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JM Vashi
Department of Vegetable Science, ASPEE College of Horticulture and Forestry, Agricultural University, Navsari, Gujarat, India

AI Patel
Department of Vegetable Science, ASPEE College of Horticulture and Forestry, Agricultural University, Navsari, Gujarat, India

CG Intwala
Department of Vegetable Science, ASPEE College of Horticulture and Forestry, Agricultural University, Navsari, Gujarat, India

Corresponding Author:
JM Vashi
Department of Vegetable Science, ASPEE College of Horticulture and Forestry, Agricultural University, Navsari, Gujarat, India

Effect of different time of sowing and planting geometry on off season okra (*Abelmoschus esculentus* L.)

JM Vashi, AI Patel and CG Intwala

Abstract
A study was conducted to find out influence of time of sowing and planting geometry on growth, yield and yield attributes of off season okra. Okra [*Abelmoschus esculentus* (L.) Moench] is one of the major short duration vegetable crop cultivated in various pockets of South Gujarat. The treatment details having three date of sowing (D_1 -2nd week of October, D_2 – 1st week of November and D_3 - 2nd week of November) and spacing (S_1- 45 cm x 10 cm, S_2- 45 cm x 20 cm and S_3- 45 cm x 30 cm). Treatment combination of sowing in 2nd week of October with spacing of 45 cm x 10 cm (D_1S_1) was found higher value for yield (t/ha) during all three years of experiment as well as in pooled analysis (9.86, 9.81, 9.64 and 9.77 respectively).

Keywords: Okra, off-season, spacing

Introduction

There are various type of agro-climatic diversity in our country which provides higher opportunities to cultivate various kind of vegetables. Due to limited resources in post-harvest management and infrastructure facilities it becomes major task to provide enough quantity of vegetables in our country for large population. On other side due to market glut the prices are drastically lower for different vegetable crops. Therefore, research toward off season cultivation particularly cultivation time and spacing are also becomes very important for enhancing farmer's income. Traditionally okra is regularly cultivated during *kharif* and summer season in South Gujarat. So to identify the best date of sowing and spacing for off season okra in South Gujarat, this research was framed.

Okra is a major warm season, *malvaceae* family, economic vegetable crop cultivated in tropical and subtropical parts of world and in India. It is probably originated in Ethiopia and then after cultivated in Mediterranean, North Africa, Arabia and India. (Nzikou *et al.*, 2006) [1]. All over the world it is known by many local names. It is called lady's finger in England, gumbo in the United states of America and bhindi in India (Ndunguru & Rajabu, 2004) [2]. Database according to (Anon., 2021) [3], it is cultivated in area of 5.31 lakh ha area and has 64.66 lakh MT production in India. Okra has multipurpose uses as fresh leaves, buds, flowers, pods, stems and seeds are used in various purposes (Mihretu *et al.*, 2014) [4]. Immature fruits (pods) are consumed as vegetables, salads, soups and stews, fresh or dried, fried or boiled. Due to high amount of oil (20-40 %) in seed, okra has potential for cultivation as an important oilseed crop also. Potassium, sodium, Magnesium and Calcium are major elements in pod. Okra is also rich source of vitamin C (16 to 29 mg), vitamin A and zinc (80 mg/g) (Cook *et al.*, 2000) [5].

There are various factors responsible for low production in okra, among them poor adoptation of cultural methods/practises, suitable cultivar in particuler region, timely plant protection measures consider mainly for low production in okra. (Saha *et al.*, 1989) [6] reported that use of cultivar having low production, improper spacing in between row to row and plant to plant (planting geometry), proper sowing time according to season, nutrient management, pest-diseases and weed population and their management are play a major role in production of okra.

The influence of time of sowing and spacing in okra affects different plant characters with respect to growth, yield and quality. Sowing with timely and suitable date is major factor and crucial for optimum yield in okra. Benefits of climatic factors like temperature, rainfall and light duration is available for those plant which sown at proper time which turn into early vegetative growth and thereby reproductive growth, yield as well as economic return. Other side improper sowing dates delays early vegetative growth and thereby resulted in decrease pod yield of okra (Ghannad *et al.*, (2014) [7]. Management of sowing with proper timing in proper season ensures higher fruit weight with higher number of pods per plant and thereby resulted in higher pod yield per plant and unit area.

