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Effect of sowing time on productivity and economics of okra (*Abelmoschus esculentus*) under semi-arid conditions

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ABSTRACT

An investigation to study the effect date of sowing on productivity of okra (*Abelmoschus esculentus* L. Moench) cv. Gujarat Okra 2 was carried out at the five farmer's field at Panchmahals district of central Gujarat under on farm trial during 2011-12 and 2012-13. The maximum plant height (97.15 cm) at the time of first flowering, number of branches (4.10), pod length (11.55 cm), pod diameter (14.20 cm), number of pods/plant (9.25), pod weight (32.40g) and fruit yield (10.41 tonnes/ha) were recorded in T_2. The minimum time (60.50 days) for flowering was recorded in T_1. The maximum gross return (₹ 116 265) and net return (₹ 86 980) was recorded in T_1 followed by T_3 (₹ 87 590, 58 390) and (₹ 75 895, 45 778) in T_2. The maximum B: C ratio (3.97) was recorded in T_1 followed by T_3 and T_2. The B: C ratio is one of most important aspect for selection of particular crop and season by the farmers to maximize the productivity and net return. The farmers of adjoining area have realized the effect of sowing time on productivity and net return and have adopted this technology.

Key words: Climate and soil properties, Date of sowing, Okra, Yield

Okra (*Abelmoschus esculentus* L. Moench) is an important vegetable crop of tropical and subtropical parts of the world (Tindall 1986). It is a semi-woody, fibrous, herbaceous annual plant with an indeterminate growth habit (Balock 1994). In India, okra is one of the most important vegetables in terms of consumption and area covered under this crop (Iremiren and Okiy 1986). It is used by people in different ways. The immature pods are consumed as boiled vegetables and are also dried and used as soup thickeners or in stews (Yadav and Dhankhar 2002). The green fruits are rich sources of vitamins, calcium, potassium and other important minerals (Lee *et al*. 1990). In Panchmahals district of Gujarat, okra is one of the most important vegetable crops. The area, production and productivity of okra of the district are 600 ha, 3000 MT and 5 MT per ha respectively (Anonymous 2010). It can be grown throughout the year with ensured irrigation facility, whereas the large numbers of farmers are growing okra during *kharif* season. The climatic conditions of the Panchmahals district of Gujarat is characterized as hot semi-arid ecosystem. The farmers of the area are not getting price from their produce due to fluctuation of demand and market rate. An attempt was made to determine the optimal sowing date to optimize the productivity and income per unit area.

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MATERIALS AND METHODS

The experiment was conducted during the *kharif* seasons of 2011 and 2012 at the five randomly selected farmers' field of the Panchmahals district of Gujarat. In the both the years of study, the month of July recorded the highest amount of rainfall and number of rainy days (Table 1).

The average monthly temperature of both the years ranged from 22.1 ^{0}C to 32.2 ^{0}C, while the average relative humidity ranged from 36.50 % to 81.44 % (Table 1). Temperature was taken daily and averaged for the month, using the minimum and maximum thermometer reading. The top soil of the experimental site was reddish black. Soil samples of study site were analyzed for their chemical properties before initiation of trial at the soil science laboratory, Central Horticultural Experiment Station (CIAH), Vejalpur, Godhra, Gujarat by following standard in laboratory. Organic matter, % sand, % silt, % clay, pH in calcium chloride and water were obtained using the methods as advocated by Walkley-Black, hydrometer and pH meter methods respectively. Details of soil physico-chemical properties are given in Table 2.

The seeds of okra variety Gujarat Okra 1 were procured from the Anand Agricultural University, Anand, Gujarat. The experimental area (1 ha) was cleaned, ploughed,

Table 1 Meteorological information for Godhra, Gujarat (June-October) 2011 and 2012

Month	Average monthly rainfall (mm)	Rainy days	Average monthly Temperature (°C)		Average relative humidity (%)
			Maximum	Minimum	
2011					
June	82.20	3	41.90	25.86	43.83
July	264.30	6	38.60	26.23	75.54
August	514.1	18	37.83	25.75	80.39
September	128.4	11	33.26	25.12	81.44
October			30.10	24.15	78.32
2012					
June	54.25	3	40.50	28.30	36.50
July	98.32	4	39.26	27.32	78.60
August	150.64	3	38.85	28.58	72.30
September	182.65	6	31.27	25.64	79.60
October			35.65	23.26	

