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Quantitative Evaluation of Sesame (*Sesamum indicum* L.) Promising Lines for Adaptability and Seed Yield in Different Agro-Climatic Conditions of Punjab (Pakistan)

By Hafiz Saad Bin Mustafa, Muhammad Anwar, Habibur Rehman, Faisal Saddique & Muhammad Aftab

Ayub Agricultural Research Institute

Abstract- Pakistan has become the fourth largest market for cooking oil after China, India and United Arab Emirates and third largest importer of the commodity. Pakistan imports crude and refined cooking oils (palm and palm olein) mainly from Malaysia and Indonesia, while it imports soybean oil from North America and Brazil. The aim of present study was to evaluate best performing sesame genotypes under different climatic conditions of Punjab province. The experiment was conducted in randomized complete block design (RCBD) with three replications at five different agro-climatic locations during Kharif 2016. Experimental material comprised of 10 genotypes with different genetic makeup. The data for seed yield was recorded and Least Significant Difference(LSD) was calculated at 5% probability level. The study showed that there is significant variability among the genotypes forseed yield. Genotypes 10003 and 50022 performed well and showed good stability in seed yield at all five locations. The cultivation of these lines in Punjab province may enhance the local production of good quality edible oil in the country.

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Strictly as per the compliance and regulations of :

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I. Introduction

Sesame (*Sesamum indicum* L.) is enriched oilseed crop with oldest history and belongs to family Pedaliaceae with chromosomal number 2n (26). Pedaliaceae consist of 16 genera and 60 species. Sesame is most important genus of this family. It is self-pollinated crop but sometime cross pollination may occur due to insects. The growth habit of sesame is annual (Peter, 2004). Sesame is originated from Africa, while tropical and sub-tropical regions are best for its cultivation (Saikat *et al.,* 2015).

Sesame is a conventional oilseed crop having branched and single stem varieties. Sesame plant bears deep root system and grows well in water deficit situations (Fazal *et al.,* 2015). Sesame is a short duration crop which completes its cycle within 100-110 days and fit as catch crop in Zaid Kharif season so, wheat can be timely cultivated. Therefore, there is great scope of horizontal expansion of sesame without affecting current area under different crops. Sesame is a very rewarding crop due to its low cost of production and high price (Anwar *et al.,* 2013).

Sesame seed contains more than 50% oil, about 25% proteins and 13.5% carbohydrate. Sesame seeds also possess the essential fatty acids such as linoleic acid and high lignin that comprises of sesaminol sesamin, sesamol and sesamolinol (Fazal*et al.,* 2013). Vitamin B complex is important for cell oxygenation favorably influence on liver cells function also present in sesame(Sarwar and Hussain, 2010). Sesame oil plays a vital role to improve human health. It decreases the Total Serum Cholesterol (TST)and Low Density Lipoprotein (LDL) and increases the antioxidant capacity in hypercholesterolemia patients (Chen et al.,2005). Sesmol is phenolic compound which is present in sesame having anti-mutagenic properties (Kaur and Saini, 2000). It causes antimicrobial effects on Klebsiella sp. (gram negative bacterium) which causes urinary infection in human (Costa *et al.,* 2007).

Edible oil is one of the most important commodities for everyday use which is deplorably facing extreme scarcity in Pakistan. Pakistan has to import 65-70% of its edible oil from the international market annually (Hussain *et al.,* 2017).Sesame is only oilseed crop which is exported by Pakistan. During 2013-14, 37.63 million tons sesame seed worth Rs.7342 million was exported (Federal Bureau of Statistics, 2013-14). According to Pakistan Bureau of statistics 2015-16 total available area for sesame in Pakistan is 80,000 hectares which is 0.96 time less than previous year (83,000 ha) and total production is 32.4 thousand tons which is 0.97 time less than previous year 33.1 thousand tons (2014-15).

The major causes of low seed yield of sesame are the cultivation of poor yielding dehiscent types, yield loss during threshing, lack of agricultural inputs such as improved varieties, fertilizers, pesticides and other agrochemicals, poor management and lack of appropriate breeding program (Olowe *et al.,* 2009;

Author α σ ¥: Directorate of Oilseeds, Ayub Agricultural Research Institute, Faisalabad (Pakistan). e-mail: saadpbg@gmail.com
Author ρ ω: Department of Plant Breeding & Genetics, University of Agriculture Faisalabad (Pakistan).

Pham *et al.,* 2010). As sesame utilization is increasing day by day therefore, it is essential to develop high yielding sesame cultivars to meet the requirement. The present study was conducted at different agro-climatic zone of Punjab (Pakistan) to evaluate the stability and seed yield performance of different sesame promising strains under different climatic conditions.

