9.42	68.90	17.98	2.58	2.08
$V_2T_0P_1$	6.52	9.69	86.21	17.79	2.69	2.34
$V_2T_1P_0$	5.96	9.66	78.68	17.03	2.78	3.27
$V_2T_1P_1$	6.39	9.87	85.18	18.56	2.79	3.37
$V_2T_2P_0$	5.79	9.61	69.52	17.89	2.61	2.12
$V_2T_2P_1$	6.07	9.67	82.74	18.76	2.66	2.27
$V_3T_0P_0$	6.29	8.64	61.72	25.83	2.65	2.19
$V_3T_0P_1$	8.60	8.94	68.41	28.32	2.73	3.23
$V_3T_1P_0$	6.93	8.79	67.10	25.80	2.89	3.34
$V_3T_1P_1$	8.78	8.94	68.24	25.61	3.01	3.65
$V_3T_2P_0$	6.82	8.77	66.46	26.30	2.71	2.44
$V_3T_2P_1$	7.53	8.86	67.99	27.07	2.83	3.43
$V_4T_0P_0$	6.77	12.50	62.79	10.47	2.91	3.71
$V_4T_0P_1$	8.83	12.89	67.06	12.58	4.67	5.78
$V_4T_1P_0$	7.30	12.68	64.06	10.98	4.11	4.91
$V_4T_1P_1$	9.05	12.79	65.62	11.33	4.54	5.66
$V_4T_2P_0$	6.88	12.54	63.36	10.70	3.08	4.41
$V_4T_2P_1$	7.91	12.75	65.01	11.30	4.41	5.37
SEM±	0.16	0.38	2.77	0.48	0.18	0.17
CD	NS	1.05	NS	NS	NS	NS

Raising of vine in each plots

Topping Treatment

Tubers of four varieties

CONCLUSION

The qualitative characters produced significantly higher value in Variety V_4 –Chhattisgarh Sarkarkand Priya. In consideration of topping the highest values was recorded from T_1 *i.e* topping at 60 DAP treatment. In consideration of plant growth retardant treatment, P_1*i.e* foliar spray of cycocel 500ppm at 60 and 80 DAP obtained the highest. In consideration of interaction effect of V_4 –Chhattisgarh Sarkarkand Priya X T_1 *i.e* topping at 60 DAP X P_1 *i.e* cycocel 500ppm as foliar spray at 60 and 80 DAP obtained the highest values and gave significant influence on quality characters like, starch recovery in root tuber (%), Total soluble sugar, total sugar in root tuber (%) and protein in root tuber (%). The experiment may be conducted in different agro-climatic zones of Chhattisgarh state. Some other growth regulators along with their combinations may be utilized in future studies.

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