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The Growth, yield and quality of sweet potato (*Ipomoea batatas* Lam.) Influenced by different plant densities

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Abstract
An investigation was carried out at the Horticulture Farm of Sri Karan Narendra Agricultural University, Jobner (Jaipur) during the period from August 2015 to Feburary 2016 to determine the growth, yield and quality of sweet potato as influenced by different spacings. The study was conducted in randomized block design with four spacings *viz*. 30 cm x 30 cm (S_1), 45 cm x 30 cm (S_2), 60 cm x 30 cm (S_3) and 75 cm x 30 cm (S_4).Vine length, leaf area, chlorophyll content in leaves, tuber weight, tuber length, tuber diameter, tuber yield (kg/plot), tuber yield (q/ha), NPK content, starch, protein, TSS and ascorbic acid content were significantly differed at different spacing levels. The maximum vine length (170.1cm), tuber weight (356.61g), tuber length (15.25cm), tuber diameter (9.07 cm), tuber yield (13.31kg/plot), tuber yield (246.54q/ha), NPK content (0.352%, 0.311% and 0.641%, respectively), starch (13.30%), protein (2.20%) and ascorbic acid content (44.00mg/100g) were found in S_4 spacing level.

Keywords: sweet potato, growth, tuber yield, tuber quality, spacing

1. Introduction
Sweet potato (*Ipomoea batatas* Lam.) belongs to the family Convolvulaceae and historically played an important role in the quest for food and the struggle for human survival in several countries. It is popularly known as "*Sakar Kand*" in India. It originated in Central America and spread to other parts of the world. Sweet potato 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 matures in of 3-9 months duration or longer depending on the variety (CIP, 2003) [4]. In India, sweet potato occupying an area over 106 hectares with production of 1088 million tonnes. Sweet potato is widely cultivated throughout India except Jammu and Kashmir. The main growing states of sweet potato are Bihar, Orissa, Uttar Pradesh, Madhya Pradesh, Maharashtra and Karnataka. In state like Rajasthan it is occupying an area over 643 hectares with production of 1979 tonnes and productivity are 3038 kg per hectare (Anonymous, 2014) [1].

Sweet potato is a very nutritive vegetable, producing substantially high edible energy per hectare per day as compared to rice, wheat, maize and cassava. It contains starch (12.7 g), sugar (4.2 g), vitamin A (709 µg) and protein (1.6 g) per 100 g of edible part

Among the various cultural practices, proper spacing and application of different doses (USDA, 2009) [22]. It is widely used as boiled and fried vegetable for canning, dehydration and flour manufacture.

In spite of its importance as food and vegetable, very little attention has been paid for improvement in cultural practices. Sweet potato is the chief source of starch and alcohol and contains 10 per cent starch and 3-6 per cent sugar. Tubers are good source of vitamin A, B, C and minerals like phosphorus, iron and calcium. Yellow and orange flesh varieties have more of carotene content (Choudhary, 2014) [3].

Plant population is one of the most important factors contributing to high yield of sweet potato (Sarkar, 1985) [17]. Optimum plant population is also another important aspect of crop production, wider plant spacing not only leads to excessive vegetative growth but also accelerates the evaporative losses of water from the bare ground. On the other hand, the struggle for existence increase with increasing plant population because of severe competition for light, water and nutrients (Sharma, 1990) [18].

The spacing of crop may be varied according to climatic condition, soil fertility and cultivars adaptation to particular region. Under the wider spacing, the plant was more vigorous in terms of leaf size, which might be due to less competition for light, nutrients and moisture as compared to closer spacing (Rai *et al*., 2003) [15]. of fertilizer at appropriate time are of great importance especially for semi-arid conditions of Rajasthan keeping adequate plant population per unit area.

Materials and methods

The field experiment was conducted at Horticulture Farm, S.K.N. College of Agriculture (S.K.N. Agriculture University) Jobner, District Jaipur during *kharif* season of 2015. The experiment area is situated at 26° 05' North latitude and 75° 28' East longitude at an elevation of 427 metres above mean sea level, in Jaipur district of Rajasthan. This region falls under agroclimatic zone III-A (Semi-Arid Eastern Plain Zone) of the state. The climate of this region is typically semi-arid, characterized by extremes of temperatures during both summer and winter. During summer, the temperature may go as high as 48℃ while in winters, it may be fall and down as low as -1℃. The average annual rainfall of this tract ranges between 300- 400 mm. The soil was sandy loam with a pH value 8.1. Soil samples were collected randomly from a depth up to 0 - 15 cm of the experimental plot and analyses were done and showed nitrogen 132.75 kg ha^{-1}, phosphorus 17.84 kg ha^{-1}, potassium 161.50 kg ha^{-1} soil and organic carbon 0.13%.Four different spacing levels were used denoted as S_1, S_2, S_3 and S_4.