Source: Meteorological Station, Godhra

Table 2 Physico-chemical properties of soil of experimental site in 2011 and 2012

Parameter	Soil analytical data		
	2011	2012	Method of analysis
Electric conductivity (ds/m)	0.52	0.49	EC meter
Organic matter (%)	0.26	0.28	Walkley-Black method
N (kg/ha)	148.20	152.60	Kjeldahl method
P_2O_5 (kg/ha)	19.0	19.80	Flame photometric
K (kg/ha)	276.2	285.3	Oxidation method
Ca (meq/100g)	2.94	1.62	AAS
Mg (kg/ha)	2.12	1.01	AAS
Sand (%)	5.7%	6.0%	Hydrometer method
Silt (%)	13.5%	10.2%	Hydrometer method
Clay (%)	68.0%	70.4%	Hydrometer method
pH (H20)	8.20	8.10	pH meter

ppm, Parts per million; AAS, Atomic absorption spectrophotometer

harrowed and mixed the recommended dose of manure and fertilizers and other management practices applied. The treatments constituted of the three sowing dates in a sequential order at 15-20 day intervals, starting from IIIrd week of June, Ist week of July and IIIrd week of July during both the years of study. The treatments were arranged in a randomized block design (RBD) and replicated five times. Okra seeds were sown 2-3 cm deep using 45×30 cm spacing. Two seeds were sown per hole and one plant from each hole was removed at 2 weeks after sowing. The plots were manually weeded two times at 4 week intervals after sowing. The full dose of FYM, phosphorus, potash and half dose of nitrogen were applied at the time of last harrowing and rest nitrogen applied in two split doses at 20-25 days interval after manual weeding. Harvesting was done when the tip of pod was observed to break easily when pressed with the finger tip (Usman 2001).

Growth parameters in terms of plant height at first flowering, number of days to first flowering, number of branches/plant, pod length, pod diameter, number of pods/plant, pod weight and yield (tonnes/ha) were collected. The data of both the year were pooled and analyzed statistically by RBD.

The data related to cost of cultivation and production were collected in all treatments time to time from all participating farmers. An average of cost of cultivation yield, net returns of different farmers was analyzed by the formula given by Samui *et al.* (2000). The cost benefit ratio was calculated by gross return was divided by cost of cultivation.

$$\text{Average} = \frac{(F1 + F2 \ldots \ldots \ldots Fn)}{N}$$

where, F1, Farmer; N, No. of farmers.

RESULTS AND DISCUSSION

Perusal of data presented in Table 3 revealed that the maximum plant height (97.15 cm) at first flowering was recorded in the plants which were sown in Ist week of July followed by at IIIrd week of June (66.95 cm) and at IIIrd week of July (53.85 cm). This might be due to the availablility adequate amount of rainfall during the period before flowering. These results are in agreement with the findings of Iremiren and Okiy (1986) and Ezeakunne (2004). Similar trend was also observed during both the years of experimentation years. Okra sown in Ist week of July took a significantly longer period (66.50 days) to first flowering compared to the mid June (60.50 days) and mid-July (64.50 days) sowings. This might be due to accumulation enough thermal units to induce early flowering. High rainfall intensity recorded between July and August, within the flower initiation period might have caused a heavy cloud cover, low temperature that could have led to low thermal units, thereby prolonging days to first flowering. These results are in consonance with the findings of Usman (2001), where the period of days to first flowering increased with each month of delayed sowing. Although, the number of branches/plant was not significantly affected by the sowing dates, the highest number of branches/plant (4.10) was recorded in T_2 (Ist week of July) followed by (3.70) in T_1 (IIIrd week of June) and 3.30 in T_3 (IIIrd week of July). This might be attributed to the more efficient use of available moisture and nutrients. The results of the study are in line of as reported by earlier workers (Ijoyah *et al*. 2010), in okra. Similar trend was observed during both the individual years. The maximum pod length (11.55 cm) and diameter (14.20 cm) were recorded in T_2 followed T_1 (8.85 cm and 9.55 cm) and T_3 (7.15 cm and 8.75 cm) respectively. The similar findings have also been reported by Ijoyah *et al*. (2010), in okra, and reported that the seed sown in late June had the highest pod length of 12.12 cm and largest

