

Original Research Article

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Effect of Planting Dates and Plant Spacing on Growth and Yield Attributes of Sweet Potato [*Ipomoea batatas* (L.) Lam.] cv.CO-3-4

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ABSTRACT

An experiment was carried out to study the effect of planting dates and plant spacing on growth and yield attributes of sweet potato cv.CO-3-4 at Horticulture Farm, Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur during May, 2016 to November, 2016. The experiment was comprised of four levels of plant spacing on four different dates with Factorial Randomized Block Design. The results revealed that the vegetative growth and yield attributes are significantly influenced by various level of spacing. The minimum time taken for 50 % sprouting (11.58 days), maximum vine length (195.92 cm), leaves per vine (91.74), tuberous per plant (5.21), tuber length (18.86 cm), tuber diameter (9.73 cm) and yield per ha (29.97 t per ha) were recorded in wider spacing 40 x 40 cm (treatment P₄). The planting dates also influenced vegetative growth and yield parameter of sweet potato. The minimum time taken for 50 per cent sprouting (11.75), maximum vine length (184.58), leaves per vine (88.50), tuberous per plant (5.08), tuber length (17.39 cm), tuber diameter (8.85 cm) and yield (30.50 t ha⁻¹) were recorded in 10th June of planting (treatment S₃). The interaction of planting dates and plant spacing also significantly influenced on sweet potato. The minimum time taken for 50 per cent sprouting, maximum vine length (226.67 cm), leaves per vine (100.33), tubers per vine (6.33), tuber length (23.00 cm), tuber diameter (10.43 cm) and yield (34.37 t ha⁻¹) were recorded in treatment P₄S₃ (40 x 40 cm and 10th June).

Keywords

Sweet potato, Yield, Growth, Plant spacing, Planting dates

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Introduction

Sweet potato [*Ipomoea batatas* (L.) Lam.] belongs to the family Convolvulaceae and has chromosome number (2n = 90). It is originated from Central America and spread to other parts of the world. The main growing states are Bihar, Orissa, Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka and

Rajasthan. Sweet potato occupied an area of 790 hectares with production of 224 tonnes in Rajasthan (Saxena *et al.*, 12).

In Rajasthan sweet potato are mainly grown in Udaipur, Chittorgarh, Jhalawar, Sikar, Bhilwara, Jaipur and Nagour district. It is a perennial crop usually grown as an annual and a starchy staple food crop in tropical, sub-

tropical and frost-free temperate climatic zones of the world and historically played an important role in the quest for food and the struggle for human survival in several 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 3-4 months duration depending on the variety (Anonymous,3). It is a very nutritive vegetable, producing substantially high edible energy per hectare per day 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 (USDA, 2013). In spite of its importance as a food and vegetable, very little attention has been given on improved cultural practices *i.e.* planting dates and spacing. The yield of tuberous roots per plant increases with the increase in plant spacing (Onwueme, 10; Mannan, 9). Wider plant spacing not only leads to excessive vegetative growth but also accelerates evaporation loss of water from the bare ground. On the other hand, the struggle for existence increases with increasing plant population because of severe competition for light, water and nutrients at high plant population. The correct date of planting leads to high vegetative growth and yield of crop. It is therefore appear logical that a adequate spacing may probably leads to greater crop yield through rapid attainment of ground cover for better interception of solar radiation and hence an increases in photosynthetic ability of crop. Scanty research works are available on the spacing and planting dates in context of Rajasthan. Therefore, it is need to find out optimum time for higher yield.