II. Material and Method

The presented study was conducted during Kharif (summer season) 2016 to evaluate the stability and seed yield of ten Sesame promising lines under five different Agro-climatic locations of Punjab, Pakistan. All the strains (50022, 40004, 40021, 87008, 40012, 10003, 50011, 70004 and Black Til along with TS-5 as check variety) have different genetic makeup. The experiment was sown in tri replicated randomized complete block design (RCBD) at five location with different agro-climatic conditions viz. Oilseeds Research Institute, Faisalabad, Adaptive Research Farm, Mandi Bahauddin, Oilseeds Research Sub-station, Piplan, Regional Agricultural Research Institute, Bahawalpur, and Oilseeds Research Station, Khanpur. Plot size for each entry was 5m x 1.8m with 45cm Row spacing at all locations. Sowing was done on flats by manual drilling. Nitrogen and phosphorus fertilizer were applied @ 60:60kg/ha at all locations. All recommend agronomic and cultural practices were applied during growing period at all the locations. The data for seed yield per plot for each entry was recorded at all locations.

The mean seed yield was compared by Least Significant Difference (LSD) test to study the significance at 5% probability level by using Statistix 8.1. Data collected were subjected to analysis of variance (ANOVA) for RCBD experiment using the method described by Steel and Torrie (1980). The F-LSD procedure as described by Obi (2001) was used in separating the treatment means. Weather records on rainfall, temperature and relative humidity (Figure 1, Figure 2, Figure 3, Figure 4 and Figure 5)were collected from meteorological department, Govt. of the Punjab (Pakistan) and www.worldweatheronline.com.

III. Result and Discussion

All the promising lines of sesame were developed through pedigree method of plant breeding. These lines were grown in five different agro-climatic conditions to check adaptability and yield stability of these lines. Figure1, Figure2, Figure3, Figure4 and Figure5 showed the mean data for temperature, humidity, rainfall and sunshine hours during the growing period of sesame crop at all five locations viz. Faisalabad, Mandi Bahauddin, Piplan, Bahawalpur and Khanpur. The data showed the existence of variability in temperature, humidity and precipitation pattern at all five locations. Similar experiment was performed by Anwar *et al.,* 2013.

The data presented in Table1 showed the mean seed yield along with least significant difference (LSD) of three replication at all five locations. Large variations were observed among all genotype at five locations for seed yield.

Table 1: Data for mean seed yield and LSD test at five locations

Sr. No.	Variety/ Line	Seed Yield (kg/ha)				
		Faisalabad	Mandi Bahauddin	Piplan	Bahawalpur	Khanpur
1.	50022	841	716	361	666	470
2.	40004	810	603	444	463	211
3.	40021	636	518	269	655	270
4.	87008	774	488	361	407	311
5.	40012	557	492	250	503	425
6.	10003	857	652	794	563	463
7.	50011	819	736	296	381	396
8.	70004	646	549	241	536	380
9.	Black Til	808	685	536	344	311
10.	TS-5 (C)	779	610	241	566	287
	LSD 5%	**122**	**142**	**53**	**267**	**72**

a) Faisalabad

During growing period of sesame (July-Oct.) maximum mean temperature 46°C in June and minimum 37°C in October was observed. While maximum rainfall (28.29mm) was occurred in July and no rainfall was observed in whole month of October. The maximum humidity was measured 36% in August and minimum 16% in October. The maximum sunshine hours was observed in July(155.5 hour) and minimum in October (93 hour). The genotype 10003 produced highest seed

yield (857kg/ha) and minimum yield was harvested from 40012(557kg/ha). The checked varietyTS-5 produced 779kg/ha seed yield in Faisalabad climatic conditions. Five lines(50011, 50022, 40004, 10003 and Black Til) produced higher yield than the check variety TS-5.Three sesame lines (40012, 40021 & 7004) gave significantly lower yield than the check varietyTS-5. Sesame genotype 87008 showed at par yield with check variety.122 LSD was measured at 5% probability level.

