



Til-18 (50022): A High Yielding Variety of Sesame (*Sesamum indicum* L.)

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Abstract: The present research was started at Oilseeds Research Institute, Faisalabad, Pakistan to develop a high yielding Sesame variety having good quantitative and qualitative characteristics under the changing climate. The newly developed sesame variety "Til-18" is an outcome of hybridization (99004 x 99005) during 2003 and further rigorous selections from F₂ following the pedigree method of plant breeding. Homozygous progenies of 50022 from F₆ were bulked in 2009 for seed yield evaluation. Its performance was evaluated in Station Yield Trials, Zonal Yield Trials, Micro Yield Trials and National Uniform Sesame Yield Trials. In all yield trials its performance was better than the existing varieties. In 2015 and 2016, the strain gave 1817 kg/ha and 1874 kg/ha seed yield respectively at Oilseeds Research Institute Faisalabad (Pakistan) in Zonal Varietal Trial. In National Uniform Sesame Yield Trials 2016 and 2017 the performance of TIL-18 was better than TS-5 (check) by giving 9.5% and 8.8% more yield respectively. TIL-18 also showed better tolerance against insect pests, Phyllody diseases and Charcoal Rot. Agronomic studies revealed that TIL-18 performed better if cultivated from 1st to 30th June and with fertilizer one bag of Di-ammonium phosphate (DAP) and half bag of Urea at the time of sowing and flowering, respectively, along with 1st and 2nd irrigation. Fatty acid profile analysis showed that it has good ratio of essential fatty acids as compared to check variety TS-5. Til-18 is a high yielding sesame variety suitable for both irrigated and rain fed regions which was approved in 50th meeting of Punjab Seed Council, Pakistan for general cultivation.

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1. Introduction

Sesame (*Sesamum indicum* L.) is the most ancient oilseed crop that has been cultivated in many tropical and subtropical areas of the world. The largest producers of sesame are China, India and Burma followed by Sudan, Uganda, Nigeria and Pakistan (Barut *et al.*, 2006). Sesame is one of the important oilseed crops in Pakistan. It is grown in 65 districts of the country as rain fed as well as irrigated crop. Due to variation in rainfall pattern, the yield is not stabilized in rainfed areas. Its total area and production during 2017-18 were remained 1,75,000 acres and 30,000 tonnes respectively (Aftab *et al.*, 2019). There is great scope of this crop due to its export potential and farmers are motivating to grow sesame especially in the Punjab province. During 2018-19, Sesame cultivated area reached 273,000 acres in Punjab (Crop reporting & Services, Punjab). Its international marketing was very encouraging and its seed worth more than Rs. 9.72 billion was exported to different

countries during 2018-19. (Pakistan Bureau of Statistics 2018-19)

Sesame seed is a rich source of edible oil that ranges from 34 to 59%, having excellent nutritional, medicinal and cosmetic quality (Morris, 2009; Cristiane *et al.*, 2016). Its seed contains about 50% oil and 20% protein (Borchani *et al.*, 2010 & Anwar *et al.*, 2013). It is the rich source of many essential amino acids like methionine, cysteine and tryptophan and unsaturated fatty acids such as oleic acid, linoleic acid and high lignin that comprise of sesamol, sesamin, sesamol and sesamolol (Shyu and Hwang 2002; Arslan *et al.*, 2007 & Uzun *et al.*, 2008). Sesamol, due to its high antioxidant properties provides prominent chemical stability avoiding rancidity to the oil; it has the highest resistance to oxidation amongst other vegetable oils (Erbas *et al.*, 2009; Emamgholizadeh *et al.*, 2015). It can be cultivated in both irrigated areas

and rain fed areas having around 350-600mm annual rainfall and has remarkable potential of withstanding high temperatures provided that the soil it is cultivated in has good drainage (Fazal *et al.*, 2015).

Sesame is an important short duration oilseed crop and is becoming farmers' preference worldwide on account of its growing demand. Since it takes only 100-120 days to grow, it is also seen as a cash crop by many and is grown in Kharif, wheat can be timely cultivated after sesame. Therefore, there is great scope of expansion without affecting prevailing cropping system (Anwar *et al.*, 2013).

