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Effects of different seeding days on the development and early productivity of Okra (*Abelmoschus esculentus* L.) under semi-arid conditions of Quetta, Balochistan-Pakistan

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Abstract

Existing research work was imagined determining the effects of different times of sowing on the development and early productivity of Okra plant. Investigation was done at Balochistan agricultural research and development center, Quetta, in the year 2016 by using the Randomized Complete Block Design (RCBD). Sowing done with the interval of ten days (10th, 20th, 30th April). The ANOVA data on germination percentage, total survival percentage, average height of plant, and number of leaves at the time of flower appearance, days for flowering, average yield/plant, average yield/plot, and yield/acre revealed significant differences in different sowing times. The maximum germination percentage (64.85), total survival percentage (65.46 a), average height of plant (92.74), number of leaves at the time of first flowering appearance (9.70), average yield/plant (341.00), average yield/plot (13958.25) and yield/acre (4222) were noted for T_3 treatment (10th April) and lowest (25.51 c, 52.08 c, 76.31, 5.60, 286.25, 3656.75 and 1106) for T_1 treatment (30th April) respectively. Similarly, days taken for flowering exhibited maximum for T_3 treatment but minimum for T_2 treatment (20th April).

Keywords: Okra; Sowing time; Growth; Yield; Climatic connnnditions

1. Introduction:

In Pakistan, Okra (*Abelmoschus esculentus* L. Moench) is one of the greatest significant temporary vegetal crops in Pakistan and commonly known as lady finger and bhindi. It is belonged to the family Malvaceae and is native of Ethiopia in Africa (Khalid *et al*., 2005). It is now widely cultivated all over the humid and sub-humid areas of the world (Farinde *et al.*, 2007). In Pakistan it is cultivated over area of 14465/hac and total production of about 109239 tons of green pods is obtained (Government of Pakistan, 2005) while in Balochistan cultivated area is 2737 hectares and production 6822 tons in 2007-08 (Government of Balochistan, 2008). The genus *Abelmoschus* comprises of

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around 150 recognized species by esculentus as the species of cultivated Okra. This vegetable crop is relatively prevalent owing to its informal farming, reliable harvest flexibility to variable humidity circumstances (resilient to scarcity and waterlogging) and soil kinds and is also tolerant to wide variation in rainfall. Due to its wide adaptability and nutritional importance okra is successfully cultivated in other countries such as Egypt, China, Thailand, Nigeria, Sudan, South Africa, Ghana, India, Brazil, Cyprus and Caribbean. The financial standing of Okra cannot be exaggerated; wholly plant portions are fully used (Farinde *et al*., 2007). Okra fruits are very popular as a vegetable among all classes of people around the world (Talukder *et al.*, 2003). Okra is a healthful vegetal which is a significant basis of carbohydrate, vitamins (A, B & C), protein, potassium, calcium, dietary fibers and minerals and later, have a dynamic role in humanoid food (Rashwan, 2011). Dry seeds of okra contain about 20 to 30 per cent crude protein and its seeds may be roasted and ground to form a non-caffeinated substitute for coffee (Onyishi, 2011). Okra has medicinal importance also as it is used for curing ulcers, relief from hemorrhoids and is useful against spermatorrhoea, chronic dysentery and genitor-urinary disorders (Adams, 1975).

The growth, yield and quality of okra are hampered severely by inefficient production methods or lack of knowledge about the best cultivation and management practices, low awareness on the nutritional and health benefits, low quality seed standards and limited market access. Its production and productivity are also seriously affected due to the use of local varieties (low yielding), sub or supra-optimal plant density (improper inter and intra-row spacing), inappropriate planting dates, soil nutrients, and severe attack of various insect pests, diseases and weeds (Saha *et al*., 1989). The importance of sowing dates and spacing in okra cannot be overlooked as it affects different plant characters. Sowing dates have great impact on the seed production, growth and quality of okra. The different cultivars require different sowing times, as good cultivars sown at improper time give poor yield. Therefore, proper and suitable date of sowing is critical to increase the production of okra. Plant sown at proper time gets advantage of climatic factors, has high growth duration, receives proper rainfall, and experience optimal temperature during establishment and the early vegetative stage. As a result, fresh fruit yield and economic returns can be obtained. Improper sowing dates lead to shorter duration, inadequate utilization of rainfall, experiences cool temperature during establishment and the early vegetative stage, and fruit takes longer time to reach marketable size. The delayed sowing causes decreased fruit yield of okra (Ghannad *et al.,* 2014). Proper sowing time gives high fresh weight of fruit, a greater number of fruits per plant and ultimately increases fruit yield per plant. Balochistan, Pakistan, which is classified through variable climatic features (temperature, relative humidity and rainfall) Okra reply to seeding time can differ. Dates of planting might play a significant role on the production of okra plants. Ordinarily, 30 degrees Celsius is considered as an optimum temperature for germination of okra seed. Absence of the okra vegetable for winter months from the market creates a great demand for the vegetable consumers. It must be ascertained that sowing of seeds in April could have materialized early production of the crop and thus compensate the higher germination percentage in April in terms of economic return.

