Research Article

Assessing the Adaptability of Newly Introduced Sesame Varieties

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Abstract | Sesame has the potential to be cultivated as a forage plant in hot and dry climate regions, and it can be used to increase the food security of a herd. A field experiment was conducted in 2022 at Medicinal Plants Farm, located in the Peshawar region of Khyber Pakhtunkhwa, using seven improved varieties of Sesame under irrigation conditions with a conventional watering frequency of once per month. The objective of the study was to identify the best-performing Sesame varieties that would enhance productivity in the target areas. The experiment followed a randomized complete block design (RCBD) with three replications. The tested Sesame varieties included TS-3, TS-5, TH-6, Till-18, DM-14, Anmol-Till, and Black King. The analysis of variance revealed significant variations in phenological parameters, specifically days to flowering and days to maturity, among the tested Sesame varieties at a significance level of ($P < 0.01$). Similarly, significant effect was also observed for seed yield and other yield attributing traits. Numerically, the top-performing Sesame varieties in terms of seed yield were Till-18 (11 qt/ha), TS-3 (10.3 qt/ha), and DM-14 (10 qt/ha), and they are recommended for the specific community and its vicinity. None the less, further studies are needed, including the evaluation of recently released varieties, to strengthen the recommendations for improved Sesame production in the target area and ensure a solid basis for the recommendations.

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Introduction

Sesame (*Sesamum indicum* L.) is the most imperative oilseed crops in Pakistan belongs to family Pedaliaceae, has the potential to be cultivated as a forage plant in hot and dry climate regions (Bashir *et al*., 2020). The sesame is now widely grown in the tropical areas of Asia and Africa. However, it is considered as the much primitive oilseed crop dating back to 1600 BC (Saydut *et al*., 2008). It is also referred as Queen of oilseeds due to its extensive farming from tropical to the temperate regions of the world and also shows resistance to oxidation and rancidity.

Sesame has high nutrition value as it contains sesamin, sesamolin, sesaminol and sesamolinol that maintain the low-density lipoprotein fats (Bashir *et al*., 2020). The chemical composition of sesame seeds includes oil (45-55%), protein (18-25%), vitamins E, A, and

B complex, carbohydrates, ash and minerals such as calcium, phosphorus, iron, copper, magnesium, zinc, and potassium (Ceccarelli *et al*., 2009). Sesame oil is primarily composed of oleic and linoleic fatty acids, which make up 85% of the oil. These fatty acids contribute to the oil's long shelf-life due to their high resistance against oxidative rancidity. Linoleic acid is also known for its cholesterol-lowering effects in human blood (Khanna, 1991). Sesame oil is commonly used in cooking dishes and salads, as well as in the production of margarine, soaps, paints, perfumes, pharmaceuticals, and insecticides. After the oil is extracted from the seeds, the remaining sesame meal is rich in protein (34 to 50%) and is often used as feed for poultry and livestock.

Sesame production is widespread, with a significant portion occurring in Asia and Africa. In 2007, global sesame production was estimated at 3.24 million metric tons, which increased to 3.84 million metric tons in 2010. In Pakistan, edible oil is an essential commodity facing scarcity, with the country importing 65-70% of its annual requirement (Hussain *et al*., 2017). Sesame is the only oilseed crop exported by Pakistan. In 2013-14, Pakistan exported 37.63 million tons of sesame seed worth Rs. 7342 million (Federal Bureau of Statistics, 2013-14). According to the Pakistan Bureau of Statistics, in 2015-16, the total available area for sesame cultivation was 80,000 hectares, which was 0.96 times less than the previous year. The total production during that period was 32.4 thousand tons, which was 0.97 times less than the previous year's production.