Asia is the biggest producer of sesame and contributing about 70% of world's total production then followed by Africa that produces around 26%. Sesame seeds are used as raw material or an ingredient in many industrial products like paints, soaps, perfumes, pharmaceuticals and insecticides and its oil is used for cooking. Sesame oil has long shelf life because of an antioxidant (Jin *et al.*, 2001).

The aim of sesame breeding program at Oilseeds Research Institute, Faisalabad (Pakistan) is to develop high yielding and disease or insect tolerant varieties suitable both for irrigated areas and rain fed areas. "Til-18" a new high yielding variety having many superior traits such as high number of pods, cluster bearing and disease tolerant has been developed and approved for general cultivation during 2018. Sesame cultivation on large areas using high yielding varieties and appropriate production technology can help to bridge up the gap between average production of the country and varietal potential of Sesame varieties as well as to increase the export magnitude.

2. Material and Methods

The present research was initiated during 2003 at research area of Oilseeds Research Institute (ORI), Faisalabad, (31.4040° N, 73.0512° E, Altitude 184 m above sea level) Pakistan. Pedigree method of plant breeding was used for the development of high yielding varieties of Sesame.

2.1. Hybridization and Study of Filial Generation:

90004, a disease tolerant sesame line, and 90005, a high yielding sesame line with cluster bearing trait, were grown at Oilseeds Research Institute, Faisalabad (Pakistan) in 2003 and crossing was performed between the two lines at the flowering stage by selecting 90004 as a female parent. Later, in 2004, F₁ plants were grown in isolation condition to produce F₂ and 80 single plants from F₂ were harvested separately on the basis of their cluster bearing ability and plant vigor in 2005. In 2006, out of these 80 separately harvested plants from F₂ generation 24 high yielding plants were used to grow F₃ progeny. Based on health and yield 40 plants were separately harvested from

selected rows out of which 29 single plants were further grown in 2007 to have progeny rows of F₄. In 2008, from the selected rows of F₄ progenies, 35 healthy plants were harvested out of which 20 were used to grow F₅ progenies having high yield, disease tolerance and cluster bearing trait. In 2009, 20 homozygous progenies were bulked from F₆, produced by bulking F₅ progenies after harvesting and were used for seed yield evaluation. All the filial generation (F₁ – F₆) were grown in isolation condition to assure self-pollination and secure from out crossing.

2.2. Evaluation and Yield Testing:

Lines bearing high yield and cluster bearing trait were evaluated in replicated Station Yield trials for two consecutive years from 2014 to 2015 and performance of elite line (50022) were assessed at research area of Oilseeds Research Institute, Faisalabad (Pakistan). During 2015 and 2016 multi-location trials of promising line were conducted under different Agro-climatic conditions (Faisalabad, Mandi Bahauddin, Piplan, Bahawalpur & Khanpur) throughout Punjab province in Zonal Varietal Trials. In order to ascertain the ability to cope with the changing climatic condition 50022 was further evaluated in National Uniform Sesame Yield Trials for two consecutive years from 2016 to 2017. TS-5 was used as check variety in all the yield trials.

The overall performance of the entrant-variety was better than the check-variety in Station Yield Trials, Zonal Varietal Trials and National Uniform Sesame Yield Trials. All yield trails were sown in Randomized Complete Block Design with three replications and each plot consisted of 4 rows with each row being 5 meters long. The 45 centimeters distance between rows was maintained and seeds were sown using Hand Seed Drill. All recommended agronomic and cultural practices were carried out during the whole tenure of the experiments. The recommended dose of NPK was applied during different growth stages and seed yield of a plot was recorded for yield evaluation at maturity.

2.3. Oil Quality Analysis:

The fatty acid profile analysis was carried out at Pakistan Council of Scientific and Industrial Research (PCSIR) Laboratories Complex, Lahore (Pakistan) during 2017. The oil contents of elite strains were determined by Nuclear Magnetic Resonance (Model MQA 7005). Fatty acid profile of elite strain was determined by Gas Chromatograph (Model Varian-3900 GC).