Materials and Methods

The present study was conducted at Horticulture Farm, Department of Horticulture, Rajasthan College of

Agriculture, Maharana Pratap university of Agriculture and Technology, Udaipur during May, 2016 to November, 2016. The experiment was comprised of four levels of plant spacing viz., 30x20 cm (P₁), 30x30 cm (P₂), 40x30 cm (P₃) and 40 x 40 cm (P₄) with four different dates *i.e.* 20th May (S₁), 30th May (S₂), 10th June (S₃) and 20th June (S₄). The experiment was laid out in factorial randomized block design with three replications. Fertilizers were applied @ 50 kg N, 60 kg P₂O₅ and 50 kg K₂O along with 3 tonnes of farmyard manure per hectare to meet the nutritional requirement of crop. The soil of experimental plot was clay loam with pH 7.4, EC 0.54 dS/m, organic carbon 0.47 % and available N,P and K as 186.5, 26.5 and 252 kg/ha, respectively. The experiment site falls under agro-climatic Zone IV *a i.e.* "South-humid Southern Plain and Aravalli Hills" of Rajasthan at altitude of 582.17 meter above mean sea level, 24°35' latitude and 74°42' E longitude. The average rainfall of this tract ranges from 592.5 mm to 620 mm per year.

The observation on vegetative growth characteristics viz., time taken for 50 per cent sprouting, vine length and leaves per vine and yield parameters viz., number of tubers per vine, tuber length, tuber diameter and yield were recorded as standard methods and statistically analysed.

Results and Discussion

Effect of plant spacing on growth parameters

A perusal of data in Table 1 indicated that various level of plant spacing significantly affected the time taken for 50 % sprouting, vine length and leaves per vine of sweet potato. The widest plant spacing (40 x 40 cm) took minimum time for 50% sprouting (11.58 days), recorded maximum vine length (195.92

cm) and leaves per plant (91.74). Whereas, maximum time taken for 50 % sprouting (13.04), minimum vine length (135.33 cm) and minimum leaves per vine (76.00) were recorded in closer spacing in treatment P₁ (30 x 20 cm). It might be due to that at widest plant spacing have less competition both for nutrient and all other resource of environment then narrow spacing and hence instead of vertical growth horizontally and produced more vine length and leaves per plant. The production of more number of leaves per plant at the wider spacing might be attributed to the more efficient use of available growth resources like nutrients, water and light energy, that would favour more photosynthetic rate and accumulation of carbohydrate for all growing points as compared to the closest spacing.

The decrease in vine length in response to closer plant spacing might be ascribed to stiffer inter plant competition for growth factors such as soil moisture, nutrients and light etc. The present finding was also supported with Yadav *et al.*, (15), Mahender *et al.*, (8) and Woelore *et al.*, (14) in *Zingiber officinale*.

Effect of planting dates on growth parameters

The data presented in Table 1 revealed that planting dates influence significantly the time taken to 50 % sprouting, vine length and leaves per vine in sweet potato. The minimum time taken to 50 % sprouting (11.75 days), maximum vine length (184.52 cm) and leaves per plant (88.50) were recorded in 10th June planting of sweet potato (treatment S₃). Whereas, minimum vine length (159.50 cm) was recorded in treatment S₁ (20th May), leaves per vine (78.33) was recorded in treatment S₂ (30th May). The vine length and leaves per vine were gradually decreased with

the delay in planting dates (Islam *et al.*, 6 in garlic). The highest sprouting in low days might be due to congenial weather conditions, favourable soil temperature. The result is supported by Alloli, (2) in sweet potato and Yadav *et al.*, (15) in *Zingiber officinale*.

Interaction effect of planting dates and plant spacing on growth parameters

The data revealed (Table 1) that the interaction effect of planting dates and spacing with respect to minimum time taken for 50 % sprouting (9.50), maximum vine length (226.67 cm) and leaves per vine (100.33) were recorded in treatment combination P₄S₃ (40 x 40 cm and 10th June). Whereas, minimum vine length (116.67 cm) was recorded in treatment combination P₁S₁ (30 x 20 cm and 20th May), minimum leaves per vine (72.67) was observed in treatment combination P₁S₂ (30 x 20 cm and 30th May). The increase in growth parameter might be due to the temperature and relative humidity was favourable during June and widest spacing increased growth parameter due to less competition for water and nutrients between plants. These similar finding was given by Yadav *et al.* (15) *Zingiber officinale*.