The planting geometry has great importance in okra production. The available area for a plant to source growth resources such as water, light and nutrients are determined by spacing. Proper plant spacing allows the plant to reach its full potential by providing enough space to spread. Improper planting distance affects initial vegetative growth and there by resulted in less number of fruits with poor quality and low yield. Whereas in higher plant population, possibilities of poor quality pods and low yield is there because of competition in between plants (Moniruzzaman *et al.,* 2007) [8]. To determine proper plant spacing in individual season for every crop is become a major problem for farmer now a days. Proper use of space is consider as important factor for better utilization of resources like soil nutrients, moisture and sunlight. Improper spacing always results in low crop production, sometimes low number of fruit per unit land or overcrowding/higher number of plants creates problem in farm operation. In case of higher planting density, there is always possibility for higher production but opposite to it, in lower plant population yield is decreases due to restriction in natural resources uses which needs for plant growth and development. Excess plants per unit area or specific area also leads the competition for important natural resources like sunlight, space, water, nutrients, moisture and also for plant spreading which ultimately resulted in number of branches, nodes, flowering, fruiting and there by yield (Zibelo *et al.,* 2016) [9]. Optimum population of plants gives early and higher yield. In okra generally pod number increases in higher plant population and decreases with lower plant population, but average fruit weight decreases with increased plant density. Spacing is a major factor which is responsible for okra plant, as it provide strength to plant for develop upper side and also initially in soil. Proper planting density always resulted in favourable condition for uptake/uses of solar radiation, soil nutrients, moisture also prevents overcrowding in between number plants, resulted in maximum utilization of resources and energy for optimum growth parameters like, branches, fruit length etc. (Kumar *et al.,* 2016) [10].

Materials and Methods

This trial for period of three years (2018-19, 2019-20 & 2020-21) was conducted on V RS, RHRS, NAU, Navsari, Gujarat India. The trial was framed in FRBD design with three repetition. Okra variety GAO-5 was used in this experiment. The treatment details included, different time of sowing (D_1 - 2nd week of October, D_2 1st week of November and D_3 -2 nd week of November) and with three spacing (S_1- 45 cm x 10 cm, S_2- 45 cm x 20 cm and S_3-45 cm x 30 cm). Number of treatment were, T_1- D_1S_1, T_2- D_1S_2, T_3-D_1S_3, T_4-D_2S_1, T_5-D_2S_2, T_6-D_2S_3, T_7-D_3S_1, T_8-D_3S_2 and T_9-D_3S_3. At the time of land preparation Farm Yard Manure (10 t/ha) was applied and apart from fertilizer doses full dose of phosphorus along with potash and half quantity of nitrogen were applied in each treatment plot, remaining dose of nitrogen was applied after 45 DAS in each treatment plot.

Growth and yield characters, days to 50 % flowering, plant height (cm) initial plant population, final plant population, average length of marketable fruit (cm), average diameter of marketable fruit (cm), average weight of marketable fruit (g), number of fruits per plan and yield per hectare (t) were recorded. Major growth and yield characters were recorded from five tagged plant.

Periodically collected data was finally analysed statistically as per the procedure given by Panse and Sukhatme (1985) [11].

Results and Discussion

Effect of time of sowing

The data in Table 1 on days to 50 % flowering shows the significant results for sowing dates during all the three year of experiment and in pooled analysis.

Date of sowing has significant effect on plant height (cm) at final harvest during the all three year of experiment and in pooled analysis, recorded higher in D_1 (84.66, 68.02, 69.31 and 73.99 respectively) whereas D_3 recorded lowest plant height (45.04, 40.01, 41.88 and 42.31 respectively) This might be due to favourable conditions for growth during first date of sowing (2nd week of October) whereas increase of lowest plant height recorded in third date of sowing (2nd week of November) due to availability of very less number of temperature hours at the time of initial plant development stage resulted in poor vegetative growth. Similar findings were also reported by Hossain *et al.,* (1999) [12], Moniruzzaman *et al.,* (2007) [8], Chattopadhyay *et al.,* (2011) [13] and Tandel *et al.,* (2017) [14]. (Table 2).

Yield characters like, pod length (cm) (7.93,7.58,and7.21) during three year of experiment and pod diameter (cm) (1.61, 1.56, 1.59 and 1.58), pod weight (g) (7.57, 7.51, 7.35 and 7.48) number of pods per plant (7.28, 7.17, 7.20 and 7.22) and pod yield (t/ha) (6.23, 6.22, 5.84 and 6.10) recorded significantly highest in okra sown during 2nd week of October (D_1) during all the three year of experiment as well as in pooled analysis followed by D_2 – 1st week of November and D_3 - 2nd week of November. The findings of this research are also corroborated with the findings of Hossain *et al.*, (2001) [15], and Tandel *et al*., (2017) [14].

Effect of planting geometry

Major characters like plant height, fruit length, fruit diameter and yield shows significant result due to different planting distance. Various levels of spacing has non-significant effect on plant height (cm) at harvest during first two year and in pooled analysis but shows significant result during third year of experiment. Spacing S_1 (45 cm x 10 cm) recorded maximum plant height (66.21, 55.52, 57.39 and 59.71 respectively) during all the years of experiment and in pooled analysis. Higher plant height was found in high density (45 cm x 10 cm) as compared to low density (45 cm x 20 m and 45 cm x 30 cm). Hossain *et al*., (2001) [15] and Talukdaer *et al.,* (2018) [16] found same result. (Table 2).