2.4. Agronomic Studies:

To find out appropriate sowing date for best seed yield sowing date trials of new line 50022 were conducted during 2014 & 2015 and seed yield was evaluated at five different sowing dates from 15th May

to 15th July with an interval of 15 days at research area of Oilseeds Research Institute, Faisalabad.

2.5. Disease Incidence:

Screening studies of diseases (Charcoal Rot and Phyllody) in sick fields were carried out at Plant Protection Research Institute Faisalabad, Punjab, Pakistan during 2016 & 2017.

2.6. Statistical Analysis:

Statistx 8.1, a computer statistical software package, was used to calculate and analyze variance for different measured traits and differences among means were tested at 5% probability level.

2.7. Varietal Approval:

The strain (50022) was evaluated in Spot Examination on 19-09-2017. The Spot Examination Committee recommended the strain for evaluation in Experts Sub-Committee meeting. After evaluation in Spot Examination and Expert Sub- Committee

Meeting, the case of candidate variety 50022 (TIL-18) for variety approval was presented for general cultivation in 50th meeting of Punjab Seed Council (Pakistan) held on May 09, 2018.

3. Results

3.1. Yield Performance Studies – Station Yield Trials:

In 2014 and 2015 TIL-18 was evaluated in Preliminary Yield Trials where it outperformed Check TS – 5 by giving 1167 kg/ha against 872 kg/ha in preliminary yield trials which is approximately 25.8% greater than that of Check TS – 5. Similarly, in Advanced Yield Trials its yield was 951 kg/ha against 699 kg/ha which is approximately 26.5% higher than that of Check TS – 5. Yield data of these trials was as under in Table-1:

Table-1: Yield Performance of advance line 50022 in yield trials.

Variety/Line	Yield kg/ha		
	PYT (2014)	AYT (2015)	Average
50022	1176	951	1063
TS-5 (check)	872	699	786
Increase (%)	25.8%	26.5%	26.15%
LSD 5%	102	98	