Table 3 Productivity of okra cv. Gujarat Okra 2, on varying date of sowing at Panchmahal district of Central Gujarat in years 2011 and 2012

Treatment	Year	Plant height at first flowering	No. of days first flowering	No. of branches/ plant	Pod length (cm)	Pod diameter	No. of pods/plant (cm)	Weight of pod (gm.)	Fruit yield (tonnes/ha)	B:C ratio
T_1	2011	70.80	61.00	3.80	9.40	10.80	6.20	22.30	8.86	4.08
	2012	63.10	60.00	3.60	8.30	9.90	6.90	20.40	8.52	3.87
	Pooled	66.95	60.50	3.70	8.85	10.35	6.55	21.35	8.69	3.97
T_2	2011	101.20	66.0	4.20	12.20	15.00	9.70	33.00	10.59	2.80
	2012	93.10	67.0	4.00	10.90	13.40	8.80	31.80	10.23	2.25
	Pooled	97.15	66.50	4.10	11.55	14.20	9.25	32.40	10.41	2.52
T_3	2011	61.30	64.00	3.40	7.90	9.30	8.30	24.50	10.35	2.92
	2012	46.40	65.00	3.20	6.40	8.20	7.80	22.90	9.64	3.08
	Pooled	53.85	64.50	3.30	7.15	8.75	8.05	23.70	9.99	3.00
SEm+		0.483	0.583	0.128	0.194	0.198	0.155	0.385	0.246	0.036
CV		1.475	1.90	7.63	4.528	4.240	4.954	3.302	5.720	2.560
CD (P = 0.05)		1.572	2.02	0.417	0.634	0.646	0.508	1.255	0.804	0.120

pod diameter of 15.0. This result in accordance with the findings as reported by Alfredo *et al*. (1999) and Hossain *et al*. (2001). Similarly, the average number of pods/plant significantly affected by date of sowing, the maximum was recorded in Ist week of July sowing (9.25/plant) and minimum in IIIrd week of June sowing (6.55). This might be due to the more number of branches produced and the exuberant vegetative growth of the plants compared to those planted later. The number of pods, therefore, would depend on the intensity of growth of the plants. The results of the present study are in close agreement with the results as reported by Ijoyah *et al*. (2010) in okra. The maximum fruit weight was recorded in T_1 (32.40 g) followed by in T_3 (23.70 g) and minimum in T_1 (21.35 g). The maximum fruit yield, i e 10.41 tonnes/ha was recorded in T_2 followed by 9.99 tonnes in T_3 and 8.69 tonnes in T_1 (Table 3). The tallest plants produced, when the crop was sown during Ist week of July, might have contributed to its greater pod weight and yield. This view supports the finding as reported by Moniruzzaman *et al*. (2007) who observed a correlation between the plant height and yield of okra.

Economics of treatments

The economics of all three treatments was calculated. The data presented in Table 4 revealed that the average cost of cultivation in all treatments is more or less similar, the maximum in T_2 (30 117) may be due to weed management practices in peak monsoon season. The maximum gross return and net return was recorded in T_1 (₹ 116 265, 86 980) followed by T_3 (₹ 87 590, 58 390) and T_2 (₹ 75 895, 45 778). The trend was observed similar during both the individual years. The maximum B: C ratio was recorded in T_1 (3.97) followed by in T_3 (3.0) and minimum in T_2 (2.52). It might be due to fluctuation the demand and supply of okra pods during the early *kharif*, and higher the demand and less availability of pods in the market may be the reason to get better prices. The B: C ratio is one of most important aspect for selection of crop and season by the farmers. It is revealed from the study that the famers of the Panchmahals district have started growing okra crop during the mid of June to fetch better return. The similar results are also reported by Kumar *et al.* (2014) in okra.

Table 4 Economics of okra growing on various date of sowing in Godhra conditions

Treatment	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Benefit: cost ratio
T_1	29 285	116 265	86 980	3.97
T_2	30 117	75 895	45 778	2.52
T_3	29 200	87 590	58 390	3.00

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