Fruit length (7.91 cm), Fruit diameter (1.56 cm), fruit weight (6.78 g) and number of fruits per plant (6.61) in pooled analysis (Table 3 to 6) recorded higher in low density 45 cm x 30 cm (S_3) than the high density might be due to availability of fair amount of resources like sunlight and nutrition through the soils which turn in to favourable condition for vegetative and reproductive growth. Hossain *et al.,* (2001) [15] and Kumar *et al.,* (2016) [10] reported same result. Okra pod yield (7.50 t/ha) found higher in closer spacing as compared to wider spacing 45 cm x 30 cm in pooled analysis. Gorachand *et al.*, (1990) [17], Randhawa and Pannun (1969) [18] and Talukdaer *et al.*, (2018) [16] were also submitted similar results and revealed that high density planting lead towards a greater number of plants reflects in a greater number of pod per plant increases overall yield.

Conclusion

The study investigated the sowing date and spacing for off season okra cultivation in South Gujarat. Among the all treatment combinations D_1S_1 - 2nd week of October + 45 cm x 10 cm spacing (T_1) were found best.

Table 1: Effect of different time of sowing and planting geometry on number of days to 50 % flowering.

2018-19					2019-20				
Treatment	**Time of sowing**			**M (S)**		**Time of sowing**			**M (S)**
	D_1	**D_2**	**D_3**			**D_1**	**D_2**	**D_3**	
S_1	44.67	47.00	50.00	47.22	S_1	44.00	47.67	50.33	47.33
S_2	44.67	46.87	49.33	46.96	S_2	44.67	48.00	49.67	47.44
S_3	45.00	47.33	50.33	47.56	S_3	44.33	48.67	50.00	47.67
Mean (D)	44.78	47.07	49.89		Mean (D)	44.33	48.11	50.00	
	D	S	D X S			D	S	DXS	
S.Em.±	0.37	0.37	0.64		S.Em.±	0.36	0.36	0.62	
C.D. at 5 %	1.11	NS	NS		C.D.at 5%	1.08	NS	NS	
C.V. %	2.35				C.V. %	2.27			
2020-21					**Pooled**				
Treatment	**Time of sowing**			**M (S)**		**Time of sowing**			**M (S)**
	D_1	**D_2**	**D_3**			**D_1**	**D_2**	**D_3**	
S_1	45.33	49.33	50.67	48.44	**S_1**	44.67	48.00	50.33	47.67
S_2	45.67	50.00	51.00	48.89	**S_2**	45.00	48.29	50.00	47.76
S_3	45.33	50.33	51.67	49.11	**S_3**	44.89	48.78	50.67	48.11
Mean (D)	45.44	49.89	51.11		Mean (D)	44.85	48.36	50.33	
	D	S	D X S			D	S	D X S	
S.Em.±	0.53	0.53	0.92		S.Em.±	0.25	0.24	0.40	
C.D. at 5 %	1.60	NS	NS		C.D. at 5 %	0.72	NS	NS	
C.V. %	9.56				C.V. %	2.68			

Table 2: Effect of different time of sowing and planting geometry on okra height (cm) at final harvest

2018-19					2019-20				
Treatment	**Time of sowing**			**M (S)**		**Time of sowing**			**M (S)**
	D_1	**D_2**	**D_3**			**D_1**	**D_2**	**D_3**	
S_1	86.82	66.77	45.04	66.21	S_1	68.08	58.48	40.01	55.52
S_2	84.57	63.36	46.09	64.67	S_2	68.34	52.45	36.18	52.32
S_3	82.59	60.62	45.54	62.92	S_3	67.64	50.95	39.51	52.70
Mean (D)	84.66	63.58	45.56		Mean (D)	68.02	53.96	38.57	
	D	S	D X S			D	S	D X S	
S. Em.±	2.36	2.36	4.09		S. Em.±	2.11	2.11	3.66	
C.D. at 5 %	7.09	NS	NS		C.D.at 5%	6.34	NS	NS	
C.V. %	10.97				C.V. %	11.84			
2020-21					Pooled				
Treatment	Time of sowing			M (S)		Time of sowing			M (S)
	D_1	D_2	D_3			D_1	D_2	D_3	
S_1	71.22	59.06	41.88	57.39	S_1	75.37	61.44	42.31	59.71
S_2	69.20	53.35	38.90	53.82	S_2	74.03	56.39	40.39	56.94
S_3	67.50	51.90	37.64	52.35	S_3	72.58	54.49	40.90	55.99
Mean (D)	69.31	54.77	39.47		Mean (D)	73.99	57.44	41.20	
	D	S	D X S			D	S	D X S	
S. Em.±	1.74	1.74	3.01		S. Em.±	1.24	1.16	1.95	
C.D. at 5 %	5.21	5.21	NS		C.D. at 5 %	3.53	NS	NS	
C.V. %	9.56				C.V. %	10.88			

Table 3: Effect of different time of sowing and planting geometry on fruit length (cm).