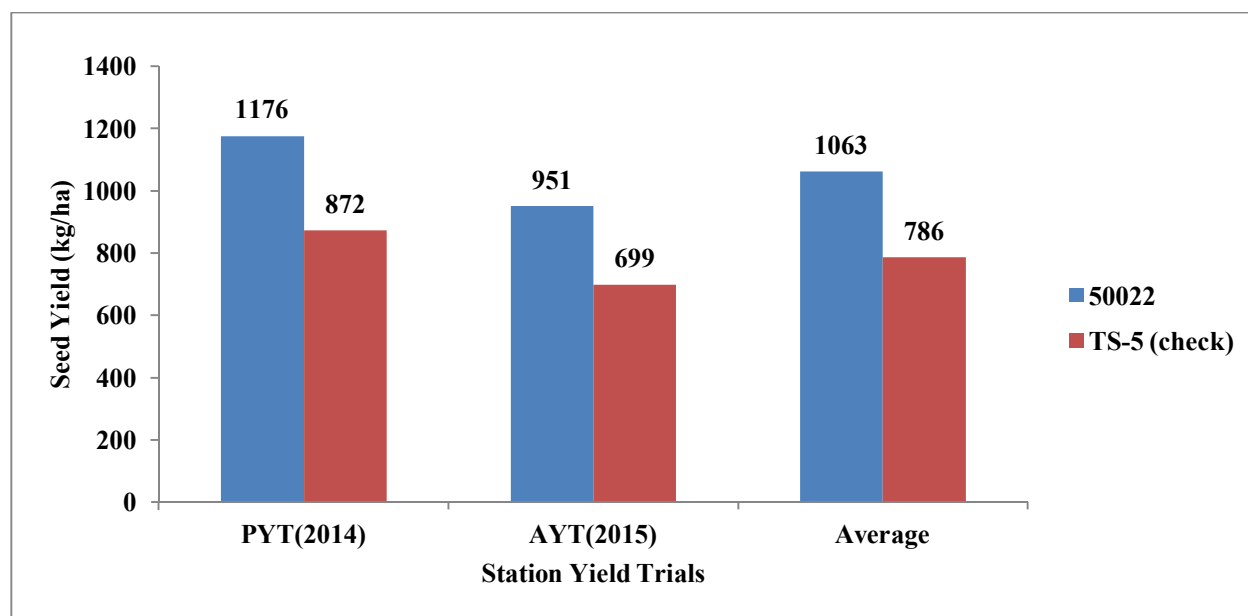


Figure 1: Performance in Station Yield Trials

3.2. Zonal Varietal Trials:

After evaluating the performance of TIL-18 at station for two years its performance was evaluated at five different locations including Oilseeds Research Institute Faisalabad, Mandi Baha Udin, Piplan,

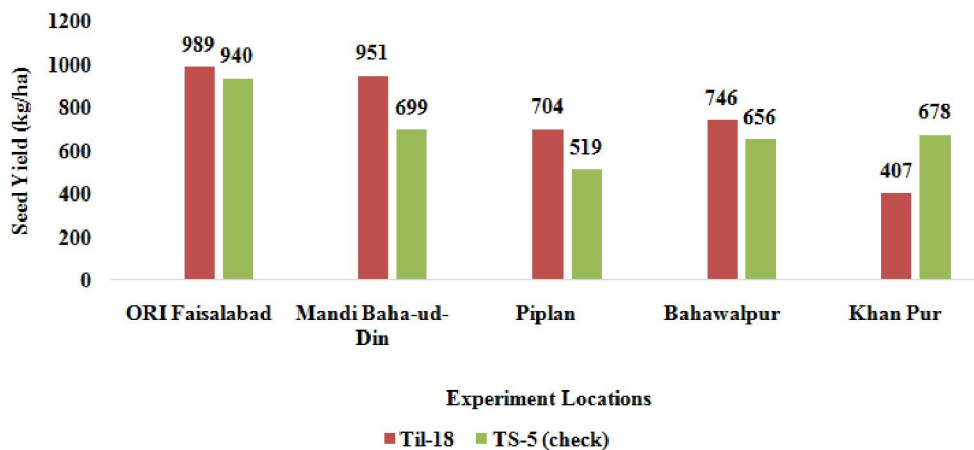
Bhawalpur and Khanpur under zonal adaptation yield trials in 2015 & 2016 where its adaptability and yield performance were tested as these happen to be the major concerns of breeders. Its yield performance was as under in Table 2 and 3:

Table-2: Yield Performance of Sesame Variety 50022 in Zonal Varietal Trial during 2015

Variety/Line	Yield (kg/ha)						% Increase
	ORI Faisalabad	Mandi Baha-ud-Din	Piplan	Bahawalpur	Khan Pur	Average	
50022	989	951	704	746	407	759	18.58%
TS-5 (check)	940	699	519	656	678	618	
LSD 5%	202	109	158	122	160		

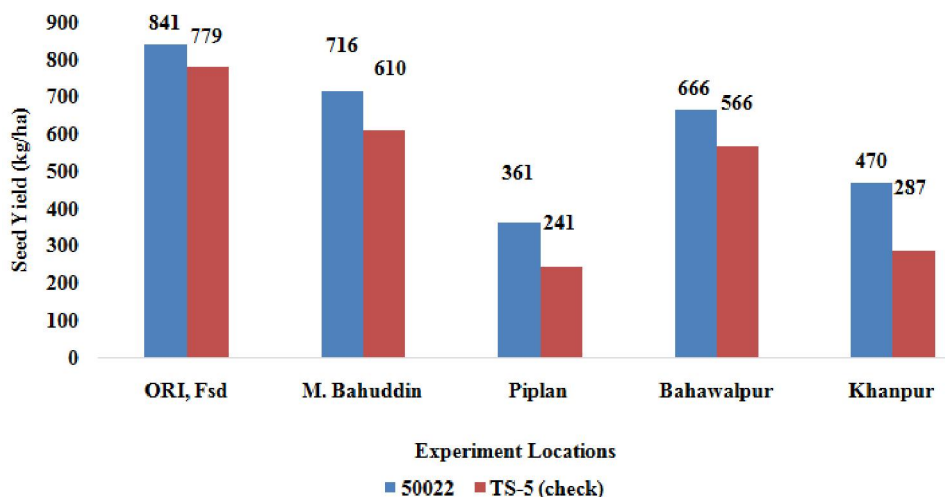
As evident from the above data TIL- 18 gave an average yield of 759 kg/ha which is 18.58% more than that of Check TS – 5. Same procedure was used by