Effect of plant spacing on yield parameters

The data presented in Table 2 revealed that maximum tubers per plant (5.21), tuber length (18.86 cm), tuber diameter (9.73 cm) and yield (29.97 t ha⁻¹) were recorded in treatment P₄ (40 x 40 cm) i.e. at wider spacing. While, minimum tubers per plant (3.36), tuber length (13.19 cm), tuber diameter (5.63 cm) and yield (22.74 t ha⁻¹) were recorded in treatment P₁ (30 x 20 cm) i.e. in closer spacing. This result is agreement with that of Beleha (4) reported that increasing plant population decreased the tuberos per plant in sweet potato.

Table.1 Effect of plant spacing, planting dates and their interaction on growth parameters of sweet potato

Treatments	Time taken for 50 % sprouting (days)	Vine length (cm)	Leaves /vine
Plant spacing			
P₁ (30 x 20 cm)	13.04	135.33	76.00
P₂ (30 x 30 cm)	12.71	168.67	79.16
P₃ (40 x 30 cm)	12.83	189.92	87.66
P₄ (40 x 40 cm)	11.58	195.92	91.74
SEm±	0.24	2.87	1.49
CD (p=0.05)	0.68	8.30	4.30
Planting dates			
S₁ (20th May)	12.08	159.50	80.33
S₂ (30th May)	12.79	163.75	78.33
S₃ (10th June)	11.75	184.58	88.50
S₄ (20th June)	13.54	182.00	87.42
SEm±	0.24	2.87	1.49
CD (p=0.05)	0.68	8.30	4.31
Interaction (PXS)			
P₁S₁	11.67	116.67	73.33
P₁S₂	13.00	125.00	72.67
P₁S₃	14.00	141.67	75.00
P₁S₄	13.50	158.00	83.00
P₂S₁	12.17	163.33	72.68
P₂S₂	14.10	164.67	74.00
P₂S₃	11.67	180.00	84.33
P₂S₄	13.00	166.67	85.67
P₃S₁	13.00	182.33	85.33
P₃S₂	12.50	184.00	80.67
P₃S₃	11.83	190.00	94.33
P₃S₄	14.00	203.33	90.33
P₄S₁	11.50	175.67	90.00
P₄S₂	11.67	181.33	86.00
P₄S₃	9.50	226.67	100.33
P₄S₄	13.67	200.00	90.67
SEm±	0.47	5.75	2.98
CD (p=0.05)	NS	17.25	8.94
C.V. %	6.50	5.77	6.18

Table.2 Effect of plant spacing, planting dates and their interaction on yield parameters of sweet potato