The main reasons for the low seed yield of sesame include the cultivation of poor-yielding dehiscent types, yield loss during threshing, inadequate use of agricultural inputs such as improved varieties, fertilizers, pesticides, and other agrochemicals, poor management practices, and the lack of appropriate breeding programs (Olowe *et al*., 2009; Pham *et al*., 2010). Any environmental differences may have greater impact on the physiology and performance of some genotypes than others. Therefore, knowledge of adaptability is useful in assessing the genotypes and recommendation to different environments with yield predictions (Sirisha *et al*., 2022). The main objective of the investigation is to study the adaptability of newly developed cultivars under agro-ecologies of Peshawar. The identification of high yielding varieties for the zone best adopted against biotic abiotic stresses.

Materials and Methods

Description of the study area

The proposed study was conducted at Pakistan Forest Institute-Peshawar, located at coordinates 69°25'26" N longitude and 35°25'41" N latitude. It is situated at an altitude of 328 meters above sea level in Pakistan, approximately 190 kilometers away from Islamabad. Analysis of long-term weather data for the area revealed that the average annual rainfall is 817 mm, ranging from 776 mm to 816 mm.

Treatments and experimental design

The experiment commenced during the main cropping season on June 15, 2022, at the Pakistan Forest Institute, Peshawar-Pakistan. Various Sesame varieties (TS-3, TS-5, TH-6, Til-18, DM-14, Anmol Till, and Black King) obtained from Ayub Agriculture Research Institute, Faisalabad were included in the study. These varieties were evaluated in randomized complete block design (RCBD) with three replications. Each experimental unit consisted of five rows measuring five meters in length. The spacing between rows and individual plants was set at 45 x 10 cm, respectively. All the cultural practices were used for proper management and a fertilizer (DAP) @ of 100 kg/ha was applied as recommended dose for better crop growth.

Data collection

Phenological parameters: The phenological characteristics of the examined varieties were documented, including the stand count at harvest, plant height (cm), number of pods plant^{-1}, days to flowering, number of branches plant^{-1} and days to maturity.

Seed yield and yield components

For the assessment of seed yield, three middle rows were harvested and the results were adjusted to account for a moisture content of 14% in each variety. For determination of yield and its components, five plants were randomly chosen from the three central rows. Data on days to flowering and maturity was noted by counting days from sowing date to flower initiation and physiological maturity, respectively. The number of pods plant^{-1} and branches plant^{-1} were determined by counting the pods and branches in the five selected plants of the three central rows of each entry.

Statistical analysis

The data collected were analyzed using the GLM procedure of SAS Statistical Software. Statistical calculations deemed effects as significant if the P-values were < 0.05. To compare means LSD tests were employed.

Result and Discussion

The analysis of variance indicated a high level of significance ($P \leq 0.01$) for days to flowering and days to maturity (Table 1). This suggests that there is a linear relationship between these parameters and the varieties studied. The high significance level shows the more diversity among the varieties and can better be utilized to identify the most adaptable varieties for the agro-ecological zone. The variety TS-5 was found earlier in flowering and maturity (38 and 78 days, respectively) accounted for the desirable trait to escape the diseases outbreak. Similar results are also reported by Singh *et al.* (2018) and Bashir *et al.* (2020). They found significant variation and concluded that variation ensure the scope for selection.

Significant differences were observed for plant height, seed yield, branch number/plant, and stand count at harvest (Table 1). This indicates that there is variation present among the newly developed varieties which provide an opportunity for recommendation of the best adapted variety to the environment tested. The variety perform better with good character and expressing high potential of their yield will be consider well adapted to the location. The variety Til-18 and DM-14 produced maximum seed yield (11 and 10 qt/hac, respectively) which indicate that these varieties are best adapted to the Peshawar location. Similar significant results, for the mention traits were detected by Sirisha *et al.* (2022), Saxena and Bisen (2017) and Bashier *et al.* (2020). They also made the high yield as base for adaptability and make recommendation environmental specific of individual variety. Among the varieties, Tate exhibited the maximum number of pods/plant (53), while Anmol-Till had the minimum (39) (Table 2). TH-6 had the highest branch number/plant (2.5), while Black King had the lowest (1.4) (Table 2). Notably, the Sesame variety Til-18 had a moderate number of pods/plant and branch number/plant, resulting in a minimum seed yield of 11 qt/ha.