S_1 = 30 cm x 30 cm
S_2 = 45 cm x 30 cm
S_3 = 60 cm x 30 cm
S_4 = 75 cm x 30 cm

The experiment was laid out in Randomized Block Design (RBD) with three replications. The whole experimental area was 24.5 m x 19.9 m, which was divided into three blocks. Each block was again divided into 20 plots and hence there were 60 (20 × 3) unit plots. The treatments were assigned randomly in each block separately. The size of unit plot was 2.40 m × 2.25 m. The distance between two adjacent blocks and plots were 1.0 m and 0.5 m. Land preparation, manuring and intercultural operations were done properly. Five plants in each plots were used for taking observation. Yield and quality parameters were recorded after harvesting and growth parameters like leaf area and chlorophyll content recorded 45 and 50 days after sowing, respectively.

Result and discussion

Table 1.1: Effect of spacing on vine length at harvest average, leaf area at 45 DAP and total chlorophyll content of sweet potato

Treatments	Vine length (cm)	Leaf area (cm^2)	Total chlorophyll content (mg/g)
Spacing			
S_1	152.5	165.3	1.033
S_2	161.4	169.4	1.070
S_3	168.9	171.1	1.093
S_4	170.1	172.0	1.102
SEm±	2.3	3.9	0.028
CD (P=0.05)	6.7	NS	NS

Growth parameters

Four different spacings were statistically significant in respect of vine length of sweet potato. The vine length was varied significantly due to the variation of spacing. It ranged from 152.5 cm to 170.1 cm. The maximum vine length was observed from the spacing of 75 cm x 30 cm (S_4) while the minimum from the spacing of 30 cm x 30 cm (S_1). The vine under the treatment of S_4 (75 cm x 30 cm) had enough space for vegetative growth and had less nutritions competition compared to other vines sown under the treatment S_1 (30 cm x 30 cm), S_2 (45 cm x 30 cm) and S_3 (60 cm x 30 cm). This might be due to wider spacing helped the individual plant to utilize more water, nutrient, light and air. In closer spacing, the plant population per unit area was higher, which led to keen competition among the plants, resulting in poor growth. These results are in agreement with the results of Joshi (1987) [7], Sounda *et al*. (1989) [21], Kumar *et al*. (2012) [9] and Sharma *et al*. (2013) [19] in radish. However, leaf area and total chlorophyll content gave non – significant results.

Table 1.2: Effect of spacing on yield attributes of sweet potato

Treatments	Tuber length (cm)	Tuber weight (g)	Diameter of tuber (cm)	Tuber yield (kg/plot)	Tuber yield (q/ha)
Spacing					
S_1	11.61	173.80	5.61	6.45	119.45
S_2	13.51	291.15	7.11	10.81	200.21
S_3	14.71	347.11	8.79	12.88	238.48
S_4	15.25	356.61	9.07	13.31	246.54
SEm±	0.27	3.40	0.11	0.16	3.56
CD (P=0.05)	0.77	9.73	0.31	0.45	10.19

Yield parameters

The maximum length of tuber (15.25 cm) the similar results were observed by Rashid and Shakur (1986) [16] in carrot, weight of tuber (356.61 g) the similar results were observed by Sirkar *et al.* (1998) [20] in radish, maximum diameter of tuber (9.07 cm). The findings agreed with McCollum *et al*. (1986) in carrot. Tuber yield (13.31 kg/plot) and tuber yield (246.54 q/ha) were recorded under wider spacing S_4 (75 cm x 30 cm) which were significantly higher over closer spacing S_1, S_2 and S_3, respectively. A similar result was observed by Muck (1980) [12] in carrot. This could be due to the more land area available per plant. Widely spaced plant had less competition for nutrient uptake, water, light and air, which helped the plant to get more nutrient, water, light and air resulted in increasing yield parameters. This finding is in conformity with the result of Pervez *et al.* (2004) [13] in radish, Lavanya *et al.* (2012) [10] in radish and Ashraful kabir *et al*. (2014) in carrot.

Table 1.3: Effect of spacing on quality parameters of sweet potato

Treatments	TSS (%)	N content (%)	P content (%)	K content (%)	Starch content (%)	Protein content (%)	Ascorbic acid (mg/100g)
Spacing							
S_1	4.15	0.218	0.269	0.536	10.92	1.36	34.51
S_2	4.25	0.285	0.296	0.591	11.78	1.78	38.50
S_3	4.33	0.331	0.309	0.635	12.61	2.07	42.21
S_4	4.36	0.352	0.311	0.641	13.30	2.20	44.00
SEm±	0.10	0.007	0.004	0.015	0.24	0.04	0.70
CD (P=0.05)	NS	0.020	0.011	0.042	0.70	0.12	2.00

Quality parameters

The TSS (%) was not significantly changed due to spacing's. Similar results were observed by Sharma *et al*. (2013) [19] in radish. The maximum NPK content (0.352, 0.311 and 0.641%, respectively), starch content (13.30 %), protein content (2.20 %) and ascorbic acid content (44.00 mg/100g) were recorded under wider spacing S_4 (75 cm x 30 cm) Which were significantly higher over closer spacing S_1, S_2 and S_3, respectively. This enhancement might be due to better moisture holding capacity, supply of micro nutrients and availability of major nutrients in soil due to favourable conditions created by spacing. The wider spacing gave significantly superiority over other spacing's for all these quality parameters. The present results are in close conformity with the findings of Joshi and Patil (1992) [8], Gonge *et al.* (2003) [5], Preeti *et al.* (2009) [14], Grabowska *et al.* (2009) [6] and Lavanya *et al.* (2012) [10].