Anwar *et al.*, Mahmood *et al.*, and Mahmood *et al.*, for evaluation of their lines “TH-6”, “Punjab Sarson” and “Faisal Canola” respectively.

**Figure 2: Performance in Zonal Varietal Trial 2015****Table-3: Yield Performance of Sesame Variety 50022 in Zonal Varietal Trial during 2016**

Variety/Line	Yield (kg/ha)						% Increase
	ORI Faisalabad	Mandi Baha-ud-Din	Piplan	Bahawalpur	Khan Pur	Average	
50022	841	716	361	666	470	611	18.66%
TS-5 (check)	779	610	241	566	287	497	
LSD 5%	109	94	145	205	131		

The mean data of Zonal Varietal Trial conducted during 2016 showed that TIL-18 outperformed over Check sesame variety TS – 5 by 18.66%.

**Figure 3: Performance in Zonal Varietal Trial 2016**

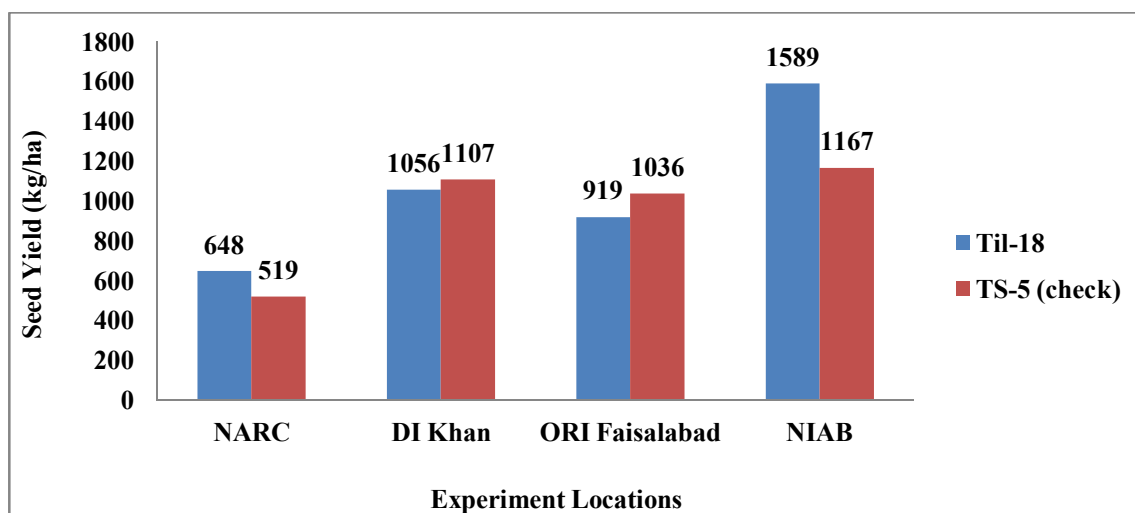
3.3. National Uniform Sesame Yield Trials:

Subsequent to zonal varietal trials performance of candidate line 50022 was evaluated in National Uniform Yield Trials 2016 and 2017 under different Agro-climatic conditions across Pakistan. Trials were

