



PLANT BREEDING & GENETICS

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REGISTRATION OF ORISUN-741 SUNFLOWER HYBRID

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ABSTRACT

The ORISUN-741 sunflower hybrid was released in 2023 for edible oil production. ORISUN-741 is a cross of two inbred lines (Hybrid of ORI-92 and RL-86) made in 2017 at Oilseed Research Institute, Faisalabad and its permanent name was assigned 2021. Evaluation was done in different replicated yield trials for four years harvested from 2018 to 2021. The hybrid was higher in yield 2648 kg/ha and 2329 kg/ha and oil content 41% profile than that of local check hybrids varieties Hysun-33 (2196 kg/ha) and AGSUN-5264 (2234 kg/ha) in National Uniform Sunflower Yield Trials 2019-20 and 2020-21, respectively. It showed more tolerance against Charcoal Rot and sucking pests and performed better as compared to commercial standard. Release of ORISUN-741 gives farmer a new choice for the production of oilseed crop.

KEYWORDS: *Helianthus annuus*; hybrid; sunflower; A line; B line; R line; cytoplasmic male sterile ; Pakistan

INTRODUCTION

Pakistan, despite being an agricultural country is severely lacking in local production of edible oil as compared to national annual consumption. Every year, a significant amount of foreign exchange reserves is used to fund imports that meet about 85–90% of the requirements which is a matter of concern for researchers and policy makers. The cost of importing edible oil came to nearly Rs. 826.482 billion because our national requirement is hardly met 10-15% by local production (GoP, 2023). Sunflower is globally 2nd crop after maize in terms of hybrid breeding (Sieler *et al.*, 2017) and the 4th with respect to contribution in world edible oil production (Dimitrijevic and Horn, 2018). Most of the economic value of sunflower comes of its high-quality oil (Radanovic *et al.*, 2018). Besides the direct human consumption for its oil, several industrial uses of sunflower add up in its commercial value (Dimitrijevic *et al.*, 2017). Its capacity to grow in diversity of ecologies and equitable drought tolerance accompanied with minimal requirement of inputs define its prevalent popularity (Dimitrijevic and Horn, 2018). Early 1970s, the only types of sunflowers that contributed to production in past centuries were open pollinated ones (Vear, 2016). Following the discovery of the CMS source and the identification of the corresponding restorer gene, the path for hybrid breeding in sunflower was established (Leclercq,

1969; Kinman, 1970; Leclercq, 1971). Farmers were enabled to get higher seed and oil yields with enhanced uniformity after the exploitation of heterosis for hybrid breeding (Bohra *et al.*, 2016). After the hybrid synthesis, sunflower stood up as major worthwhile crop globally and exhilarated the instituting of numerous centers of sunflower breeding in public and private sector (Skoric, 2012; Seiler *et al.*, 2017). Oilseeds Research Institute, (ORI) Faisalabad is one of the most recognized public sector institutes in Pakistan working on hybrid development of sunflower owning a vast germplasm of locally developed cytoplasmic male sterile (CMS) and fertility restorer (R) lines to be utilized in constitution of well adapted local sunflower hybrids (Ejaz *et al.*, 2023). This study presents the methodical background of a heat tolerant sunflower hybrid ORISUN-741 with increased yield potential and adaptability to local climate of Punjab, Pakistan approved for general cultivation in farmer field.

MATERIALS AND METHODS

Location of the experiment: ORI, Faisalabad and other Punjab locations (Sahiwal, Kabir Wala, Karror, Bahawalpur, Muzaffargarh, Rajanpur and Multan) suitable for sunflower production were the sites of all evaluation trials for this hybrid. The flat plains of Faisalabad (31°26'S, 73°06'E), which are located above 186 meters above sea level and have an arid

or semiarid climate, are located in North-East Punjab. They receive 13 to 417 mm of precipitation annually, with average winter temperatures between 21 and 28 °C and summer temperatures between 30 and 45 °C.