1.1. Objectives:

- To regulate the optimum seeding time for the diversity
- To deliver a foundation for regulating seeding times
- To enhance harvest in semi-arid climatic condition of Quetta.

2. Materials and Methods:

2.1. Climate and Metrological Data of study area:

Quetta is the capital of Balochistan province. It is located at an elevation of 1676 - 1900m above sea level. The type of weather of the study area is usually cold and dry. Extreme rainfall and snowfall arise in January and February. Summer periods remain modest, although June and July are the warmest month. January is the coolest month (Leghari & Zaidi, 2013). The difference in weather is the chief environmental feature, because of that flora of southern region varies from that of Northern. Due to distinction in these features, there is a dissimilarity in the penology of the crops from period to period (Leghari *et al.,* 2013b).

2.2. Experimental Details and Layout:

The present investigation was planned and perform in Balochistan Agricultural research and development Centre, Quetta, Pakistan in the year 2016. The plot was thoroughly ploughed and brought to the fine tilth. Planking

and harrowing were completed earlier the implementation of layout of the investigational field. The required area was marked, and 27 plots were prepared according to the layout plan. Seeds were lodged on elevated edges through diverse seeding times and planting spacing's. Around 2-3 seeds were seeded on one place then thinning of plantlets was done keeping one plant/stand after sprouting. Manures were practical by the rate of 100kg/ha nitrogen, 60 kg/ha phosphorus, 50 kg/ha potassium to the soil. The experimental plot was irrigated during the cropping period on need-based conditions. In order to maintain the uninterrupted growth of crop, four weeding were carried out as per the requirement. For recording of the observations 5 plants from the entire inhabitants were arbitrarily designated since, all the plants get identical environmental conditions and different characters occupied in investigation are Germination percentage, Total survival percentage, Average height of plant, number of leaves at the time of first flowering, Days taken for flowering, Average yield / plant, Average yield/plot and Yield per acre. Trial was arranged by RCBD method by 3 replications. Three seeding days at ten days interval i.e., 10th (T_1), 20th (T_2), and 30th April (T_3), and three planting distances i.e., 60 × 45cm (S_1), 60 × 60cm (S_2) and 60 × 75cm (S_3). Data collected was statistically analysis as defined by Steel & Torrie, (1980).

2.3. Plant Protection:

To control insect-pests and diseases the plant protection measures were adopted as per recommendations given in the package of practices for okra in semi-arid climatic conditions of Quetta.

2.4. Observations Recording and Analysis:

During the course of investigation following parameters were measured as; Germination percentage of okra seed and Total number of survival plants was determined by counting the total number of germinated seeds and Total number of survival plants in each treatment and then intended in percentage. Five plants were selected randomly in individually action and then the final height of 5 arbitrarily designated plants was noted in centimeters by measuring tape (Leghari *et al.,* 2013a). Number of leaves of each plant was determined by counting the leaves and days taken for first flowering were counted from germination dates to flowering dates. The average of these observation was used for statistical analysis and interpretation of results. For average yield/plant (gm) single plant was selected in each treatment and edible green pods from each picking was weighed, then the average of total picking was made. Average yield of green pods/plot (gm) was recorded by multiplying the yield per plant with the total number of plants in the entire plot and then it was converted in grams. Green pods of okra produced by a plot in each treatment were weighed and then converted to per acre. Yield per acre was shown in kilograms.

2.5. Statistical Analysis:

Collected data were subjected to analysis of variance technique (ANOVA). Duncan's multiple range test at 5% probability was used to compare the alterations among treatment (Steel & Torrie, 1980).