Table 1: *The mean square values for crop phenology, yield, and yield components of Sesame, as affected by the variety, at medicinal plants farm 2022.*

Source of variation	Degree of freedom	Means squares						
		DF	DM	YLD (qt/ha)	PH (cm)	PPP	SCH	BNPP
Replication	2	0.76	0.76	0.9	767	103	404	0.04
Treatment	6	12.4**	11.4**	162.7*	35*	59*	209.7*	0.4^{ns}
Error	12	0.76	0.76	1.75	178.9	113	88.8	0.27

*Ns= non-significant at 0.05 probability level; * = significant 0.05 probability level. DF= Days to 50% flowering, DM= days to 95% maturity, PPP= Pods/plant, PH= plant height, SCH= stand count at harvesting, BNPP= branch number per plant, YLD= Yield, CV(%) = coefficient of variation in percent.*

Table 2: *The mean values of yield and yield components for the sesame varieties that were tested at medicinal plants farm in the year 2022.*

Varieties	YLD (qt/ha)	PH (cm)	PPP	SCH	DTM	DF	BNPP
TS-3	10.3a	137.13b	45.6b	091.8b	81b	41a	2.1a
TS-5	07.9d	128.9d	53.0a	086.2b	78c	38c	2.2a
TH-6	09.6bc	136.7b	41.2c	090.5b	81b	41b	2.5a
Til-18	11.0a	137.7b	44.7b	104.5a	81b	41b	2.2a
DM-14 Anmol	10.0b	137.5b	39.0d	108.7a	85a	45a	1.7a
Till	08.9c	135.3c	44.9b	091.7b	81b	41b	2.2a
Black King	08.3c	139.5a	46.0b	090.2b	81b	41b	1.4a
LSD	0.9	1.8	3.9	05.8	1.7	1.6	0.9
CV (%)	114	009.8	23.8	009.9	1.1	2.1	25.9

**Means with the same letter are not significantly different. PH=plant height, PPP= pod per plant, SCH=stand count at harvest, DTM= days to 95% maturity YLD=yield, LSD= least significant difference, CV (%) = coefficient of variances in percent.*

Conclusions and Recommendations

Introducing improved and high-yielding varieties of sesame has the potential to significantly increase agricultural production and productivity in lowland areas such as Pakistan Forest Institute, Peshawar, where the use of improved sesame varieties is not common. The adoption of these improved varieties could be one of the strategies to enhance productivity among small farmers. However, the implementation and evaluation of improved sesame varieties have not been conducted in the target area. Therefore, this research was initiated to assess the performance of improved varieties in sesame production. The study was conducted in Pakistan Forest Institute-Peshawar, using irrigation with a conventional watering frequency of once per month in 2022. The main objective of the study was to identify the best-performing varieties that would enhance sesame production in the area. The experiment followed a randomized complete block design (RCBD) with three replications in Pakistan Forest Institute-Peshawar. Seven improved sesame varieties were tested as treatments. The analysis of variance revealed that certain phenological parameters, specifically days to flowering and days to maturity, were significantly influenced by the varieties. However, there was no significant effect of varieties on seed yield. The top-performing sesame varieties in terms of seed yield were Til-18 (11 qt/ha), TS-3 (10.3 qt/ha) and DM-14 (10 qt/ha), which are recommended for the specific community and surrounding areas. None the less, further studies should be conducted, including the evaluation of recently released varieties, to strengthen the recommendations for improved sesame production in the target area.

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Novelty Statement

In a pioneering field experiment at Medicinal Plants Farm in the arid Peshawar region, Sesame emerges as a promising forage plant with significant potential for bolstering food security in herds.

