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Appraisal of various Okra Genotypes on the basis of growth and yield Traits under Agro-climatic conditions of Peshawar

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Agroclimatic conditions are important for the development of plants. These factors can increase or decrease the yield of plant. We studied the effect of Agroclimatic condition on different varieties of *Abelmoschus esculents* (Okra). We tried to find out the yield attribute of different genotypes of *Abelmoschus esculents* (Okra). For this purpose, we cultivated different varieties of *Abelmoschus esculents* (Okra) using RCBD (Randomized complete block design) with three replications. We observed various plant traits during June and July. The observations were recorded for growth, yield and biomass parameters. In context of plant height variety Swat Green showed significant values (94.41cm) during June 2021 and (118.84cm) during July 2021, in context of branches of plant variety Sabz Pari showed significant values (1.77) during July 2021and number of leaves variety Sabz Pari showed significant values (20.04) during June 2021 and (29.79) during July 2021, number of flowers per plant variety Sabz Pari showed significant values (3.23) during June 2021 and (3.50) during July 2021, fruits per plant variety showed significant values during June 2021 and (118.84cm) during July 2021, fruit length variety showed significant values during June 2021 and (118.84cm) during July 2021, weight per fruit variety showed significant values during June 2021 and (118.84cm) during July 2021, the weight of fruits per plant variety showed significant values during June 2021 and (118.84cm) during July 2021. Agroclimatic conditions of Peshawar are favourable for the growth and yield of *Abelmoschus esculents* (Okra) during June and July.

Keywords: Agroclimatic conditions, *Abelmoschus esculents,* yield attribute, Peshawar

INTRODUCTION

Agro climate is defined as the total climatic conditions making possible to cultivate the crops economically. Agro climatic conditions refer to soil types, rainfall, temperature, and water availability which influence the type of vegetation. Soil of district Peshawar contains 32.6% sand, 42.56% silt and 20% clay. These percentages shows that the soil belongs class loam. Loam is a soil comprised of almost equal amounts of sand and silt and a little less clay the average pH of Peshawar district is about 7.4 (Rehman et al. 2017) Winter in Peshawar starts from Mid of November to the end of March. Summer months are May to September. The mean maximum temperature in summer is over 40 °C (104 °F) and the mean minimum temperature is 25 °C (77 °F). The mean minimum temperature during winter is 4 °C (39 °F) and maximum is 18.35 °C (65.03 °F). *Abelmoschus esculentus* (Okra) grows best at temperatures between 75 and 90 °F (Ali et al. 2018) *Abelmoschus esculentus* (Okra) belonging to the family Malvaceae also known as lady's finger and locally known as bhindi with somatic chromosome number 2n=130. The showy corolla of *Abelmoschus esculentus* (Okra) is basically self-pollinated crop cooked, canned and consumed in various forms in the subtropics of world for its tender, delicious green fruits (Rajesh et al. 2018). For cultivation as a garden crop as well as on large commercial farms this crop is suitable (Tripathi *et*

al. 2011). As green immature pods or sun dried and ground into powdery form consumed by almost all Sudanese people in the preparation of favourable Sudanese Molah locally known as weika is used as an ingredient (Osman et al. 2005). Due to soil deficiency in most of the nutrients required for plant growth and fruit development the crops yield obtained in Pakistan are lesser than existing potential. The plant could not grow vigorously to resistant insect pests and disease attack and crop produces lower yields than the potentials due to soil nutrient deficiency (Faisal et al. 2021) *Abelmoschus esculentus* (Okra) depends on several factors such as seed quality, nutrition, climatic conditions, and cultural practices as well as differences in genetic potentials for growth and yield performance (Eshiet et al. 2014). For sustainable *Abelmoschus esculentus* (Okra) cultivation and minimizing reliance on expensive imported *Abelmoschus esculentus* (Okra) seed production on domestic level is an essential component. Generally supplied by unreliable sources or the seed is produced by local farmers (Reddy et al. 2017). Produce fruit throughout the season after developing 5 to 8 leaves and continue to flower and produce fruit (Meena et al. 2017). The fruit must mature on the plant for seed production and to divert the photo assimilate distribution from plant growth and flower formation. Thus, the total number of pods formed increase with harvesting the young pods (Setubal *et al.* 1994). Farmers generally pick green fruits and allow only a small number of pods to mature for seed production and hence the seed yield is minimized. The commercial production of seed is further restricted (Khan and Jaiswal et al. 1988). Thus, seed quality may be enhanced by fruit load management (Moniruzzaman et al. 2007; Faisal et al. 2021) and the hard seediness' observed in most Hibiscus species is Another major problem in seed production (Musara et al*.* 2015) delay or failure to germinate is caused by the hard seeds which are characterized by thick seed coat (Khan et al. 2019). Hence, the current study was planned to investigate *Abelmoschus esculentus* (Okra) genotypes based on growth characters and yield attributes of each genotype.