2018-19					2019-20				
Treatment	**Time of sowing**			**M (S)**		**Time of sowing**			**M (S)**
	D_1	**D_2**	**D_3**			**D_1**	**D_2**	**D_3**	
S_1	7.63	7.29	7.08	7.33	S_1	7.58	7.93	7.14	7.55
S_2	7.96	7.62	7.33	7.64	S_2	7.67	8.03	7.42	7.71
S_3	8.20	7.72	7.37	7.76	S_3	7.49	8.33	7.41	7.74
Mean (D)	7.93	7.54	7.26		Mean (D)	7.58	8.10	7.32	
	D	S	D X S			D	S	D X S	
S.Em.±	0.08	0.08	0.14		S.Em.±	0.09	0.09	0.16	
C.D. at 5 %	0.25	0.25	NS		C.D.at 5%	0.28	0.28	NS	
C.V. %	3.25				C.V. %	3.69			
2020-21					Pooled				
Treatment	Time of sowing			M (S)		Time of sowing			M (S)
	D_1	D_2	D_3			D_1	D_2	D_3	
S_1	7.21	7.73	6.82	7.25	S_1	7.47	7.65	7.01	7.38
S_2	7.85	8.30	7.52	7.89	S_2	7.83	7.98	7.42	7.74
S_3	8.00	8.97	7.67	8.21	S_3	7.90	8.34	7.48	7.91
Mean (D)	7.20	7.47	5.20		Mean (D)	7.73	7.99	7.31	
	D	S	D X S			D	S	D X S	YXD
S. Em.±	0.18	0.18	0.32		S. Em.±	0.17	0.08	0.12	0.13
C.D. at 5 %	0.55	0.55	NS		C.D. at 5 %	NS	0.22	NS	0.38
C.V. %	7.07				C.V. %	5.01			

Table 4: Effect of different time of sowing and planting geometry on fruit diameter (cm).

2018-19					2019-20				
Treatment	**Time of sowing**			**M (S)**		**Time of sowing**			**M (S)**
	D_1	**D_2**	**D_3**			**D_1**	**D_2**	**D_3**	
S_1	1.58	1.52	1.49	1.53	S_1	1.53	1.47	1.44	1.48
S_2	1.61	1.55	1.52	1.56	S_2	1.56	1.51	1.50	1.53
S_3	1.64	1.59	1.54	1.59	S_3	1.60	1.52	1.53	1.55
Mean (D)	1.61	1.55	1.51		Mean (D)	1.56	1.50	1.49	
	D	S	D X S			D	S	D X S	
S. Em.±	0.03	0.02	0.04		S. Em.±	0.03	0.03	0.05	
C.D. at 5 %	0.09	0.09	NS		C.D.at 5%	0.08	0.08	NS	
C.V. %	3.25				C.V. %	5.19			
2020-21					Pooled				
Treatment	Time of sowing			M (S)		Time of sowing			M (S)
	D_1	D_2	D_3			**D_1**	**D_2**	**D_3**	
S_1	1.52	1.46	1.45	1.48	S_1	1.54	1.48	1.46	1.50
S_2	1.55	1.48	1.48	1.50	S_2	1.57	1.52	1.54	1.53
S_3	1.59	1.51	1.53	1.54	S_3	1.61	1.54	1.53	1.56
Mean (D)	1.55	1.48	1.49		Mean (D)	1.58	1.51	1.50	
	D	S	D X S			D	S	D X S	
S. Em.±	0.02	0.02	0.04		S. Em.±	0.01	0.01	0.02	
C.D. at 5 %	0.06	0.06	NS		C.D. at 5 %	0.07	0.06	NS	
C.V. %	4.13				C.V. %	4.52			

Table 5: Effect of different time of sowing and planting geometry on fruit weight (g)

2018-19					2019-20				
Treatment	**Time of sowing**			**M (S)**		**Time of sowing**			**M (S)**
	D_1	**D_2**	**D_3**			**D_1**	**D_2**	**D_3**	
S_1	7.18	6.43	5.72	6.44	S_1	7.11	6.42	5.69	6.41
S_2	7.55	6.23	5.71	6.50	S_2	7.57	6.01	5.61	6.39
S_3	7.98	6.52	6.09	6.86	S_3	7.86	6.57	6.07	6.83
Mean (D)	7.57	6.39	5.84		Mean (D)	7.51	6.33	5.79	
	D	S	D X S			D	S	D X S	
S.Em.±	0.17	0.17	0.28		S.Em.±	0.23	0.23	0.68	
C.D. at 5 %	0.50	0.50	NS		C.D.at 5%	0.68	0.68	NS	
C.V. %	7.48				C.V. %	10.43			
2020-21					Pooled				
Treatment	Time of sowing			M (S)		Time of sowing			M (S)
	D_1	D_2	D_3			D_1	D_2	D_3	
S_1	6.94	6.22	5.53	6.23	S_1	7.08	6.36	5.65	6.36
S_2	7.50	5.90	5.38	6.26	S_2	7.54	6.05	5.57	6.38

