Original Research Article

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Effect of Sowing Time on Performance of Okra [*Abelmoschus esculentus* (L.) Moench] Varieties under Jalandhar Conditions

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ABSTRACT

A field experiment was conducted at the experimental farm, Department of Agricultural Sciences, DAV University, Jalandhar in spring-summer season of 2019 to study the response of sowing time on growth and fruit yield of okra varieties. The experiment was laid out in randomized block design with three replications and 12 treatment combinations, comprising of four sowing time viz., 1st March, 10th March, 20th March and 15th April and three varieties viz., Arka Anamika, S-51 and Punjab Suhawani. Sowing of okra on 10th March and 1st March proved best for plant height, number of nodes, number of pickings, harvest duration, number of fruits per plant, fruit length, fruit breadth, average fruit weight and fruit yield. Among treatment combinations, 10th March × Punjab Suhawani gave highest yield which was at par with 10th March × S-51 and 1st March × Arka Anamika which might be due to significant effect of vegetative and yield contributing traits in these combinations. All the varieties performed best during early sowing dates as compared to late sowing dates. Hence from the present studies, it is recommended that okra should be sown from 1st March to 10th March in Jalandhar area to harness maximum vegetative growth and fruit yield.

Keywords

Okra, Owing time, Arka Anamika, Punjab Suhawani, S-51

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Introduction

Okra (*Abelmoschus esculentus* L. Moench) is one of the most important export oriented vegetable crop of India ranking first in production with 6095 thousand tonnes from an area of 509 thousand hectare (Anonymous, 2018a). It is commonly grown in the states of Maharashtra, Gujarat, Karnataka, Tamil Nadu,

Haryana, Punjab, Uttar Pradesh, Bihar, West Bengal and Odisha (Swarup, 2006). In Punjab, it occupies an area of 4.57 thousands hectares producing 47.65 thousand tonnes per annum (Anonymous, 2018b). It is mainly cultivated for its tender green fruits which are cooked in curry and are also used in soups. The roots and stem are used for clearing cane juice during preparation of *jaggary*. Its dry seeds contain

13-22% edible oil and 20-24% protein. Its seed cake is also used as animal feed. The dry fruit shell and stem contain crude fibres which are used in manufacture of paper and cardboard. Okra has certain medicinal values like curing ulcers and relief from haemorrhoids. It is beneficial to people suffering from leucorrhoea and general weakness. The high iodine content in its fruits is considered useful to control goiter (Thamburaj and Singh, 2018).

It is a warm season crop and thrives best under hot and humid condition. Day temperature ranging from 25°C to 40°C and night temperature over 22°C is required for proper growth, flowering and fruit development (Dhankhar *et al.*, 2009). It is susceptible to low night temperatures and seed fails to germinate below 17°C (Thamburaj and Singh, 2018). In Punjab, its cultivation starts from January, as off-season crop to get higher prices and to avoid incidence of yellow vein mosaic virus (Tandel *et al.*, 2017). But generally in this region, during January-February the temperature falls to 5°C in night and remains around 12°C in the morning leading to poor germination. The sudden rise or fall in temperature at any phase of crop growth can affect the normal growth, flowering, pollination, fruit development and subsequently decreases the crop yields (Afroza *et al.*, 2010).

Altering the sowing time is among the few adaption strategies available to cope with the temperature extremes. Precise knowledge of optimum sowing time and selection of important varieties plays an important role in increasing crop yields as it provides suitable environmental conditions at all the growth stages of the crop. Timely planting has advantage of favourable climatic conditions, increased growth duration, proper rainfall and optimal temperature during establishment and early vegetative growth (Bake *et al.*, 2017a).

Proper sowing dates gives high fresh weight of fruit, more number of fruits per plant and ultimately increases fruit yield per plant (Bake *et al.*, 2017b). On the other hand, delayed sowing hampered vegetative growth due to warmer temperature during the growth period, which promotes excessive early stem growth, reduces flowering time and reduced incident radiation photosynthesis thus, affecting dynamics of reproductive growth and development and subsequently reduced yields (Ghannad *et al.*, 2014). In addition, late sown crops are exposed to increased population of pests and diseases (Reddy and Reddi, 2014) and may suffer from high virus infestation (Sastri *et al.*, 2004). Generally, climatic conditions as well as sowing dates are different for different varieties (Tindall, 1983; Nonnecke, 1989). The different varieties require different sowing times, as good variety sown at improper time give poor yield and decreased economic returns (Ghannad *et al.*, 2014) due to early induction of flowering, unfavourable temperature and rainfall. Thus, there is a scope of increasing okra yield per unit area with appropriate selection of varieties and suitable sowing date. The information available so far regarding suitable sowing time for different varieties of okra is inadequate under Jalandhar district which is the most productive vegetable growing zone in the Punjab. Therefore, the present investigation was carried out to with the objectives to find out the most suitable sowing time for optimum growth and fruit yield of three okra varieties viz., Arka Anamika, S-51 and Punjab Suhawani.