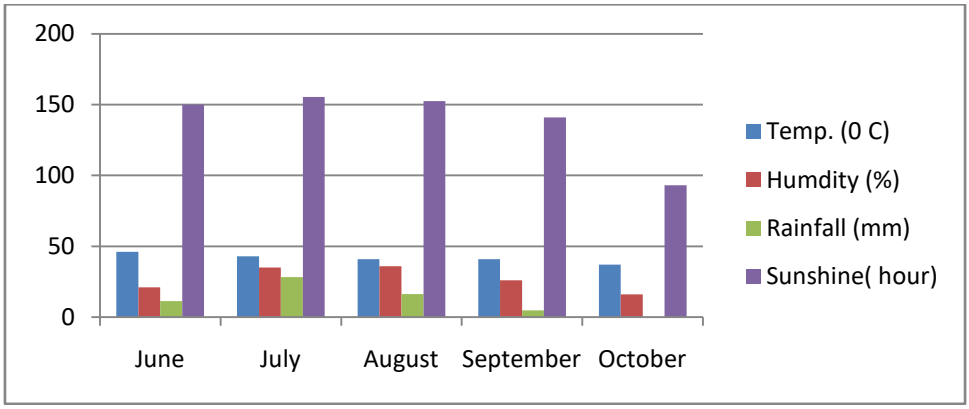

Figure 1: Faisalabad Climatic condition during growing period June – October, 2016

b) Mandi Bahauddin

During growing period of sesame (July-Oct.) maximum mean temperature (43°C) in June and minimum 35 °C in October was observed. While maximum rainfall(56.17mm) was occurred in July and no rainfall occurs in whole month of October. The maximum humidity was measured 39% in August and minimum 15% in October. The maximum sunshine hours was observed in July(155 hour) and minimum in October (93.8hour).The genotype 50011 produced highest seed yield(736kg/ha) and minimum yield was harvested from 87008(488kg/ha). The checked variety TS-5 produced 610kg/ha seed yield in Mandi Bahauddin climatic conditions. Four lines(50011, 50022, 10003and Black Til) produced higher yield than the checked variety TS-5. Four lines (87008, 40012, 40021 & 70004) gave lower yield than the check variety.10003 showed at par seed yield with check variety. 142 LSD was measured at 5% probability level.

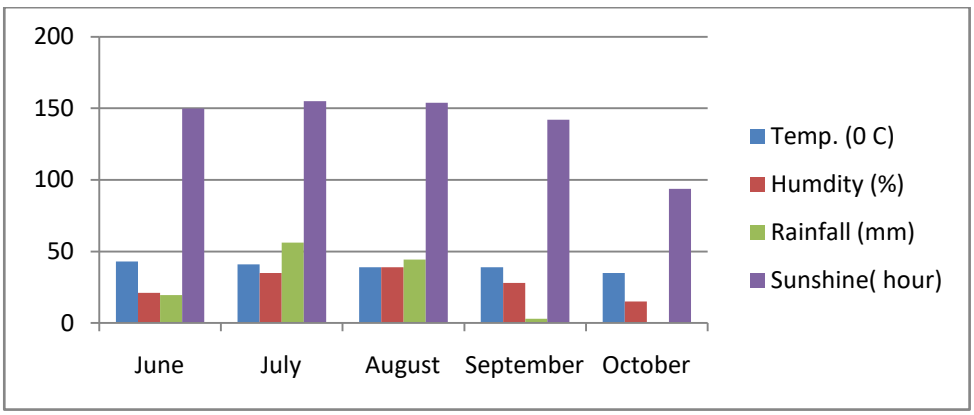

Figure 2: Mandi Bahaudin climatic condition during growing period June – October, 2016

c) Piplan

During growing period of sesame (July-Oct.) maximum mean temperature (45°C) in June and minimum 35°C in October was observed. While maximum rainfall(48.84mm) was occurred in July and no rainfall was observed during whole months of September and October. The maximum humidity was measured 31% in August and minimum 16% in October. The maximum sunshine hours was observed in July and august (155 hour) and minimum in October (93 hour). The genotype 10003 produced highest seed yield(794kg/ha) and minimum yield was harvested from 70004 along with check variety (241kg/ha). The checked variety TS-5 produced lowest seed yield 241kg/ha in Piplan climatic conditions. Sixlines(50022, 40004, 87008, 10003, 50011 and Black Til) produced significantly higher yield than the checked variety TS-5.While three lines (40021, 40012 & 70004) produced at par seed yield than the check variety. 53LSD was measured at 5% probability level.