Conculsion

On the basis of the results obtained in present investigation, it may be concluded that the application of different plant spacing levels in best plant spacing is 75 cm × 30 cm enhanced the growth, yield and quality of sweet potato.

References

1. Anonymous. Indian Horticulture Database-2014. National Horticultural Board, Gurgaon, 2014.
2. Ashraful K, Arfan A, Waliullah MH, Men-Ur Rahman MM, Rashid A. Effect of spacing and sowing time on growth and yield of carrot (*Daucus carrota* L.). International Journal of Sustainable Agriculture, 2013; 5(1):29-36.
3. Choudhary BR. Vegetables. Kalyani publishers, 2014, 264-269.
4. CIP. (International Potato Center) Lima, Peru Sweet potato. Treasure for the poor in sweet potato main, 2003, 25.
5. Gonge VS, Bhole DT, Deshmukh DT, Warade AD, Kale VS. Effect of plant density and nitrogen levels on seed yield and quality of radish (*Raphanus sativus* L.) var. Pusa Chetki. Orrisa Journal of Horticulture, 2003; 31:82-84.
6. Grabowska A, Kunicki E, Libik A. The effects of different methods of cultivation and plant spacing on the chemical composition of broccoli heads. Folia Horticulturae, 2009; 21(2):25-34.
7. Joshi PC. Effect of plant density, nitrogen and phosphorus on the yield and quality of radish (*Raphanus sativus* L.). M.Sc. (Ag.) Thesis, Gujarat Agricultural University, Sardar Krushinagar, Dantiwada (GUJARAT) India, 1987.
8. Joshi PC, Patil NS. Note on effect of plant density, nitrogen and phosphorous on yield of radish. Indian Journal of Horticulture, 1992; 49(3):265-266.
9. Kumar M, Kumar S, Kumar P, Rathore SVS, Singh RN, Singh SK. Effect of steckling size and spacing on growth, yield and quality of radish seed cv. Pusa Rashmi. Progressive Agriculture. 2012; 12(1):194 -198.
10. Lavanya A, Vani VS, Reddy PSS, Sasikala K. Root yield and quality of radish as affected by sowing dates and spacing. Vegetable Science. 2012; 39(2):177-179.
11. McCollum TG, Locascio SJ, White JM. Plant density and row arrangement effects on carrot yields. Journal of American Society of Horticultural Sciences. 1986; 111(5):648-651.
12. Muck HJ. Effect of row spacing on processing carrot root yields. American Society of Horticultural Science, 1980; 15(2):144-145.
13. Pervez MA, Ayub CM, Saleem BA, Virk NA, Mahmood N. Effect of nitrogen levels and spacing on growth and yield of radish (*Raphanus sativus* L.). International Journal of Agriculture and Biology. 2004; 6(3):504-506.
14. Preeti S, Srivastava BK, Singh MP, Singh PK. Effect of date of planting and spacing on the performance of broccoli. Indian Journal of Horticulture, 2009; 66(1):137-140.
15. Rai N, Patel RK, Dongra R. Effect of various spacings and fertilizer combinations on growth and yield of knol-khol cv. White Vienna. Agricultural Sciences Digest, 2003; 23(1):41-43.
16. Rashid M, Shakur MA. Effect of date of planting and duration of growing period on the yield of carrot. Bangladesh Horticulture, 1986; 14(2):28-32.
17. Sarkar AK. Effect of plant density on yield of sweet potato. ARC Training, sweet potato, 1985, 1-4. http://www.arc-avrdc. org/ pdf_ files/Asit(3-N).pdf.
18. Sharma PC. Effect of seed rate, row spacing and growth regulators on the yield of methi (*Trigonella foenum-graecum* L.). M.Sc. (Ag.) Thesis submitted to RAU, Bikaner, Rajasthan, 1990.
19. Sharma UG, Vihol NJ, Chavda JC. Influence of plant density and nutrient management on growth, yield and quality of radish (*Raphanus sativus* L.) cv. Pusa Chetki. Asian Journal of Horticulture, 2013; 8(2):671-676.
20. Sirkar B, Saha A, Bose TK. Effect of plant density on growth and yield of radish. Journal of Interacade. 1998; 2(6):17-20.
21. Sounda G, Ghanti P, Ghatak S. Effect of levels of nitrogen and different spacing on vegetative growth and yield of radish. Environmental Science and Ecology. 1989; 7(1):178-180.
22. USDA. (U.S. Department of Agriculture). Agricultural Research Service USDA Nutrient Data Laboratory Home Page, 2009. http://www. ars. usda. gov/ba/blmrre/ndl, accessed 14 September 2012.