S_3	7.61	6.40	5.95	6.65	S_3	7.82	6.50	6.04	6.78
Mean (D)	7.35	6.17	5.62		Mean (D)	7.48	6.30	5.75	
	D	S	D X S			D	S	D X S	
S.Em.±	0.15	0.15	0.25		S.Em.±	0.11	0.11	0.19	
C.D. at 5 %	0.65	NS	NS		C.D. at 5 %	0.32	0.32	NS	
C.V. %	10.16				C.V. %	9.43			

Table 6: Effect of different time of sowing and planting geometry on number of fruits

2018-19					**2019-20**				
Treatment	**Time of sowing**			**M (S)**		**Time of sowing**			**M (S)**
	D_1	**D_2**	**D_3**			**D_1**	**D_2**	**D_3**	
S_1	7.24	6.75	5.43	6.47	S_1	7.11	6.43	5.69	6.41
S_2	7.21	6.86	5.59	6.55	S_2	7.22	6.01	5.62	6.28
S_3	7.38	6.88	5.72	6.66	S_3	7.20	6.57	6.07	6.61
Mean (D)	7.28	6.83	5.58		Mean (D)	7.17	6.33	5.79	
	D	S	D X S			D	S	D X S	
S. Em.±	0.13	0.13	0.23		S. Em.±	0.23	0.23	0.39	
C.D. at 5 %	0.40	NS	NS		C.D.at 5%	0.68	NS	NS	
C.V. %	6.05				C.V. %	10.49			
2020-21					Pooled				
Treatment	Time of sowing			M (S)		Time of sowing			M (S)
	D_1	D_2	D_3			D_1	D_2	D_3	
S_1	7.40	7.13	4.33	6.29	S_1	7.25	6.77	5.15	6.39
S_2	7.47	7.53	5.60	6.87	S_2	7.30	6.80	5.60	6.57
S_3	6.73	7.73	5.67	6.71	S_3	7.10	7.06	5.82	6.66
Mean (D)	7.20	7.47	5.20		Mean (D)	7.22	6.88	5.52	
	D	S	D X S			D	S	D X S	YxD
S. Em.±	0.13	0.13	0.23		S. Em.±	0.25	0.10	0.17	0.17
C.D. at 5 %	0.40	0.40	0.69		C.D. at 5 %	1.00	NS	NS	0.51
C.V. %	6.06				C.V. %	7.77			

Table 7: Effect of different time of sowing and planting geometry on yield (t/ha)

2018-19					**2019-20**				
Treatment	**Time of sowing**			**M (S)**		**Time of sowing**			**M (S)**
	D_1	**D_2**	**D_3**			**D_1**	**D_2**	**D_3**	
S_1	9.86	8.16	5.98	8.00	**S_1**	9.81	8.06	5.96	7.94
S_2	5.23	4.77	3.54	4.51	**S_2**	5.33	4.84	3.52	4.56
S_3	3.58	3.43	2.61	3.21	**S_3**	3.52	3.55	2.61	3.23
Mean (D)	6.23	5.45	4.04		Mean (D)	6.22	5.48	4.03	
	D	S	D X S			D	S	D X S	
S. Em.±	0.19	0.19	0.33		S. Em.±	0.18	0.18	0.31	
C.D. at 5 %	0.57	0.57	0.57		C.D.at 5%	0.54	0.54	0.93	
C.V. %	10.87				C.V. %	10.35			
2020-21					Pooled				
Treatment	Time of sowing			M (S)		Time of sowing			M (S)
	D_1	D_2	D_3			D_1	D_2	D_3	
S_1	9.64	7.01	3.08	6.57	S_1	9.77	7.74	5.00	7.50
S_2	4.86	4.26	2.18	3.77	S_2	5.14	4.62	3.08	4.28
S_3	3.03	2.42	0.94	2.13	S_3	3.38	3.13	2.05	2.85
Mean (D)	5.84	4.56	2.06		Mean (D)	6.10	5.17	3.38	
	D	S	D X S			D	S	D X S	YxD
S. Em.±	0.15	0.15	0.25		S. Em.±	0.27	0.10	0.17	0.17
C.D. at 5 %	0.44	0.44	0.75		C.D. at 5 %	1.06	0.28	0.49	0.49
C.V. %	10.46				C.V. %	10.63			