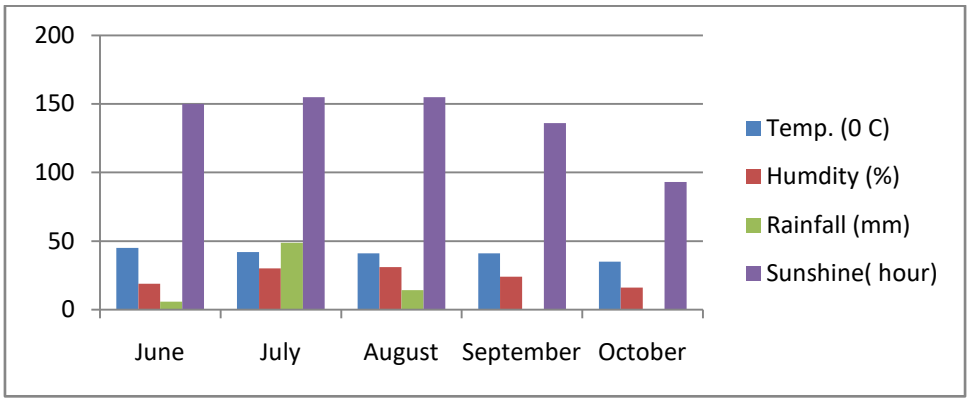

Figure 3: Piplan climatic condition during growing period June – October, 2016

d) Bahawalpur

During growing period of sesame (July-Oct.) maximum mean temperature (44°C) in June and minimum 37°C in October was observed. While maximum rainfall(24.75mm) was occurred in July and no rainfall occurs in whole month of October. The maximum humidity was measured 36% in August and minimum 17% in October. The maximum sunshine hours was observed in July(153.8 hour) and minimum in Sep (93 hour). The genotype 50022 produced highest seed yield (666kg/ha) and minimum yield was harvested from Black Til (344kg/ha). The checked variety TS-5 produced 566kg/ha seed yield in Bahawalpur climatic conditions. Two lines(50022 and 4002l) produced higher yield than the checked variety TS-5.Four lines (40004, 87008, 50011 & Black Til) gave lower yield than the check variety while 40012, 10003 & 70004 showed at par seed yield with check variety. 267 LSD was measured at 5% probability level.

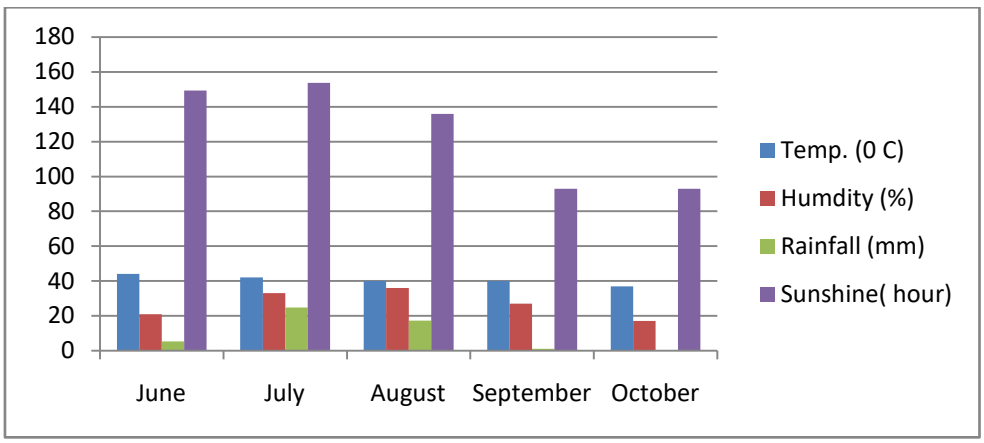

Figure 4: Bahawalpur climatic condition during growing period June – October, 2016

e) Khanpur

During growing period of sesame (July-Oct.) maximum mean temperature (44°C) in June and minimum 37°C in October was observed. While maximum rainfall(10.5mm) was occurred in August and no rainfall was observed in whole month of October. The maximum humidity was measured 36% in August and minimum 19% in October. The maximum sunshine hours was observed in July (153.8 hour) and minimum during September and October (96 hour). The genotype 50022 produced highest seed yield(470kg/ha) and minimum yield was harvested from 40004 (211kg/ha). The checked variety TS-5 produced 287kg/ha seed yield in Khanpur climatic conditions. Five lines(50022, 40012, 10003, 50011, and 70004) produced significantly higher yield than the checked variety TS-5.Genotype 40004 gave significantly lower yield than the check variety. While three sesame lines (40021, 87008 & Black Til) showed at par seed yield with check variety. 72 LSD was measured at 5% probability level.