Breeding history and source of origin: Inbred lines used in the development of hybrid ORISUN-741 were obtained from existing germplasm of sunflower at ORI Faisalabad. The promising sunflower medium duration hybrid is product of cross between ORI-92A x RL-86 that was first constituted in 2017 and tested against check hybrids for yield prospective. ORI-92 A x RL-86

(CMS Line) (R Line)



ORISUN-741
(F1 Hybrid)

Characterization and adaptability: DNA fingerprinting for the uniqueness *Helianthus annuus* L. hybrids for oleic acid and yield traits under multi location trials in Pakistan” was carried out. Oil contents and quality was tested in seed technology lab of ORI Faisalabad. The hybrid ORISUN-741 was tested for yield performance in different agro-climatic zones of Punjab and at different locations in Pakistan. Response of hybrid towards different treatments of fertilizer doses and sowing dates was also studied at ORI, Faisalabad. Insect pest and disease reaction of ORISUN 741 was examined in comparison with commercial check hybrids.

STATISTICAL ANALYSIS

Using analysis of variance, every character recorded during the study was statistically analyzed (Steel *et al.* 1997) and variations were found across all parameters. There was a significant variation in yield across all morphological traits and yield-related metrics.

RESULTS AND DISCUSSION

Table 2: Comparison of yield in micro yield trial 2019 (ORISUN-741 VS Hysun-33)

Hybrid	Seed yield in (kg/ha)							
	FSD	Sahiwal	Kabirwala	Karor	M.Garh	BWP	Avg.	% Increase
ORISUN-741	2810	2750	2456	3342	2958	2487	2800	12%
Hysun-33 (C)	2361	2433	2067	3380	2783	1928	2492	

C= Check, FSD = Faisalabad, M. Garh = Muzaffargarh, BWP = Bahawalpur

The above results from the 2019 Micro Yield Trial showed that ORISUN-741 produced 12% better seed yield than the check hybrid Hysun-33

Yield evaluation trials: ORISUN-741 hybrid had been tested for yield performance on a variety of agro-climatic zones in Punjab, Pakistan including Station yield trials (SYT) at ORI Faisalabad in 2018 showing 3 % increase in yield over the commercial check hybrid. Yield increase was recorded as 12% in micro yield trials (MYT) conducted at different locations within Punjab during 2019 and 21 % and 4 % yield increase over check hybrid in National Uniform Sunflower Yield Trial at different locations all over Pakistan during 2019-20 and 2020-21 respectively. Graphical and tabulated presentation of yield data of all trials are given below.

Table 1: Comparison of yield in station yield trial 2018 (ORISUN-741 VS Hysun-33) at ORI Faisalabad.

Hybrid	Seed yield in (kg/ha)	
	Seed yield	Percent increase over check
ORISUN-741	2861	3
Hysun-33 (Check)	2791	

Agronomic Performance of Orisun-741

Fertilizer response: Five distinct NPK combination treatments were used to monitor ORISUN-741's response. Between treatments, the mean seed yield data varied from 2154 to 3128 kg/ha and was statistically significant Table 7. Treatment 4, in which N: P: K was applied at 153:99:62 kg/ha, produced the highest seed yield of 3042 kg/ha. Treatment 5 produced a statistically comparable seed yield of 2798 kg/ha.

Sowing Date: At fifteen-day intervals, the mean yield of ORISUN-741 in the sowing date trial was evaluated between December 1st and February 15th. In Table 8, the yield data is displayed. According to the table, the treatment with the highest mean yield (3136 kg/ha) was treatment 3 (1 January), and the treatment with the second-highest yield (2899 kg/ha) was treatment 2 (15 December).