3. Results:

Research studies embodied in this investigation was aimed to determining the effects of different dates of sowing on various parameters of growth in relation to okra plant. There were three dates of planting by ten days interval. Data were collected on different parameters, which were included as; Germination percentage, Total survival percentage, Average height of plant, Number of leaves at the time of first flowering, Days taken for flowering, Average yield / plant, Average yield / plot and Yield per acre. The research was designed statistically by RCBD method. Statistical analysis was carried out and significant differences were shown in analysis of variance. Mean values for significant treatments were then subjected to statistical analysis and the results obtained were compared for performance of individual treatments. These studies were carried out in the Balochistan Agricultural Research and Development Centre, Quetta. The results pertaining to each parameter are discussed separately below.

3.1. Germination Percentage

Statistical data obtained on germination percentage of okra plants highly reflected upon significant differences for three treatments. Germination percentage of okra plants indicated significant superiority for T_3

(64.85%) over T_2 (44.53%) that, in turn, occupies the next best position and T_1 (25.51%) showed lowest germination percentage (Table 1 & 3).

Table 1: Effects of different sowing days on developmental parameters of Okra plant

Parameters	Days of seeding			Significant level
	T_1 (10th April)	T_2 (20th April)	T_3 (30th April)	
Germination percentage	25.51^{c}	44.53^{b}	64.85^{a}	***
Total survival percentage	52.08^{c}	56.65^{b}	65.46^{a}	**
Average height of plant (cm)	76.31^{c}	84.43^{b}	92.74^{a}	***
Number of leaves at the time of first flowering appearance	05.60^{c}	07.90^{b}	09.70^{a}	**
Days taken for flowering	31.75^{ab}	29.75^{b}	34.00^{a}	*

Table 2: Effects of different planting Times on developments of Okra crop

Parameters	Sowing Dates			Significant level
	T_1 (10th April)	T_2 (20th April)	T_3 (30th April)	
Average yield/plant	286.25^{b}	324.25^{a}	341.00^{a}	**
Average yield/plot	3656.75^{c}	7824.75^{b}	13958.25^{a}	***
Yield/acre	1106^{c}	2366^{b}	4222^{a}	***

** = Significant and *** = highly significant at 5% significant level

Table 3: Summary of statistical analysis (ANOVA) for Propagation (%).

S.O.V.	df	S.S.	M.S.	F.R.
Replicate	3	24.93	8.310	
Treatment	2	3097.19	1548.597	1134.82**
Error	6	8.19	1.365	
Total	15	3130.31		

** = highly significant

3.2. Total Survival Percentage

Information obtained on total survival percentage of okra plants reflected highly significant variation for different times of sowing treatments. Significantly highest survival percentage was noted for T_3 (65.46%), which followed by T_2 (56.65%) and lowest was noted in T_1 (52.08%) treatment (Table 1 & 4).

Table 4: Summary of statistical analysis (ANOVA) for Total Survival (%).

S.O.V.	df	S.S.	M.S.	F.R.
Replicates	3	2.43	0.810	
Treatment	2	369.79	184.897	83.57**
Error	6	13.27	2.212	
Total	11	385.49		

**= highly significant

3.3. Plant Height

Average plant height exhibited highly significantly differences amongst treatments when analysis of variance performs. Mean values for various treatments presented in Table 1 & 5 showed highest plant height in T_3 (92.74 cm) over T_2 (84.43 cm) that, in turn, occupies the next best position significantly and T_1 (76.31 cm) showed least plant height.

Table 5: Summary of ANOVA for Height of Plant (cm)

S.O.V.	df	S.S.	M.S.	F.R.
Replication	3	0.11	0.036	
Treatment	2	539.74	269.87	20759.23**

Error	6	0.08	0.013
Total	11	539.93	

** = highly significant

3.4. Number of leaves at the appearance of first flowering

Data on number of leaves at appearance of first flowering were subjected to statistical analysis and found differences amongst treatments. Results indicated significant superiority of T_3 (9.70) over T_2 (7.90), which occupies the next best position significantly, and it turned out to be superior to T_1 (5.60) (Table 1 & 6). Number of leaves is usually dependent on the vigor and height of plant. The fact that T_3 (30th April) presented greatest number of leaves reflected upon the findings the same treatment might have given the better vigor. This might be due to suitable for okra in the semi-arid condition of the study area. This has been found by the data on height of the plants.