MATERIALS AND METHODS

The experiment was conducted at Agriculture Research Institute (ARI) Tarnab, Peshawar during the year 2021 and was carried out in Randomized Complete Block Design (RCBD). The whole field was divided into three main replicates. Then each replicate was further divided into 5 sub replicates i.e., 3×5-meter square area representing each genotype, following Katrina et al. (2019).

Collection of seeds

The seeds were collected from vegetable section of Tarnab farm Peshawar (ARI). The seeds were certified from physiology department of Tarab farm Peshawar. The following five different genotypes of seeds were used in this experiment Sabzpari, Super Green, Swat Green, Singhram, Arkanomika.

Treatments	Genotypes
T1	Sabzpari
T2	Arkanomica
T3	Swat green
T4	Singhram
T5	Super green

Plot Size

The size of plot was 20×12-meter square area and the field was irrigated.

Ploughing

The fields were ploughed.

Designing

The field were divided into three main replicates and then each replicate was further divided into 5 treatments representing each genotype. Four rows were created in each treatment

Plants tagging

Two plants were randomly selected from each row in every treatment and properly tagged with plastic tags named as R_1P_1, R_1P_2, R_2P_1, R_2P_2, R_3P_1, R_3P_2, R_4P_1, R_4P_2 etc.

Date of sowing

The seeds were sown in the agriculture institute (ARI) Peshawar on 9th April 2021. The seeds were sown in the CRBD (complete randomized block design) in three replications each containing five treatments at spacing of 12cm and 60cm between the plants and the rows.

Data Collection

Days to initiation of germination

Number of days to completion of germination was counted from the date of sowing to completion of germination.

Growth Parameters

No of leaves

The total number of leaves per plant of the selected plants were counted in each treatment.

Plant Height

The length of selected plants from each treatment were noted with the help of scale in cm.

Number of Branches

Number of branches of selected plants from each treatment were noted.

Number of Flowers
Number of flowers were noted from selected plants from each treatment.

Yield parameters

Number of fruits
Number of fruits were noted from selected plant from each treatment.

Fruit length
Number of fruit length were noted from selected plant fruit from each treatment.

Average weight per fruit
Average weight per fruit were noted from selected plant from each treatment.

Average weight of fruit per plant
Average weight of fruit per plant were noted from selected plant from each treatment.

Days to flowering
Number of days were counted from the sowing date to initiation of first flower in each treatment.

Days to fruiting
Number of days were counted from sowing date to initiation of first fruit in each treatment.

RESULTS AND DISCUSSION

The current experiment was performed during June-July 2021 at the physiology department of Tarnab agriculture institute GT Road Peshawar. The following okra varieties were used, i.e., Sabz Pari, Arkanomika, Swat Green, Singhram, Super Green. These varieties were evaluated for growth and yield indices under agroclimatic conditions of Peshawar.

The observations were recorded for plant height, branches of the plant, number of leaves, number of flowers per plant, fruits per plant, fruit length, weight per fruit, the weight of fruits per plant.

Plant height

Our results indicate that the variety Swat Green shows significant values in plant height with respect to soil, air, temperature agroclimatic conditions. It shows that the variety Swat is well for agroclimatic conditions of Peshawar. However, the variety Singhram shows insignificant value. The variety is not suitable for the agroclimatic conditions of Peshawar. The agroclimatic conditions of Peshawar do not favour good plant Height in variety Singhram. The variety Swat Green shows significant Plant Height at agroclimatic conditions of Peshawar (43°C) And pH 7.4 of soil. Faisal et al. (2021) also worked on different varieties of okra and found that variety Sabz Pari had significant value in plant height at these Maximum 46°c temperatures and 7 pH of soil conditions similarly Khan et al. (2020) also worked at same agroclimatic conditions on different okra varieties and found that variety Pusa Green and Clemson had significant value in plant height at these Maximum 47°C temperatures and at 8.3 pH of soil conditions. Our results are corroborated with the other works at same agroclimatic conditions.