CONCLUSION

Table-3: Overall yield performance of ORISUN-741 in national uniform sunflower yield trial, 2019-20

Hybrid	Seed yield (kg/ha)									
	AZRC, DI Khan	ICI, Hyderabad	ORI, FSD	Rajanpur	ICI, Multan	ARI, Tando jam	ORS, BWP	ORP-NARC, Islamabad	Average	% Increase
ORISUN-741	2657	1422	3300	3283	3447	1150	2809	3115	2648	21%
Hysun-33 (Check)	3011	1185	2197	3003	2880	1202	1597	2496	2196	

AZRC DI Khan = Arid Zone Research Centre, Dera Ismaiel Khan, ICI= Imperial Chemical Industries, ORI, FSD= Oilseeds Research Institute, Faisalabad, ARI, Tando jam = Agricultural Research Institute, Tando jam, ORS, BWP = Oilseeds Research Station, Bahawalpur, ORP-NARC= Oilseed Research Program National Agricultural Research Centre

Table-4: Yield performance of ORISUN-741 in national uniform sunflower yield trial, 2019-20 (Punjab locations)

Sr. #	HYBRIDS	ORI-FSD	RajanPur	ICI- Multan	ORS- Bhawalpur	Average (kg/ha)	% Increase
1	ORISUN-741	3300	3283	3447	2809	3209	32%
2	Hysun33 (Check)	2197	3003	2880	1597	2419	

ORI, FSD= Oilseeds Research Institute, Faisalabad, ICI= Imperial Chemical Industries, ORS = Oilseeds Research Station

Table-5: Yield performance of ORISUN-741 in national uniform sunflower yield trial, 2020-21

Hybrid	Seed yield in (kg/ha)											
	ORP-NARC, Islamabad	AZRC, DI Khan	ORS, BWP	ORI-FSD	ARS, Karror	ARI, Quetta	Sygenta, DG Khan	ICI, Multan	ICI, Hyderabad	ORP, ARI, Ternab	Average	% Increase
ORISUN-741	2905	2690	1229	3586	3821	1150	2567	2140	1391	1810	2329	4 %
AGSUN-5264 (Check)	3326	2357	1449	2773	2824	1126	2914	1502	1574	2497	2234	

ORP-NARC= Oilseed Research Program, National Agricultural Research Centre, AZRC DI Khan = Arid Zone Research Centre, Dera Ismaiel Khan, ORS, BWP = Oilseeds Research Station, Bahawalpur, ORI, FSD= Oilseeds Research Institute, Faisalabad, ARS, Karror= Agronomic Research Station, Karror, ARI, Quetta= Agricultural Research Institute, Quetta, ICI= Imperial Chemical Industries, ORP, ARI, Tando jam = Oilseed Research Program, Agricultural Research Institute, Tando jam.

Table-6: Yield performance of ORISUN-741 in national uniform sunflower yield trial, 2020-21 (Punjab locations)

Sr#	Hybrids	BWP	FSD	Karror	DG Khan	Multan	Average	% Increase
							Kg/ha	
1	ORISUN-741	1229	3586	3821	2567	2140	2668	16%
2	AGSUN-5264 (Check)	1449	2773	2824	2914	1502	2292	

According to the aforementioned National Uniform Sunflower Yield Trials data, ORISUN-741 produced 21% more seed in 2019–20 and 4% more than conventional check hybrids in 2020–21

Table-7: ORISUN-741's reaction to varying NPK fertilizer levels at the Oilseeds Research Institute in Faisalabad in 2020 and 2021

Treatment	Nitrogen (kg/ha)	Phosphorus P ₂ O ₅ (kg/ha)	Potash K ₂ SO ₄ (kg/ha)	Seed yield 2020 (kg/ha)	Seed yield 2021 (kg/ha)	Mean (kg/ha)
T ₁	119	85	62	2356	2154	2255
T ₂	147	85	62	2528	2358	2443
T ₃	124	99	62	2856	2664	2760
T₄	153	99	62	3128	2956	3042
T ₅	160	115	62	2856	2740	2798

Table-8: Response of ORISUN-741 to different dates of sowing during 2019-20 and 2020-21 at Oilseeds Research Institute, Faisalabad