Table 6. Summary of ANOVA for number of leaves at Appearance of Flowering

S.O.V.	**df**	**S.S.**	**M.S.**	**F.R.**
Replication	3	0.45	0.149	
Treatment	2	33.79	16.893	100.03**
Error	6	1.01	0.169	
Total	11	35.25		

** = highly significant

3.5. Flowering Period

One would observe from the mean values of days taken for flowering that T_3 and T_1 stood at equivalence. Similarly, Amjad *et al.,* (2001) reported that the time required to flowering was not affected by the sowing dates. In a similar manner T_1 and T_2 behaved significantly alike. As such T_1 occupied an intermediate position. These means followed a sequence of T_3, T_1 and T_2 giving 34, 31.75 and 29.75 days for flowering, respectively (Table 1 & 7). Various means, however, did not depict a well- defined superiority among different treatments, because T_3 (30th April) came at par with T_1 (10th April) and likewise T_1 and T_2 exhibit identical statistical position.

Table 7: Summary of statistical analysis for days taken for Flowering

S.O.V.	**df**	**S.S.**	**M.S.**	**F.R.**
Replication	3	16.33	5.444	
Treatment	2	36.17	18.083	5.66**
Error	6	19.17	3.194	
Total	11	71.67		

** = highly significant

3.6. Average yield/plant

Data on average yield/plant were exposed to statistical analysis and consequences gotten are showed in Tables 2 & 8 as analysis of variance. Consequences indicated differences amongst treatments turned highly significant. The average yield/plant were found highest for T_3 (341 gm) which followed by T_2 (324.25 gm) they both excelled from T_1 (286.25 gm) treatment significantly. Late sowing on 30th April (T_3) obtained the highest and early sowing on 10th April (T_1) showed lowest position. This might be due to that the yield of plant would not only depend upon the absorbent vigor of plant and also on the agro-climatic condition.

Table 8: Summary of ANOVA for Average Yield/plant (gm)

S.O.V.	**df**	**S.S.**	**M.S.**	**F.R.**
Replication	3	206.33	68.778	
Treatment	2	6296.17	3148.083	25.83**
Error	6	731.17	121.861	
Total	11	7233.67		

** = highly significant

3.7. Total yield/plot and Total yield/acre:

Obtained mean values of total yield/plot and average total yield/acre showed highly significant variation amongst different sowing dates. Consequences displayed significant superiority of T_3 (13958.25gm/plot and 4222kg/acre) over T_2 (7824.75gm/plot and 2366kg/acre) that occupies the next best position significantly and turned out to be superior to T_1 (3656.75 gm/plot and 1106kg/acre) treatment, respectively (Table 2, 9 & 10).

Table 9: Summary of ANOVA average yield/plot (gm)

S.O.V.	df	S.S.	M.S.	F.R.
Replicate	3	2046568.25	682189.417	
Treatment	2	214817264.67	107408632.33	319.60**
Error	6	2008422.333	236070.333	
Total	11	218880254.92		

** = highly significant

Table 10. Summary of ANOVA for yield/Acre (kg).

S.O.V.	df	S.S.	M.S.	F.R.
Replication	3	188042	62680	
Treatment	2	19654532	9827266	319**
Error	6	184763	30793	
Total	11	20027337		

** = highly significant

4. Discussion:

The variation in germination percentage on different dates were also reported by Amjad *et al.* (2001). They found maximum germination percentage when crop was sown on 25 April or 5 May, while significantly minimum germination was recorded when crop was sown on 15 April. This might be because of the result of usual ecological circumstances particularly temperature and humidity on seed propagation. Okra is a summer or midsummer crop therefore it prefers warmer temperatures. Superiority of T_3 these results could be attributed to favorable study area (Quetta city) temperature for germination. It is facts that Okra is primarily a midsummer crop and would prefer warmer temperature for germination. Our data have confirmed these findings. The month of April provides sufficiently appropriate temperature for the germination of seed; it appears from the data that earlier plants presented low germination percentage. Similar observations were also reported by Hussain *et al.* (2006). The difference in seeding days is the key reason of alteration in sapling appearance and their existence and potency of seedlings, as reported by Gadakh *et al.* (1991). Relative humidity and monthly average temperature were noted over the trial period for two years and were well-thought-out best for development and growth of Okra (Katung, 2007). Iremiren & Okiy, (1986) observed poor germination in early sowing date.