Table1: Plant height

Treatments	Plant height (cm)
Sabzpari	80.38±5.55ab
Arkanomika	85.91±8.53ab
Swat Green	94.41±4.11a
Singhram	73.75±2.74b
Super Green	89.76±6.71 ab

Number of Leaves

Our results indicate that the variety Sabz pari shows significant values in the number of leaves with respect to soil, air, temperature agroclimatic conditions. It shows that the variety Sabz Pari are admirably adapted to the agroclimatic conditions of Peshawar. However, the variety Singhram shows insignificant value. The variety Singhram is not suitable for the agroclimatic conditions of Peshawar. The variety Sabz Pari shows the significant value at agroclimatic conditions 43°C and pH 7.4 of soil. Uddin *et al.* (2014) worked on the growth and yield of okra as influenced by various levels of nitrogen and found that the maximum number of leaves was found from N2. In this experiment he used different levels of nitrogen i.e., N0, N1, N2, N3. Similarly, Katrina *et al.* (2019) worked on Response growth and yield of okra to giving dosage levels of chicken manure and variation of plants spacing and found that the dosage of chicken manure 35 ton/ha gives the best number of leaves at 80 DAP flowers per plant.

Table 2: Number of leaves per plant

Treatments	No of leaves per plant
Sabzpari	20.04±1.46 a
Arkanomika	15.33±0.92 b
Swat Green	15.33±0.93 b
Singhram	13.11±1.22 b
Super Green	14.35±0.76 b

Number of Flower per Plant

Our results indicate that the variety Sabz Pari shows significant value in the number of flowers per plant with respect to soil, air, temperature agroclimatic conditions. It shows that the variety Sabz Pari is well adapted for the agroclimatic conditions of Peshawar. However, the variety Singhram shows insignificant value. The variety Singhram is not suitable for the agroclimatic conditions of Peshawar.

Table 3: Number of flowers per plant

Treatments	No of flower per plant
Sabzpari	3.23±0.40 a

Arkanomika	2.60±0.10 ab
Swat Green	2.23±0.17 b
Singhram	2.00±0.11 b
Super Green	2.26±0.20 b

Fruits per Plant

Our results indicate that the variety Sabz Pari shows significant values in fruits per plant with respect to soil, air, temperature agroclimatic conditions. It shows that the variety Sabz Pari is admirably adapted in the agroclimatic conditions of Peshawar. However, the variety Swat Green shows insignificant value. The variety Swat Green is not suitable for the agroclimatic conditions of Peshawar.

Table 4: Fruits per plant

Treatments	Average no of fruits per plant
Sabzpari	13.26±1.29a
Arkanomika	10.69±1.16ab
Swat Green	9.04±0.53ab
Singhram	10.47±0.71b
Super Green	10.21±0.15b

Fruit Length

Our results indicate that the variety Super Green shows significant values in fruit length with respect to soil, air, temperature agroclimatic conditions. It shows that the variety Super Green is well for the agroclimatic conditions of Peshawar. However, the variety Singhram shows insignificant value. The variety Singhram is not suitable for the agroclimatic conditions of Peshawar. The variety Super Green shows the significant value at agroclimatic conditions 43°C and pH 7.4 of soil. Khan et al. (2002) also worked at same agroclimatic conditions on varieties of okra and found that variety Pusa Green had significant value in Fruit Length at these Maximum 47°C temperatures and at 8.3 pH of soil conditions similarly Faisal et al. (2020) also worked at climatic conditions on varieties of okra and found that variety Sabz Pari had significant value in Fruit Length at Maximum 46°C temperature and at 7 pH of soil conditions

Table 5: Fruit length

Treatments	Average fruit length (cm)
Sabzpari	9.96±0.12ab
Arkanomika	9.83±0.61ab
Swat Green	9.46±0.32ab
Singhram	8.96±0.31b
Super Green	10.53±0.31a

Weight per Fruit

Our results indicate that variety Sabz Pari shows significant values in weight per Fruit with respect to soil, air, temperature agroclimatic conditions it shows that variety Sabz Pari is well adapted to agroclimatic conditions of Peshawar. However, the variety Swat Green shows insignificant value. The variety Swat Green is not suitable for the agroclimatic conditions of Peshawar. The variety Sabz Pari shows the significant value at agroclimatic conditions 43°C and pH 7.4 of soil. Faisal *et al.* (2021) also worked on different varieties of okra and found that variety Sabz Pari had significant value in weight per fruit at these Maximum 46°C temperatures and at 7 pH of soil conditions similarly Ashraf *et al.* (2020) also worked on different varieties of okra and found that variety IPSA Okra had significant value in weight per fruit at different conditions of Temperature the maximum temperature recorded during the experiment were 36°C while in our experiment it was 43°C.