Date of sowing	Yield (kg/ha)		Avg. (kg/ha)
	2019-20	2020-21	
1 st December	2725	2656	2690
15 th December	2942	2856	2899
1st January	3230	3042	3136
15 th January	2812	2752	2782
1 st February	2583	2376	2479
15 th February	2350	2250	2300

Table-9: Observation of charcoal rot disease in ORISUN-741 during NUSYT 2020 at Faisalabad

Name of hybrids	Intensity scale (A-D)	Remarks
ORISUN-741	B (15cm)	Tolerant
Hysun-33	C (24 cm)	Moderately Tolerant
FH-331	C (23 cm)	Moderately Tolerant

Based on data from 2020, the candidate hybrid ORISUN-741 has tolerance to Charcoal Rot.

INSECT PEST REACTION OF ORISUN-741

Table-10: Observation of insect pests in ORISUN-741 during 2019

Sr.No	Hybrid	White fly/leaf (ETL= 5)	Jassid/leaf (ETL= 1)	Head moth/plant (ETL= 1)
1	ORISUN-741	0.36	0.61	0.05
2	Hysun-33	0.45	0.73	0.06

The sunflower hybrid ORISUN-741 have better insect tolerance against white fly, Jassid and head mouth as comparison to the check hybrid Hysun-33.

Table-11: Observation of Insect pest in ORISUN-741 during 2020

Sr. No	Hybrid	White fly/leaf (ETL= 5)	Jassid/leaf (ETL= 1)	Head moth/plant (ETL= 1)
1	ORISUN-741	0.48	0.76	0.26
2	Hysun-33	0.65	0.94	0.30

Measurements of quality in ORISUN-741:

Table-12: Comparison of Oil quality (ORISUN-741 VS Hysun-33)

Name of hybrid	Oil content %	Oleic acid%(u-9)	Linoleic acid%(u-6)
ORISUN-741	41	52	30
Hysun 33 (C)	40	40	46
Sunflower Oil Standards*	≤ 38	14-40	48-74