Author's Contribution

Zia Ur Rahman and Naveed Ahmad: Conception of idea, devised the methodology and original draft writing. Hammad Ud Din: Data compilation and formal analysis. Adnan Ahmad and Fazli Amin: review and editing.

Conflict of interest

The authors have declared no conflict of interest.

References

Bashir M.R., Yaseen, M., Mahmood, A., Mohyo-ud-Din, A. and Khan, Q.A.T., 2020. Adaptability trials of sesame germplasm against *Macrophomina phaseolina* by using AMMI biplot analysis in Pakistan. Int. J. Agric. Biol., 23: 851–856.

Ceccarelli, S., Guimarães, E.P. and Weltizien, E., 2009. Plant breeding and farmer participation: Breeding for nutritional quality traits. Rome.

Federal Bureau of Statistics. 2013-2014. Govt. of Pakistan, External Trade Section, Karachi.

Felter, H.W. and Lloyd, J.U., 1898. King's American dispensatory. Retrieved from www.ibiblio.org/herbmed/eclectic/kings/sesamum.html

Geremew, T., Adugna, W., Muez, B. and Hagos, T., 2012. Sesame Production Manual. Ethiopian Institute of Agricultural Research Embassy of the Kingdom of the Netherlands, EIAR, Ethiopia, pp. 49.

Gomez, A.K. and Gomez, A.A., 1984. Statistical procedures for agricultural research. John Wiley and Sons.

Gooding, M.J., Murdoch, A.J. and Ellis, R.H., 2000. The value of seeds. In: M. Black and J.D. Bewley (Eds.), seed technology and its biological basis. Sheffield Academic Press. pp. 1-41.

Hussain, F., Rafiq, M., Ghias, M., Qamar, R., Razzaq, M.K., Hameed, A., Habib, S. and Mustafa, H.S.B., 2017. Genetic diversity for seed yield and its components using principal component and cluster analysis in sunflower (*Helianthus annuus* L.). Life Sci. J., 14(5): 71-78.

Khanna, K.R., 1991. Biochemical aspects of crop improvement. Plant Breeding and Genetics

National Botanical Research Institute. Lucknow, India.

Morris, J.B., 2002. Food, industrial, nutriceutical and pharmaceutical uses of sesame genetic resources. In: J. Janick and A. Whipkey (Eds.), Trends in Crops and New Uses. ASHS, Alexandria, VA. pp. 153-156.

Olowe, V.I.O., Adeyemo, Y.A. and Adeniregun, O.O., 2009. Sesame: The underexploited organic oilseed crop. Retrieved from http://www.unepunctad.org/cbtf/event/kampala5 (Accessed May 3, 2012).

Pham, T.D., Nguyen, T.D.T., Carlsson, A.S. and Bui, T.M., 2010. Morphological evaluation of sesame (*Sesamum indicum* L) varieties from different origins. Austral. J. Crop Sci., 4(7): 498-504.

Saxena, K. and Bisen, R., 2017. Genetic variability studies in sesame (*Sesamum indicum* L.). Ann. P. Soil Res., 19(2): 210-213.

Saydut, A., Duz, M.Z., Kaya, C., Kafadar, A.B. and Hamamci, C., 2008. Trans esterified sesame (*Sesamum indicum* L.) seed oil as a biodiesel fuel. *Bioresour. Technol.*, 99: 6656–6660. https://doi.org/10.1016/j.biortech.2007.11.063

Singh, A., Bisen, R. and Tiwari, A., 2018. Genetic variability and character association in sesame (*Sesamum indicum* L.) genotypes. Int. J. Curr. Microbiol. App. Sci., 7(11): 2407-2415. https://doi.org/10.20546/ijcmas.2018.711.274

Sirisha, A.B.M., Haseena, S.K., Banu, Saritha. R., Sujatha, V., Tulasi, T. and Lakshmi, 2022. Stability studies of sesame (*Sesamum indicum* L.) cultivars using AMMI model. Int. J. Curr. Sci., 12(2): 775-788.