Contrary to our results, Amjad *et al.* (2001) reported that the vegetable height was not pretentious knowingly through the time of sowing and it was almost the same at each of the sowing date. However, they found plant height was significantly affected by various fertilizer doses. Present consequences indicated highest plant height in T_3 and lowest in T_1 treatment which might be due to variation in local (Quetta) climatic condition (temperature) as compared to Faisalabad because okra prefers warmer temperatures for better growth. At current study site temperature remain low comparatively on early days of April then that of late April this could be attributed to the genetic constitution of the plant, which could grow in higher temperature coupled with lack of humidity. The fact that other treatments lacked behind could not be attributed the early transplanting because in the month of April, regardless of their date of planting, the plants are subjected to higher temperature. This could be attributed to the initial advantage, which the April planting affected for better germination and development of growth, due of favorable temperature condition. Likewise, Mondal *et al.* (1989) perceived that Okra seeded in April made the maximum plants height, that harvest great yield with respect to the seed seeded during June. According to Singh *et al.* (1986) under Hisar (Haryana) conditions the okra crop sown on 15th June recorded supreme plant height, number of branches and number of pods/plants, length of pods, weight of 1000 seeds and seed yield/hectare.

The variation in number of leaves per plant due to different sowing time was also noted by other investigators (Amjad *et al.,* 2001; Elhag & Ahmed, 2014) depending on environmental condition of the experimental sites. Amjad *et al.* (2001) reported maximum number of leaves once plant was seeded on 15th April or 5th May and minimum leaves numbers was recorded when crop was sown on April 25 this might be due to variation in

environmental and weather conditions. Similarly, Elhag & Ahmed, (2014) found highest plant height and number of leaves at early sowing on 1st of July instead of late seeding on July 20th and August 10th. Good start of plants would reflect upon the better vigor situation. It is parallel to the common statement that well began is half done, for the future development of plant. Hence, greater number of leaves by virtue of better vigor could be consequent upon good short in germination. Highest height of plant, greatest number of fruits/plant and maximum fruit yield from Okra crop was recorded by Mondal *et al.* (1989) when seedling was done on 20th April during spring summer season.

This information indicated that later planting developed early flowering period. The cause may be because of the adaptation of diverse Okra cultivars to native situations as well as getting the best temperature and promising ecological circumstances. Similar statement was also reported by Hussain *et al.* (2006). Further that it has generally been seen that the more vigorous the plant in growth, the delayed flowering could occur. This could be attributed to a tendency of plant to its vegetative growth. Prompt picking on May 28th and June 8th, 2005, seeding times were because of rapid appearance and quick flowering, getting an optimal temperature and length of day that produced timely flowering and acquired fewer number of days to first picking. The aim strengthens due to the adaptation of various Okra varieties to local circumstance and receipting the best temperature and environmental situations. Similar statement was also reported by Hussain *et al.* (2006). It was observed for germination, height and number of leaves of plant that T_3 occupied the highest place. It had out yielded plants of the other treatments. Similar observations were also reported by Bake *et al.* (2017). They found maximum fruit yield per plant on late sowing date D3 (30th June) as compared to the 10th (D_1) and 20th (D_2) treatments. Present consequences are in agreement by the conclusions of Talukder *et al.* (2003); Firoz *et al.* (2007) and Bake *et al.* (2017). The variation in in total yield/plot and total yield/acre were also noted by other researchers (Yogesh *et al.,* 2001; Talukder *et al.,* 2003; Firoz *et al.,* 2007; Bake *et al.,* 2017). Bake *et al.* (2017) reported that in case of sowing dates, D_1 (June 10th) seeding listed greatest fruit yield (q/ha).

5. Conclusion:

After investigation, it can be resolved that in Quetta Balochistan, Pakistan which had semi-arid condition, the best seeding time for Okra would be the early April. This linked by a different parameter, which were included as; Germination percentage, Total survival percentage, Average height of plant, Number of leaves at the time of first flowering, Days taken for flowering, Average yield / plant, Average yield / plot and Yield per acre. It is though suggested that additional study be completed to assess a broader range of Okra variations and crosswise diverse places inside changed climatic conditions of Balochistan, Pakistan and to meet the great demand of market created by the vegetable consumers.

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