Fig. 1: Yield comparison of ORISUN-741 with Hysun-33 in Micro Yield Trial, 2019

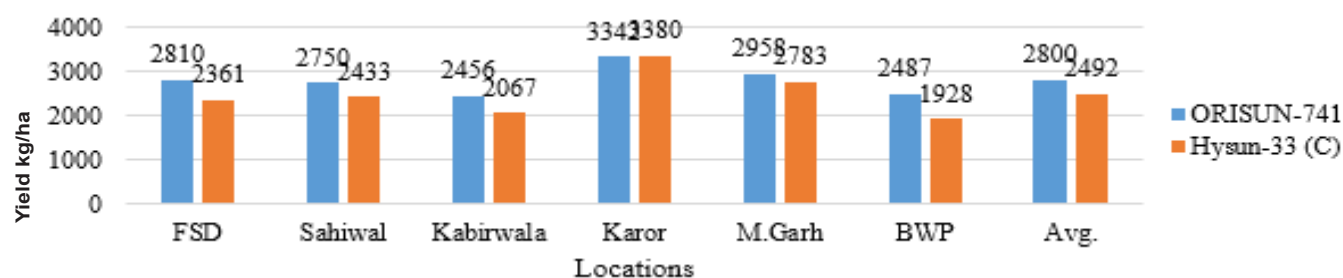


Fig. 1: Yield comparison of ORISUN-741 in micro yield trial during 2019

C= Check, FSD = Faisalabad, M. Garh = Muzaffargarh, BWP = Bahawalpur

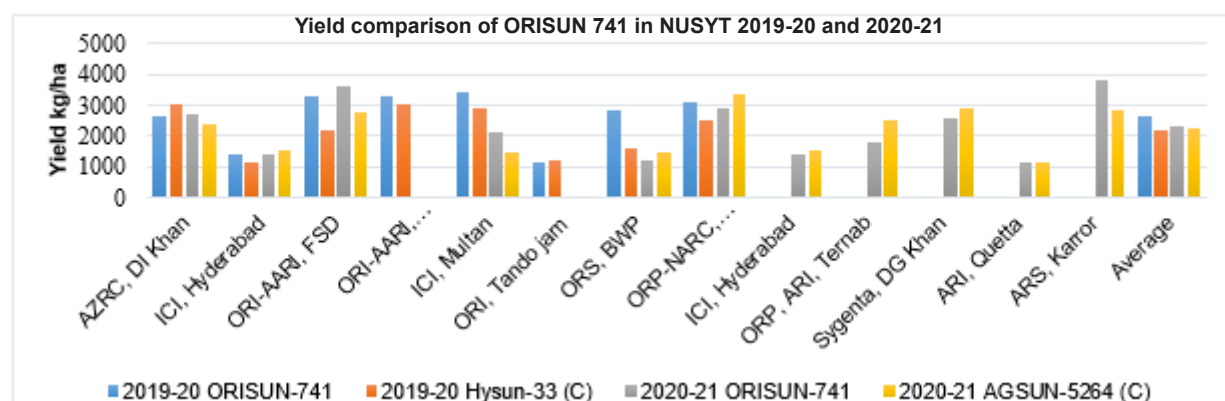


Fig. 2: ORISUN-741's yield performance in the national uniform sunflower yield trial in 2019–20 and 2020–21 across Pakistan

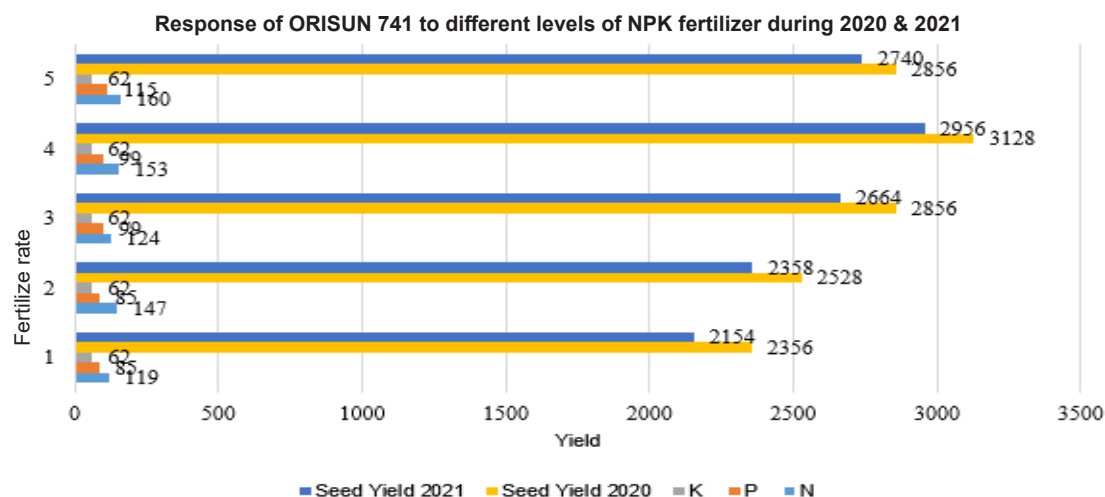


Fig. 3: Represents the results how ORISUN-741 responded to different doses of NPK fertilizer in 2020 and 2021 at Oilseeds Research Institute, Faisalabad.

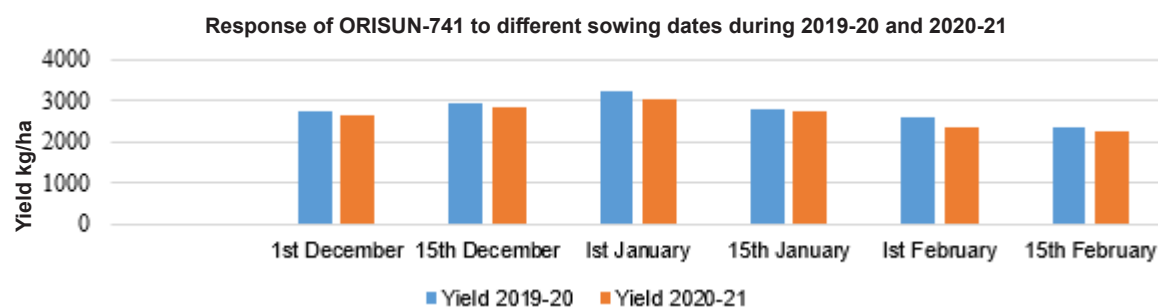


Fig. 4: Response of ORISUN-741 to different sowing dates during 2019-20 and 2020-21