Materials and Methods

The field studies were carried out at Experimental farm, DAV University, Jalandhar during spring summer, 2019. The soil of experimental site was alkaline in reaction (pH 8.9), sandy loam in texture and available N, P and K were 219.62, 6.67 and

29.12 kg/ha, respectively. The field experiment was conducted in randomized block design with factorial concept with three replications. The treatment comprised of four sowing dates (1st March, 10th March, 20th March, 15th April) and three varieties (Arka Anamika, S51 and Punjab Suhawani). The varieties were sown at the spacing of 45cm × 15cm in a plot size of 3m×3m. The entire recommended dose of phosphorus, potassium and FYM and one-third nitrogen was applied at the time of field preparation while the remaining nitrogen was applied in two equal split doses at 30 and 45 days after sowing. All cultural and management practices were followed whenever needed. Ten random plants were selected per plot for collection of data. Observations were recorded on days to 50% germination, days to first flower, plant height, number of branches per plant, number of nodes per plant, internodal length, days to first picking of fruit, number of pickings, harvest duration, number of fruits per plant, average fruit weight and fruit yield. Fruit yield was recorded on per plot basis and converted to per hectare. The data recorded during the course of investigation was subjected to statistical analysis using factorial randomized block design (Panse and Sukhatme, 1985). The interpretation of result was based on F test and critical difference (CD) at 5% level of significance.

Results and Discussion

As evident from Table 1 days to 50% germination was significantly influenced by sowing time. Maximum germination was recorded when crop was sown on 15th April which was found to be significantly superior over other sowing dates except 20th March. This might be due to the availability of optimum temperature for germination during later sowing dates as compared to early sowing dates. Late germination in early sowing dates was due to availability of low

temperatures for germination during that period. Gadakh *et al.*, (1990) reported that variation in sowing dates was the main cause of seedling emergence, their survival and vigour. Similar results were also reported by Hussain *et al.*, (2006).

Minimum days to first flower were observed when okra was sown in April while, maximum days were taken by March sowing dates (1st, 10th and 20th March) except 10th March × Arka Anamika. This is attributed to the fact that in late sown crop physiological changes were rapid which facilitated early flowering (Dash *et al.*, 2013) while high rainfall intensity recorded during the flower initiation period in March sowings might have caused a heavy cloud cover along with low temperature that could have led to low thermal units, thereby prolonging days to first flower. Similar findings were also reported by Bake *et al.*, 2017 and Kumar *et al.*, (2015).

Sowing on 10th March recorded significantly taller plants as compared to 1st March, 20th March and 15th April which may be ascribed to the fact that plant growth occurred in suitable temperature range which might have attributed to the enhanced plant metabolic activities like photosynthesis due to favorable weather conditions. The early sowings received more growing duration as compared to late sowing. Plant height in early (1st March) and late (20th March and 15th April) sown crop was affected by low (<18⁰C) and high temperature (>30⁰C) prevalent in the early stages of the vegetative growth, respectively, which led to the reduction in plant height. Das *et al.*, 2018 also reported decrease in plant height with delayed sowing due to higher ambient air temperatures encountered by the later sown crop which resulted in its stunted growth. The interaction 10th March × S-51 produced the tallest plants and it was at par with 1st March × S-51. This might be due to fact that March sowing plants

received proper environment, water and other natural resources that results in better growth (Dash *et al.*, 2013).

Although, the number of branches per plant was not significantly affected by sowing dates and sowing time $\times$ variety, the highest branch number per plant was obtained from late sowing (20th March and 15th April) which might be attributed to the more efficient use of longer days available in later sowing dates. Similar findings were also reported by Ijoyah *et al.*, (2010) and Kumar *et al.*, (2015).