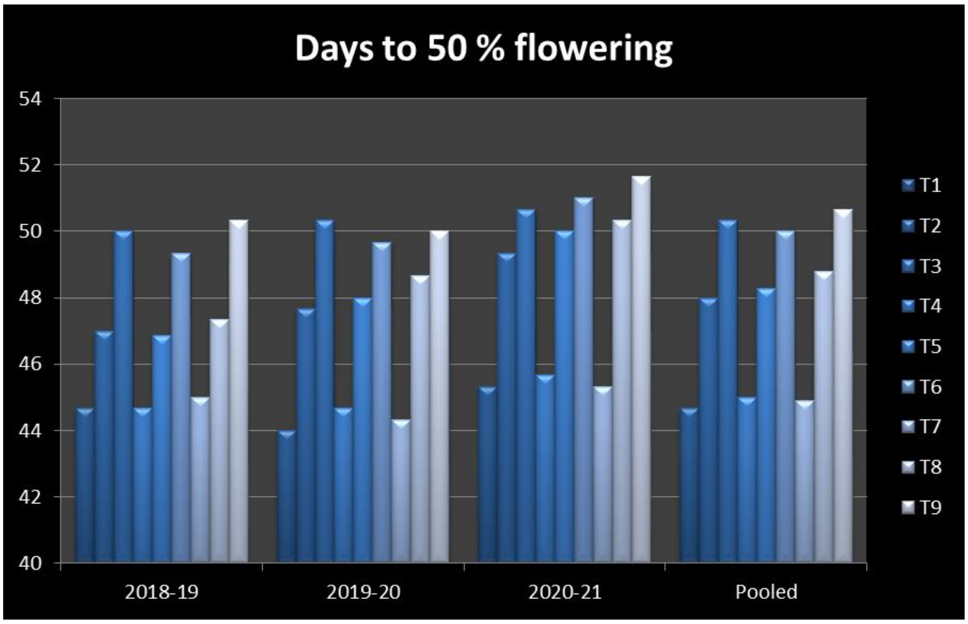

Fig 1: Effect of different time of sowing and planting geometry on days to 50 % flowering

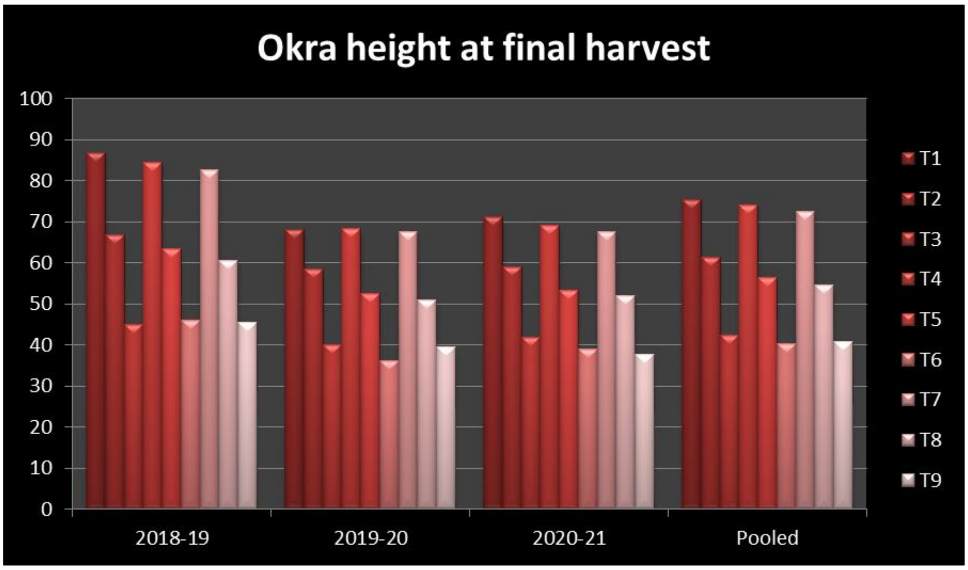

Fig 2: Effect of different time of sowing and planting geometry on okra height at final harvest (cm)

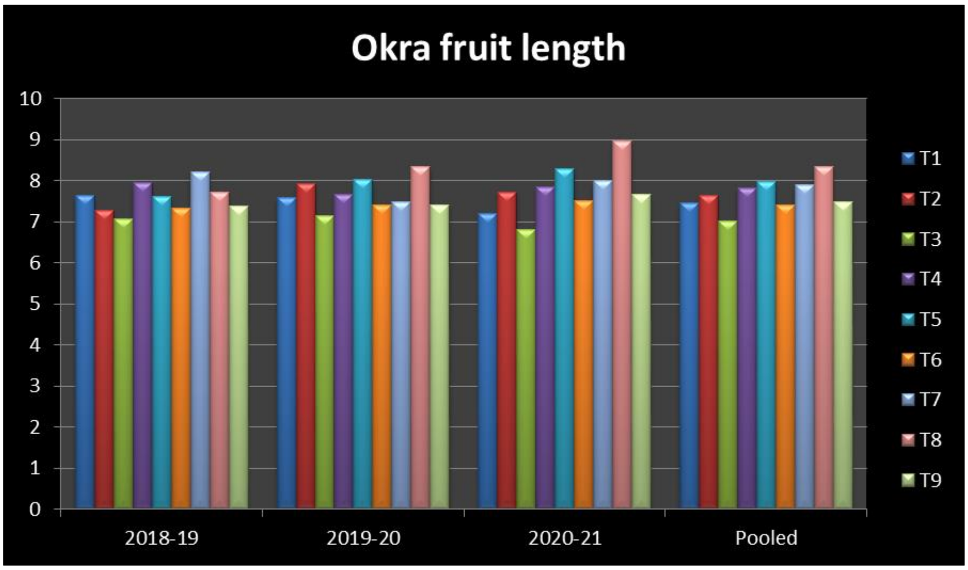

Fig 3: Effect of different time of sowing and planting geometry on okra fruit length (cm)