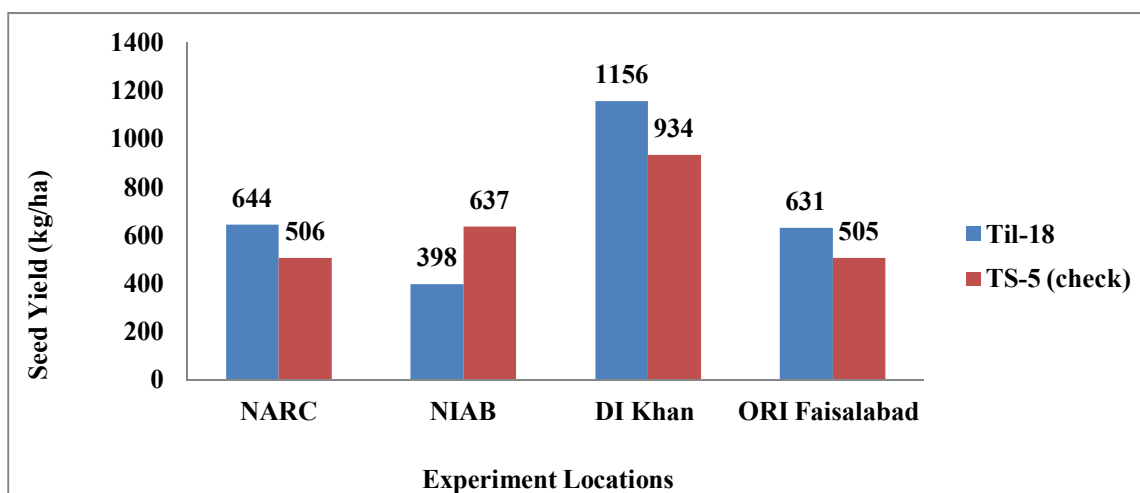
conducted under supervision of Oilseed Coordinator, Pakistan Agriculture Research Council (PARC), Islamabad, Pakistan. Yield performance was as under in Table 4 and 5:

Table-4: Yield Performance of Sesame Variety 50022 in National Uniform Sesame Yield Trial 2016

Variety/Line	Yield (kg/ha)					% Increase
	NARC	DI Khan	ORI Faisalabad	NIAB	Average	
50022	648	1056	919	1589	1053	9.5%
TS-5 (check)	519	1107	1036	1167	953	
LSD 5%	154	198	79	142		

**Figure 4: Performance in National Uniform Sesame Yield Trial 2016****Table-5: Yield Performance of Sesame Variety 50022 in National Uniform Sesame Yield Trial during 2017**

Variety/Line	Yield (kg/ha)				Average	% Increase
	NARC	NIAB	DI Khan	ORI Faisalabad		
50022	644	398	1156	631	707	8.8%
TS-5 (check)	506	637	934	505	645	
LSD 5%	112	98	134	160		

**Figure 5: Performance in National Uniform Sesame Yield Trial 2017**

As evident from the tables above National Uniform Sesame Yield Trial TIL-18 average yields were 1053 Kg/ha and 707 kg/ha in 2016 and 2017 respectively which were 9.5% and 8.8% more than the yields of Check variety TS – 5.

3.4. Agronomic Performance:

During the calendar years 2014 and 2015 seed yield performance of line 50022 was evaluated at five

different planting times between 15th May and 15th July with 15 days interval and it was observed that it yielded higher quantities if planted between 30th May and 30th June giving 840.0, 951.4 and 867.3 kg/ha respectively. In the past, same experiment has also been conducted by other scientists to check sowing data (Churl *et al.*, 2005 & Anwar *et al.*, 2012). Yields at different planting dates were as under in Table 6:

Table-6: Average Seed Yield of Sesame Variety 50022 as affected by different dates and Sowing times at Oilseeds Research Institute, Faisalabad during 2014 and 2015

Date of Sowing	Seed Yield (kg/ha)		Average (kg/ha)
	2014	2015	
15 th May	715.13	734.63	725.0
30 th May	828.57	850.50	840.0
15 th June	937.87	965.12	951.4
30 th June	852.57	882.12	867.3
15 th July	404.75	381.13	393.0