The number of nodes per plant was found significant for sowing time. Sowings in March month recorded maximum number of nodes per plant as compared to April sowing which might be attributed to air temperature differences. The maximum temperature and sunshine hours also affected the initial growth of okra (Pundarkia *et al.*, 1972). El-Warakly (2014) reported that the number of nodes on main stem were highest in mid April as compared to mid March or/and mid May. On the contrary, Bake *et al.*, 2017 reported more number of nodes with advancement in date of sowing from 1st June to 30th June.

Sowing time and interaction between sowing time $\times$ variety non-significantly influenced the inter-nodal length. El-Warakly (2014) also reported that inter-nodal length was not significantly affected by the sowing dates.

Days for first picking of fruit varied significantly among sowing time and sowing time $\times$ variety (Table 2). Minimum days for first picking of fruit were in 15th April sowing and maximum days were taken by 1st March.

The reason for the earliest picking in case of the plants sown on 15th April might be due to favorable temperature and good sunshine resulting in the quick emergence and early

flowering leading to accumulation of more photosynthates thereby inducing early picking as compared to the okra crop planted on 1st March, 10th March and 20th March. These findings are in agreement with Hussain *et al.*, (2006), Moniruzzaman *et al.*, (2007) and Dash *et al.*, (2013). The treatment combination 15th April $\times$ Arka Anamika was significantly superior to other treatments due to its favourable response on days to 50% germination and days to first flower thus accumulating enough thermal units for early maturity.

Prolonged harvest duration is an important aspect to catch an early market in one hand and to avoid gluts in the market on the other hand so as to ensure maximum returns. Harvest duration was maximum in 1st March followed by 10th March, 20th March and 15th April. During the period of flowering and fruit setting, the weekly average temperature was low which might have resulted in prolonged harvest duration in earlier sowings. While flowering and fruit setting period in later dates coincided with the high ambient temperature resulting in reduced harvest duration. These findings are in agreement with Iremiren and Okiy (1986) and Ekwu and Nwokwu (2012).

The number of pickings were significantly reduced as sowing was delayed from 10th March to 15th April. Okra sown on 10th March and 20th March recorded the maximum number of pickings followed by 1st March due to the longer harvest duration. These results are in agreement with Hussain *et al.*, (2006) and Tandel *et al.*, (2017).

The number of fruits per plant was significantly influenced by sowing time, genotypes and sowing time $\times$ genotype. The highest number of fruits was obtained on 10th March which might be due to more number of nodes per plant and longer harvest duration.

Table.1 Effect of sowing time on growth parameters in different varieties of okra

Sowing time	Varieties	Days to 50% germination	Days to first flower	Plant height (cm)	Number of branches	Number of nodes	Internodal length (cm)
1st March	Arka Anamika	11.66	52.66	64.50	1.53	18.20	2.66
	S-51	11.33	54.33	82.13	1.06	13.86	3.06
	Punjab Suhawani	13.00	54.66	55.93	1.46	18.56	2.60
Mean		12.00	53.88	67.52	1.35	16.87	2.77
10th March	Arka Anamika	11.00	41.33	74.80	1.26	17.00	2.46
	S-51	9.66	46.00	83.60	1.60	18.86	2.73
	Punjab Suhawani	10.00	50.00	54.80	1.13	18.66	2.55
Mean		10.22	45.77	71.06	1.33	18.17	2.58
20th March	Arka Anamika	7.00	46.00	56.13	1.26	16.53	2.50
	S-51	6.66	45.00	70.40	1.26	16.60	3.90
	Punjab Suhawani	8.00	46.33	51.00	1.73	17.66	2.33
Mean		7.22	45.77	59.17	1.42	16.93	2.91
15th April	Arka Anamika	7.00	41.00	47.93	1.33	13.40	2.95
	S-51	7.00	43.00	54.40	1.60	14.06	3.58
	Punjab Suhawani	7.00	45.00	54.58	1.33	15.33	2.35
Mean		7.00	43.00	52.30	1.42	14.26	2.96
Sowing time							
SE		0.24	0.42	.80	0.11	0.77	0.23
CD 0.05		0.70	1.22	2.35	NS	2.27	NS
Sowing time × variety							
SE		0.41	0.72	1.38	0.18	1.34	0.40
CD 0.05		NS	2.11	4.06	NS	NS	NS