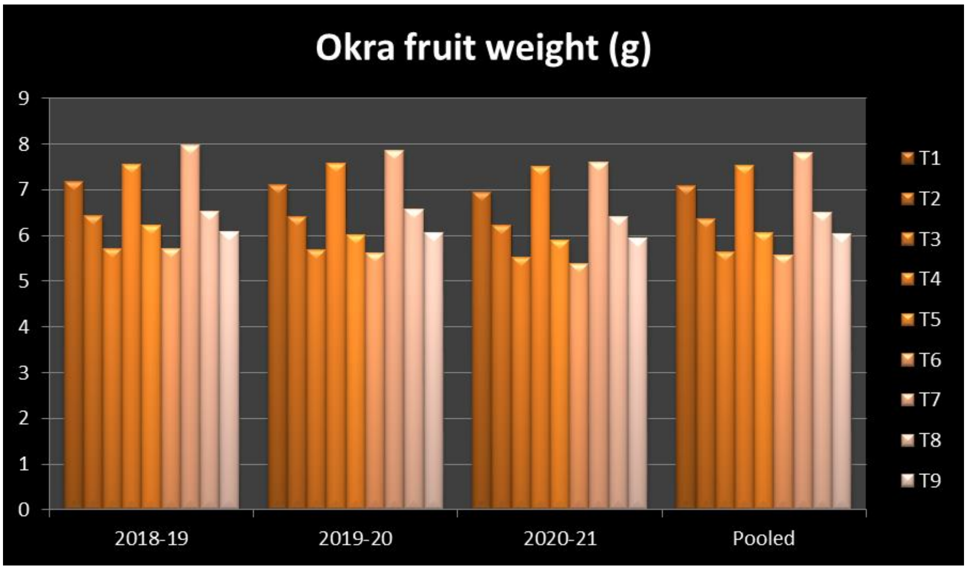

Fig 4: Effect of different time of sowing and planting geometry on okra fruit weight (g)

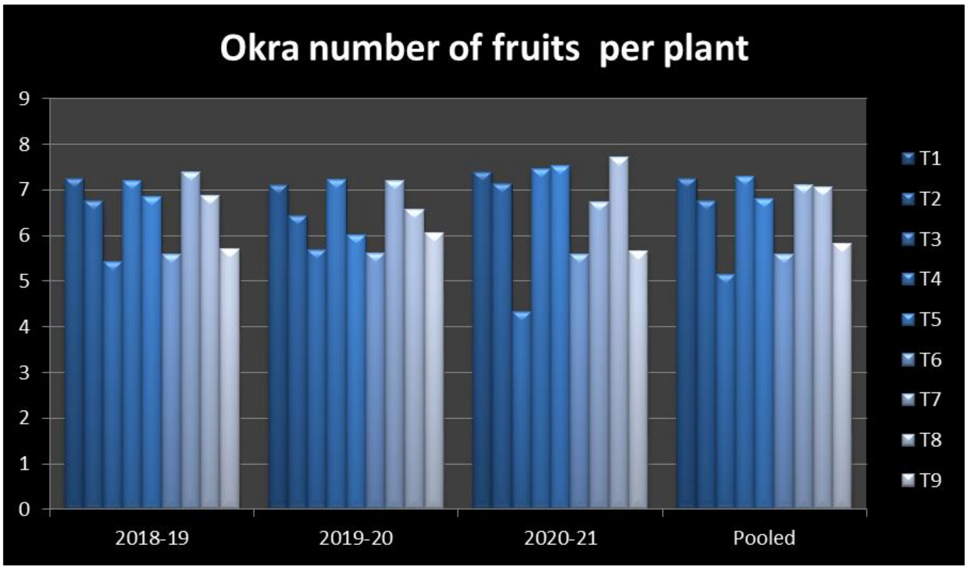

Fig 5: Effect of different time of sowing and planting geometry on number of fruits