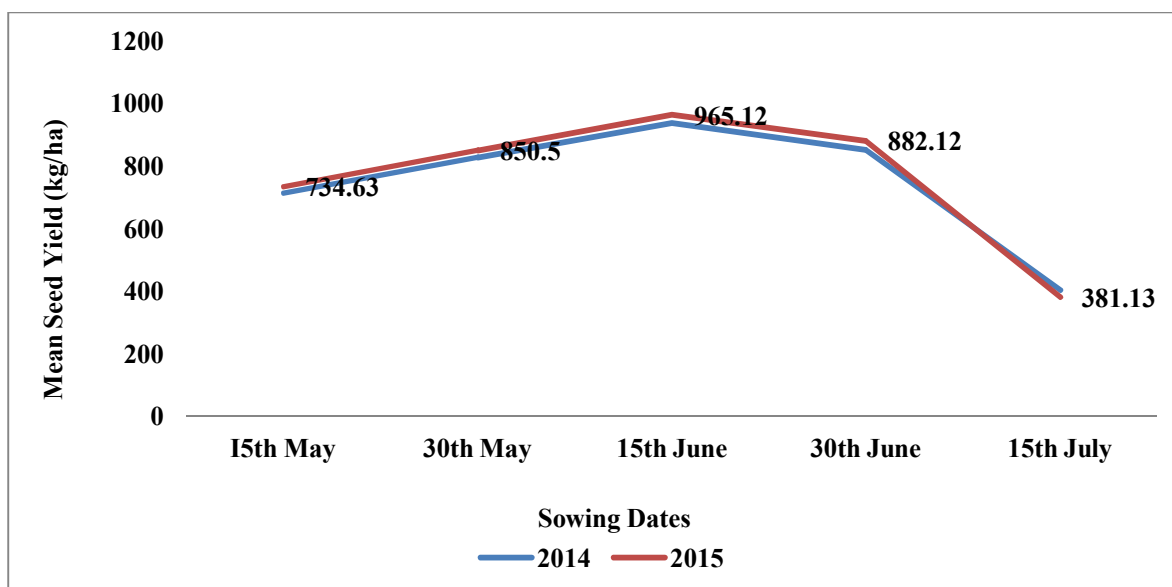


Figure 6: Yield Performance in Sowing Date Trial

3.5. Reaction towards Disease:

Screening studies were carried out by Oilseed Pathology division during calendar years 2016 and

2017 and TIL-18 was placed in tolerant group for both Charcoal Rot and Phyllody diseases.

Table-6: Reaction against charcoal Rot and Phyllody diseases.

Variety/line	Average Disease %age under Natural condition.			
	2016		2017	
	Charcoal Rot	Phyllody	Charcoal Rot	Phyllody
50022	0	03	0	01
TS-5 (check)	0	03	10	04

3.6. Oil Quality Studies

Gas Chromatograph (Model Varian-3900 GC) showed that 50022 (Til-18) have 50% oil content with

higher level of essential fatty acids omega 6 and omega 3 than check variety TS-5 showed in table 7.

Table-7: Comparison of Fatty acid profile

Name of Fatty Acid	Percentage (%)	
	50022	TS-5 (check)
Oleic Acid (Omega 9)	20.7	25
Linoleic Acid (Omega 6)	61.1	59.1
Lenolenic Acid (Omega 3)	1.1	0.3
Total Oil Content	50	48