Treatments	No. of tubers/vine	Tuber length (cm)	Tuber diameter (cm)	Yield ha ⁻¹
Plant spacing				
P ₁ (30 x 20 cm)	3.63	13.19	5.63	22.74
P ₂ (30 x 30 cm)	4.29	14.47	7.07	24.10
P ₃ (40 x 30 cm)	5.13	17.61	9.30	26.19
P ₄ (40 x 40 cm)	5.21	18.86	9.73	29.97
SEm±	0.10	0.45	0.15	0.37
CD (p=0.05)	0.30	1.31	0.45	1.06
Planting dates				
S ₁ (20 th May)	4.00	14.47	6.69	21.36
S ₂ (30 th May)	4.38	15.53	7.43	23.51
S ₃ (10 th June)	5.08	17.39	8.85	30.50
S ₄ (20 th June)	4.79	16.75	8.77	27.63
SEm±	0.10	0.45	0.15	0.37
CD (p=0.05)	0.30	1.31	0.45	1.06
Interaction (PXS)				
P ₁ S ₁	3.33	12.60	3.67	18.90
P ₁ S ₂	3.50	12.80	4.83	20.90
P ₁ S ₃	3.67	13.47	6.70	26.40
P ₁ S ₄	4.00	13.90	7.33	24.75
P ₂ S ₁	3.50	12.90	5.50	19.42
P ₂ S ₂	4.00	14.17	6.61	22.00
P ₂ S ₃	4.50	15.07	7.92	29.32
P ₂ S ₄	5.17	15.73	8.25	25.65
P ₃ S ₁	4.67	16.57	8.37	21.70
P ₃ S ₂	5.33	17.40	8.84	22.27
P ₃ S ₃	5.83	18.00	10.33	31.90
P ₃ S ₄	4.67	18.47	9.67	28.87
P ₄ S ₁	4.50	15.80	9.22	25.40
P ₄ S ₂	4.67	17.73	9.44	28.87
P ₄ S ₃	6.33	23.00	10.43	34.37
P ₄ S ₄	5.33	18.90	9.83	31.25
SEm±	0.21	0.91	0.31	0.73
CD (p=0.05)	0.60	2.73	0.93	2.19
C.V. %	7.88	9.78	6.74	4.93

At wider spacing better plant exposure for high radiation interception might have increased the photosynthetic efficiency of the plant. The present finding was also conformity by Zamil *et al.*, (18), Zaeg *et al.*, (17) and Gulluoglu and Arioglu (5) in *Solanum tuberosum*. Further the number of tubers produced per stem is less in higher densities as share of the light and food is reduced resulting in reduced number of tuberous root as reported by Razaei and Soltani (11).

Effect of planting dates on yield parameters

The data revealed that effect of planting dates on yield attribute was observed significant effect. The perusal of data (Table 2) revealed that maximum tubers per plant (5.08), tuber length (17.39 cm), tuber diameter (8.85 cm) and yield (30 50 t ha⁻¹) were recorded in treatment S₃ (10th June). Whereas, minimum tubers per plant (4.00), tuber length (14.47 cm), tuber diameter (6.97 cm) and yield (21.36 t ha⁻¹) were recorded in treatment S₁ (20th May). It might be due to favourable climatic condition, soil and atmospheric temperature during June planting. Earlier in month of May the soil and atmospheric temperature was higher and this affect the growth of sweet potato. This finding was supported by Alloli *et al.*, (2) in sweet potato, Yenagi *et al.*, (16) in *Solanum tuberosum* and Mahender *et al.*, (8) in *Zingiber officinale*.

Interaction effect of planting dates and spacing on yield parameters

The data indicated in table 2 that the maximum tubers per plant (6.33), tuber length (23.00 cm), tuber diameter (10.43 cm) and yield (34.37 t ha⁻¹) were recorded in treatment combination P₄S₃(40 X 40 cm and 10th June). Whereas, the minimum tubers per plant (3.33), tuber length (12.60 cm), tuber

diameter (3.67 cm) and yield (18.90 t ha⁻¹) were recorded in treatment combination P₁S₁ (30 X 20 cm and 20th May). This might be due to June planting and wider spacing, the growth period passes through favourable temperature, relative humidity and good moisture conditions, which improves the tubers per plant, tuber length, tuber diameter and yield of sweet potato. The similar findings were also recorded by Kushwah *et al.*, (7), Alloli *et al.*, (2) in sweet potato and Yadav *et al.*, (13) in *Zingiber officinale*.

On the basis of experimentation it is concluded that the vegetative growth characteristics *viz.* time taken for 50 % sprouting, vine length, leaves per vine and yield attributes *viz.* number of tubers per plant, tuber length, tuber diameter and yield were recorded superior in spacing 40 x 40 cm (treatment P₄) and planting date of 10th June (treatment S₃). The treatment combination of P₄S₃ (40 x 40 cm and 10th June) was superior for vegetative and yield attributes of sweet potato.

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