Table 6: Weight per fruit

Treatments	Average weight (gm) per fruit
Sabzpari	18.69±1.37a
Arkanomika	13.81±2.17ab
Swat Green	12.02±0.46b
Singhram	13.75±1.44ab
Super Green	15.66±1.70ab

Weight per plant

Our results indicate that variety Sabz Pari shows significant values in weight per plant with respect to soil, air, temperature agroclimatic conditions It shows that variety Sabz Pari is well adapted to agroclimatic conditions of Peshawar. However, the variety Swat Green shows insignificant value. The variety Swat Green is not suitable for the agroclimatic conditions of Peshawar. The variety Sabz Pari shows the significant value at agroclimatic conditions 43°C and pH 7.4 of soil Because Sabz Pari also showed significant value in number of leaves and flowers per plant. Leaves play a vital role in growth of plant via photosynthesis and flowers converts to fruit and it leads that plant to gives us satisfactory results. Khan *et al.* (2020) also worked on different varieties of okra and found that variety Pusa Green had significant value in weight per fruit at these Maximum 47°C temperatures and at 8.3 pH of soil condition similarly Firoz et al. (2007) worked on yield attributes of okra influenced by planting time and he found that the highest weight per plant was obtained from plants of July sowing.

Table 7: Weight per plant

Treatments	Average weight (gm) of fruits/plant
Sabzpari	251.22±42.28a
Arkanomika	151.36±34.67ab
Swat Green	109.10±10.22b
Singhram	146.02±24.92b
Super Green	160.26±19.15ab

Plant Height

Our results indicate that variety Swat Green shows significant values in plant height with respect to soil, air, temperature agroclimatic conditions It shows that variety Swat Greens are admirably adapted to agroclimatic conditions of Peshawar. However, the variety Singhram shows insignificant value. The variety Singhram is not

suitable with the agroclimatic conditions of Peshawar.

Table 8: Plan height

Treatments	Plant height (cm)
Sabzpari	102.93±8.25 ab
Arkanomika	113.71±10.93 ab
Swat Green	118.84±3.26 a
Singhram	98.10±1.41 b
Super Green	116.70±7.41 a

Branches per plant

Our results indicate that variety Sabz Pari shows significant values in branches per plant with respect to soil, air, temperature agroclimatic conditions. Therefore, variety Sabz Pari is admirably adapted to agroclimatic conditions of Peshawar. However, the variety Super Green shows insignificant value. The variety Super Green is not suitable for the agroclimatic conditions of Peshawar. Faisal et al. (2020) also worked on different varieties of okra and found that variety Sabz Pari shows significant value in no of branches per plant at Maximum 46°C temperature and at 7 pH of soil conditions similarly Maduwanthi and Karunarathna (2019) worked on the Growth and Dry Matter Accumulation of Okra as Influenced by different plating pattern. The higher number of branches was recorded in T1 due to the free and wider spacing between planting rows so that's why okra plants used energy properly and produced a higher number of branches per plant.

Table 9: Branches per plant

Treatments	No of branches per plant
Sabzpari	1.77±0.26 a
Arkanomika	1.20±0.20 b
Swat Green	1.13±0.66 b
Singhram	1.06±0.06b
Super Green	1.03±0.03b

Leaves per plant

According to results variety Sabz Pari shows significant values in leaves per plant with respect to soil, air, temperature agroclimatic conditions it shows that variety Sabz Pari is admirably adapted to agroclimatic conditions of Peshawar. However, the variety Singhram shows insignificant value. The agroclimatic conditions of Peshawar do not support growth of variety Singhram.

Table 10: Leaves per plant

Treatments	No of leaves per plant
Sabzpari	29.79±4.53a
Arkanomika	22.82±1.07b
Swat Green	21.98±2.05b
Singhram	17.38±0.18b
Super Green	21.59±2.30b

Flower per plant

Our results indicate that variety Sabz Pari shows significant values in flower per plant with respect to soil, air, temperature agroclimatic conditions. It shows that variety Sabz Pari is well adapted to agroclimatic conditions of Peshawar. However, the variety Singhram shows insignificant value the variety Singhram is not suitable with the agroclimatic conditions of Peshawar.