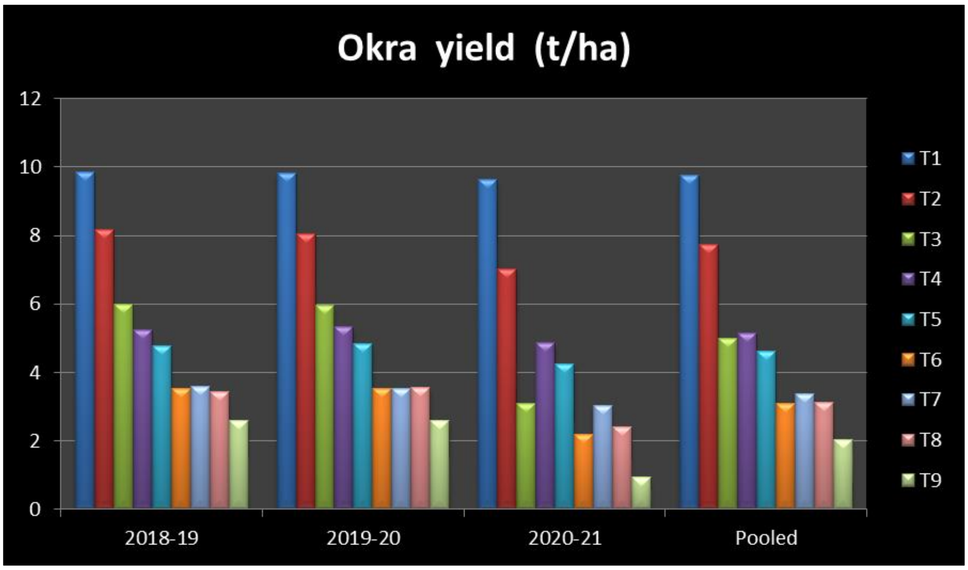

Fig 6: Influence of sowing dates and spacing on off season okra yield (t/ha)

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Nzikou J, Mvoula-Tsieri M, Matouba E. A study on gumbo seed grown in Congo Brazzaville for its food and industrial applications. African J. Biotech. 1985;5(24):2469-2475.
2. Ndunguru J, Rajabu AC. Effect of okra mosaic virus disease on the above-ground morphological yield components of okra in Tanzania. Scienta Horticulturae. 2004.99:225-235.
3. Anonymous. Indian Horticultural Database. National Horticulture Board. Gurgaon; c2021.
4. Mihretu Y, Wayessa G, Adugna D. Multivariate Analysis among Okra (*Abelmoschus esculentus* (L.) Moench) Collection in South Western Ethiopia. J Plant Sci., 2014.9(2):43-50.
5. Cook JA, Jagt DJ, Pastuszyn A, Mounkaila G, Glew RS, Millson M, Glew RH. Nutrient and chemical composition of 13 wild plant foods of Niger. J Food Comp. Anal. 2000;13:83-92.
6. Saha PK, Aditya DK, Sharfuddin AFM. Effects of plant spacing and picking interval on the growth and yield of okra cv. Pusa Sawani. Bangladesh J Hort. 1989;17(2):10-14.
7. Ghannad M, Madani H, Darvishi HH. Effects of different sowing times, irrigation intervals and sowing methods on okra. Int. J Farming and Allied Sci. 2014:3(6):683-689.
8. Moniruzzaman M, Uddin MZ, Choudhury AK. Response of okra seed crop to sowing time and plant spacing in south eastern hilly region of Bangladesh. J Agri'l. Res., 2007;32(3):393-402.
9. Zibelo H, Tsadik KW, Sharma JJ. Effect of inter and intra row spacing on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench] at Humera. J Bio Agric and Healthcare. 2016;6(3):92-108.
10. Kumar S, Dagnoko S, Haougui A, Ratnadass A, Pasternak D, Kouame C. Okra (*Abelmoschus* spp.) in West and Central Africa: potential and progress on its improvement. African J Agric. Res. 2010;5:3590-3598.
11. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, India; c1985.
12. Hossain MD, Salam MA, Islam MS, Masud MAT. Yield and quality of okra seed as influenced by time of sowing and pant spacing. Bangladesh J Seeds Sci Tech., 1999;3(1-2):83-87.
13. Chattopadhyay A, Dutta S, Bhattacharya I, Karmakar K, Hazra P. Technology for vegetable crop production. Published by All India Coordinated Research Project on Vegetable crops, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India; c2011. p. 680
14. Tandel BM, Nayaka P, Shah KA. Yield of okra as influenced by the different sowing dates and plant spacing. Int. J Chem. Stud. 2017;5(5):91-93.
15. Hossain MD, Salam MA, Islam MS, Masud MAT. Year round okra production and economic return as influenced by spacing in Barisal region. Bangladesh J Agric. Res., 2001;26:319-328.
16. Talukder MAH, Mannaf MA, Alam MK, Salam MA, Amin MMU. Influence of sowing time, plant spacing and picking interval on the growth and yield of okra. Pakistan. J Biol. Sci. 2003;6(18):1626-1630.
17. Gorchand M, Malik SC, Mondal G. Growth and yield of bhindi (*Abelmoschus esculentus* L. Moench) as influenced by time of sowing and planting density. Orissa J Hort. 1990;18:26-31.
18. Randhawa GS, Pannum MS. The effects of row spacing and level of nitrogen on the growth and yield of okra. (*Abelmoschus esculentus* L. Moench) J Res. Punjab Agric. Univ.Pakistan.1969;6:302-324.