Table.2 Effect of sowing time on fruit yield and yield parameters in different varieties of okra

Sowing time	Varieties	Days to first picking	Number of pickings	Harvest duration	Number of fruits per plant	Average fruit weight (g)	Fruit Yield per hectare (q/ha)
1st March	Arka Anamika	62.00	12.00	51.66	9.73	9.18	132.72
	S-51	63.00	10.00	52.66	4.90	8.59	81.21
	Punjab Suhawani	67.00	14.00	54.00	8.77	8.45	124.16
Mean		64.00	12.00	52.77	7.80	8.74	112.70
10th March	Arka Anamika	57.00	13.00	51.33	7.90	8.03	94.84
	S-51	56.00	13.66	52.33	9.95	9.45	138.81
	Punjab Suhawani	58.00	13.00	53.66	10.08	9.78	152.15
Mean		57.00	13.22	52.44	9.31	9.09	128.60
20th March	Arka Anamika	53.00	13.00	47.00	6.02	8.10	72.21
	S-51	53.00	13.33	47.00	5.34	7.52	62.95
	Punjab Suhawani	53.00	13.33	47.00	5.39	8.60	63.43
Mean		53.00	13.22	47.00	5.58	8.07	66.19
15th April	Arka Anamika	49.00	9.66	33.00	2.57	7.51	28.76
	S-51	51.00	9.66	33.00	3.43	7.56	39.69
	Punjab Suhawani	51.00	10.00	33.00	3.02	7.73	31.88
Mean		50.33	9.77	33.00	3.01	7.60	33.44
Sowing time							
SE		0.36	0.58	0.12	0.23	0.14	4.06
CD (5%)		1.05	1.69	0.36	0.70	0.41	11.93
Sowing time × Variety							
SE		0.62	1.00	0.21	0.41	0.25	7.04
CD (5%)		1.82	NS	0.62	1.19	0.73	20.66

These findings are in close conformity with the results of Hussain *et al.*, (2006), Ekwu and Nwokwu (2012), Dash *et al.*, (2013), and Undie and Litio (2018). Among interactions, 10th March × Punjab Suhawani, 10th March × S-51 and 1st March × Arka Anamika recorded more number of fruits per plant which might be due to favorable response on growth attributes.

Maximum average fruit weight was obtained when sown on 10th March which was significantly superior to 15th April. It might be due to increased length and breadth in March sowings as compared to April sowing dates. Similar results were reported by Firoz *et al.*, (2007), Ekwu and Nwokwu (2012), Dash *et al.*, (2013), Sonu *et al.*, (2013) and Ijoyah *et al.*, (2010). 10th March × Punjab Suhawani, 10th March × S-51 and 1st March × Arka Anamika observed more average fruit weight which might be due to the increased length and breadth of fruits produced by the plants sown on 10th March and 1st March.

The highest fruit yield per hectare varied significantly among sowing time and sowing time × variety. The maximum fruit yield was recorded in 10th March followed by 1st March, 20th March and 15th April. This might be attributed to the favourable climatic conditions that prevailed throughout the crop growth when sown on 10th March. On the other hand, 15th April sowing lead to overall reduced growth and vigour of plants due to excessive high temperature conditions (41°C) which are not so conducive for okra and offer short duration for growth and development to the plants. These findings were close confirmative with the result of Undie and Litio, 2018, Das *et al.*, 2018, Morwal and Patel, 2017, Bake *et al.*, 2017, Ghannad *et al.*, 2014 and Ijoyah *et al.*, 2010 in okra. The treatment combinations 10th March × Punjab Suhawani, 10th March × S-51 and 1st March × Arka Anamika were significantly superior over other treatment

combinations. Higher fruit yield is attributed to the favorable response of 10th March on growth and yield attributes like plant height, number of nodes per plant, number of pickings, harvest duration, number of fruits, fruit length, fruit breadth and average fruit weight. Similarly, 1st March is found next best treatment for plant height, harvest duration, fruit size, and average fruit weight.

Sowing of okra from 1st March to 10th March and proved best for plant height, number of nodes, number of pickings, harvest duration, number of fruits per plant, fruit length, fruit breadth, average fruit weight and fruit yield per hectare. Hence, from the present studies it is recommended that okra should be sown from 1st to 10th March in Jalandhar area to harness maximum fruit yield.

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