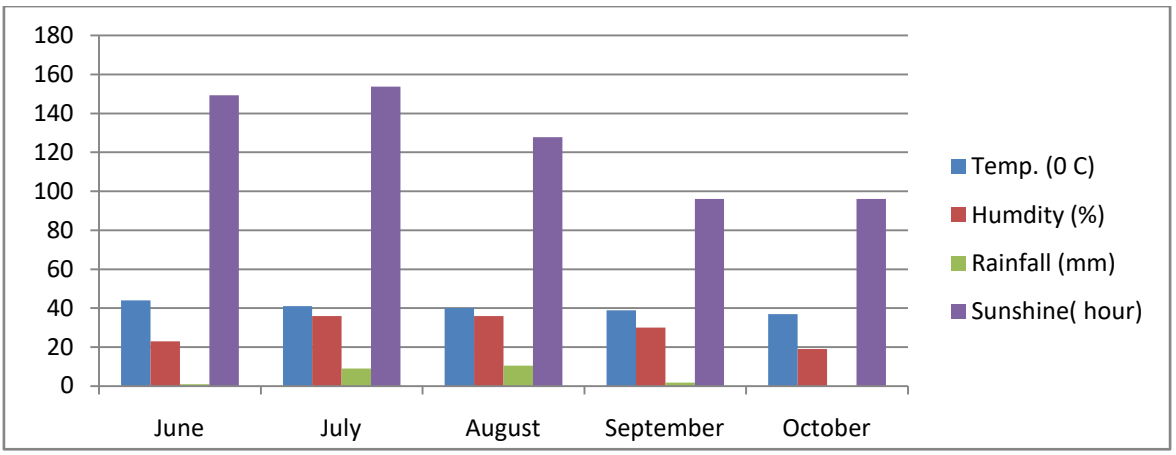

Figure 5: Khanpur climatic condition during growing period June – October, 2016

The data prescribed in Figure6 showed the comparison between seed yield among ten genotypes at all five locations. The data showed that significant variability was found among the 10 sesame accessions for seed yield. Earlier investigations by other researchers also showed significant variation among sesame genotypes inseed yield. (Adebisi *et al.,* 2005;Ehsanullah*et al.,* 2007; Nahar *et al.,* 2008;Parameshwarappa *et al.,* 2009; Pham *et al.,* 2010;).All the sesame lines produced highest yield in Faisalabad climatic condition. Promising lines 10003 and 50022 performed well and showed good stability in seed yield at all five locations. The genotypes 50011 and Black Til also performed well in Faisalabad and Mandi Bahauddin climatic conditions. Genotype 40021 showed good performance only under Bahawalpur climatic conditions. Other genotypes had not shown any significant performance. Other sesame lines produced lower or at par yield with check variety TS-5 so these lines lost their worth for further evaluation. Ogbonna and Ukaan 2012 performed similar experiment on sesame accessions and observed similar results in his material.

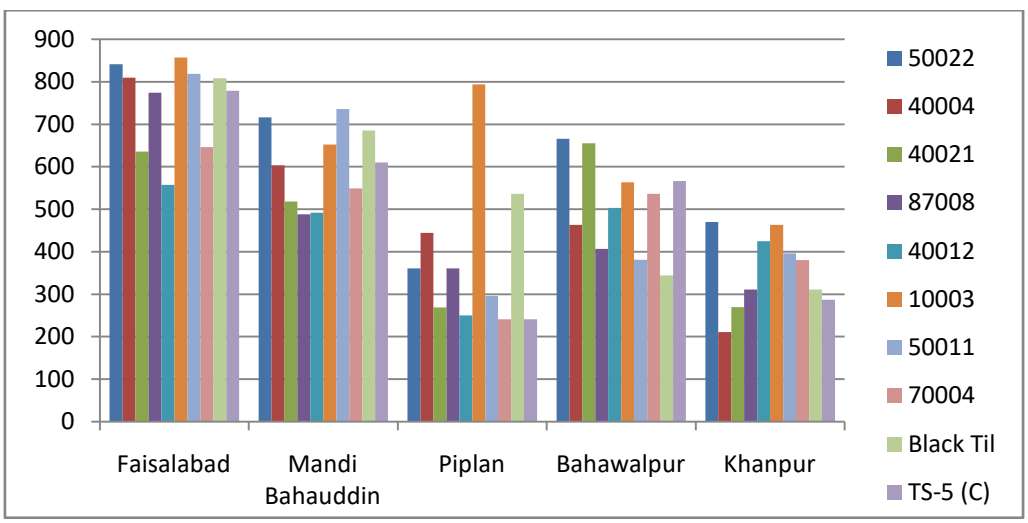

Figure 6: Mean seed yield(kg/ha) at five different Agro-climatic locations of Punjab(Pakistan)

IV. Conclusion

It is concluded that 10003 and 50022 are the overall best performing sesame lines under Punjab climatic conditions. The variety approval case of these lines should be submitted to Punjab Seed Council for general cultivation of these lines in Punjab (Pakistan).The cultivation of these lines in Punjab province may enhance the local production of good quality edible oil in the country which will ultimately reduce the import bill of edible oil.

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