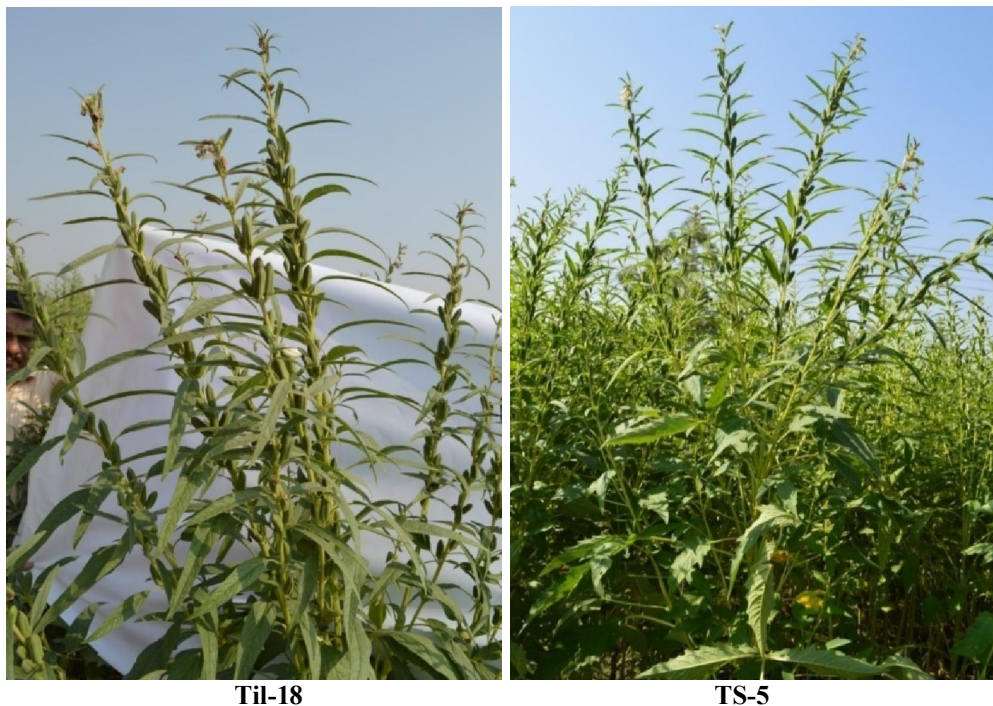
3.7. Variety Approval:

After evaluation in Spot Examination, Expert Sub- Committee, and in 50th meeting of Punjab Seed Council (Pakistan) held on May 09, 2018, the Sesame strain 50022 was approved as variety with name TIL-18 for general cultivation.

4. Discussion

According to descriptor established of Federal Seed Certification & Registration Department, Pakistan the salient agronomic and botanical description was recorded. TIL-18 (50022) has bold seed which is desirable characteristic and is suitable for edible purpose. It matures within 100-120 days that is comparable with TS-5 variety. The plant type and growth habit are determinate. Its leaf is green, flat, semi erect, and lobed in type. The flowers are

pendulant, tubular, two lipped white with purple color and bell shaped reportedly taking 39-45 days for opening (Anwar *et al.*, 2012). Capsule shape is square in attitude and its shattering is nil. No. of seeds/capsule are 58-66 and capsules/plant are 70-85. Seed color is white, and it possess 50-53% edible oil. 1000 seed weight is 3.3g. It is evident from the sowing date trial that new variety TIL-18 when planted in the month of June. It performed better and matured in 110 to 120 days. It is well fitted in our cropping pattern i.e. as most of the land is fallow after harvesting of wheat crop. Farmer can earn more profit by planting sesame crop as it has low cost of production than any other crop. Similar procedure for variety development and approval of Sesame and Canola variety was adopted by Anwar *et al.*, 2013 and Mahmood *et al.*, 2019 respectively.



Til-18

TS-5

Figure 7: Til-18 vs TS-5

5. Conclusion

Sesame is one of the important oilseed crops in Pakistan. It is grown in 65 districts of the country as rain fed as well as irrigated crop. Due to variation in rainfall pattern, the yield is not stabilized, and the farmers cannot get sustained income. There is great scope of this crop due to its export potential. During 2018-19, its international marketing was very encouraging and its seed worth more than Rs. 9.72 billion was exported by Pakistan to different countries. Sesame cultivation on large areas using high yielding varieties and appropriate production technology can enhance domestic sesame production as well as increase the export magnitude. The newly developed sesame variety "Til-18" is suitable for both irrigated and rain fed areas having good yield potential under the scenario of climate change. It is concluded Til-18 will enhance the area and production of sesame crop in the country which ultimately increase profitability of the sesame growers.

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