Table11: Flower per plant

Treatments	No of flower per plant
Sabzpari	3.50±0.98a
Arkanomika	2.63±0.08a
Swat Green	2.50±0.30a
Singhram	2.30±0.25a
Super Green	2.66±0.21a

Fruits per plant

Our results indicate that variety Sabz Pari shows significant values in fruit per plant with respect to soil, air, temperature agroclimatic conditions It shows that variety Sabz Pari is admirably adapted to agroclimatic conditions of Peshawar. However, the variety Super Green shows insignificant value. The variety Super Green is not suitable for the agroclimatic conditions of Peshawar. Ashraf *et al.* (2020) also worked on different varieties of okra and found that variety JHALOK had significant value in Fruits per plant at different temperatures conditions. Similarly, Faisa*l* et al. (2021) also worked on different varieties of okra and found that variety Sabz Pari shows a significant value at different temperatures conditions.

Table 12: Fruits per plant

Treatments	No of fruits per plant
Sabzpari	8.86±1.27 a
Arkanomika	7.40±0.47 ab
Swat Green	6.56±1.10 ab
Singhram	5.99±0.73 b
Super Green	6.06±0.24 b

Fruits length

Our results indicate that variety Super Green shows significant values in fruits length with respect to soil, air, temperature agroclimatic conditions. It shows that variety Super Green are admirably adapted to agroclimatic conditions of Peshawar. However, the variety Singhram shows insignificant value variety Singhram is not suitable with the agroclimatic conditions of Peshawar.

Table 13: Fruits length

Treatments	Fruit length (cm)
Sabzpari	10.80±0.20 a
Arkanomika	10.10±0.65 a
Swat Green	10.50±1.00 a
Singhram	9.86±0.68 a
Super Green	11.76±0.23 a

Weight per Fruit

Our results indicate that variety Sabz Pari shows significant values in weight per fruit with respect to soil, air, temperature agroclimatic conditions It shows that variety Sabz Pari are admirably adapted to agroclimatic

conditions of Peshawar. However, the variety Singhram shows insignificant value. The variety Singhram is not suitable with the agroclimatic conditions of Peshawar.

Table 14: Weight per fruit

Treatments	Average weight per fruit (gm)
Sabzpari	23.62±1.97 a
Arkanomika	19.99±1.08 a
Swat Green	21.89±3.67 a
Singhram	17.73±2.34 a
Super Green	21.86±1.48 a

Weight of Fruit per Plant

Our results indicate that variety Sabz Pari shows significant values in weight of fruit per plant with respect to soil, air, temperature agroclimatic conditions It shows that variety Sabz Pari are admirably adapted to agroclimatic conditions of Peshawar, however, the variety Singhram shows insignificant value. The variety Singhram is not suitable with the agroclimatic conditions of Peshawar.

Table 15: Weight of fruit per plant

Treatments	Average weight of fruits (gm)/plant
Sabzpari	213.41±47.36 a
Arkanomika	148.89±17.65 ab
Swat Green	150.30±43.90 ab
Singhram	108.45±23.63 b
Super Green	131.98±4.45 ab

CONCLUSIONS

According to our observation that variety Sabz Pari shows significant value in response to agroclimatic conditions of Peshawar. However, the variety Super Green shows insignificant value. The variety Super Green is not suitable for the agroclimatic conditions of Peshawar. Overall agroclimatic conditions of Peshawar are favourable for the growth and yield of *Abelmoschus esculents* (Okra) during June and July.

Author contributions

Conceptualization, N.I; methodology, N.I., software, A.M.K.H.; S.A.I, validation M.A. and AMHK.; formal analysis, A.M.H.K, S.O.I, G.R, M.K, P.M, A.B, M.B, M.U, S.AI, and Z.U .; investigation, N.I.; data curation, G.R writing-original draft preparation, A.M.H.K.; writing-review and editing, M.A.U.Z, M.A. and A.M.H.K.; supervision, M.A. authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement

Not applicable.

Data Availability Statement

All of the data is included in the article/Supplementary Material.

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Conflict of interest

The authors declared that present study was performed in absence of any conflict of interest.

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