Disease reaction of ORISUN-741 for charcoal rot

Scale for the rating of disease (length of stem 'cm' covered by infection) set by CDRI, NARC:

1-10 = A, 11-20 = B, 21-30 = C, 31 and above = D

MORPHOLOGICAL CHARACTERIZATION OF ORISUN-741

Morphological characteristics of ORISUN-741 were observed in the research area of ORI Faisalabad during 2019-20. Data of morphological traits are presented in the Table 13.

Table 13. Morphological description of Hybrid ORISUN-741 sunflower hybrid orisun-741

1- SEEDLING CHARACTERISTICS		
1.1	SEEDLING LENGTH	100-110 mm (After 14 days)
1.2	SDL HAIRINESS	Medium
1.3	SDL COLOR	Light Green
1.4	ANTHOCYANIN	Weak
1.5	HYPOCOTYL ANTHOCYANIN COLORATION	Absent
1.6	SIZE OF COTYLEDONS	Medium
1.7	SHAPE OF COTYLEDONS	Oval
2-PLANT CHARACTERISTICS		
2.1	PLANT HEIGHT (cm)	195-210 cm
2.2	STEM ANTHOCYANIN	Absent
2.3	STEM DIAMETER	22-30 mm
2.4	STEM BRANCHING	Absent
2.5	PLANT COLOUR	Light Green
3-LEAF CHARACTERISTICS		
3.1	LEAF COLOUR	Green
3.2	LEAVES PER PLANT	25-34
3.3	LEAF ANTHOCYANIN	Absent
3.4	LEAF ATTITUDE	Semi erect
3.5	LEAF SURFACE	Smooth
3.6	LEAF SIZE	Medium
3.7	PETIOLE LENGTH	14-20 cm
3.8	LEAF SHAPE	Cordate
3.9	LEAF MARGINS	Dentate
3.10	LEAF HABBIT OF PETIOLE	Semi-erect

4-FLOWER CHARACTERISTICS

4.1	DAYS TO FLOWERING (50%)	66-72 days
4.2	RAY FLORET COLOUR	Yellow
4.3	DISC FLORET COLOR	Yellow
4.4	POLLINATION	Cross Pollination

5-HEAD CHARACTERISTICS

5.1	HEADS/PLANT	Single
5.2	HEAD SIZE/DIAMETER	Large (15-18 cm)
5.3	HEAD SHAPE	Weakly convex
5.4	HEAD ATTITUDE	Slightly embracing
5.5	HEAD ANGLE	180
5.6	SEED WEIGHT/HEAD	55-59 g

6-SEED CHARACTERISTICS

6.1	SEED COLOUR	Black
6.2	SEED SIZE	Medium
6.3	SEED SHAPE	Broad ovoid
6.4	1000 SEED WEIGHT	50-56 gm
6.5	AVERAGE YIELD	3209 kg/ha
6.6	OIL %	41%

7-RESISTANT TO

7.1	Charcoal rot	MR
7.2	Insects/Pests	MR

“ORISUN-741” is the perfect ideotype for cultivation and promotion across Punjab. For commercial production in Punjab, Pakistan, the new hybrid “ORISUN-741” has been approved by the Punjab Seed Council (PSC), located in Lahore. In Punjab, Pakistan, it is a true boon in disguise for sunflower farmers.

Conflict of interest

The authors declare no conflict of interest.

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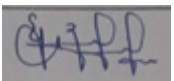
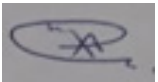
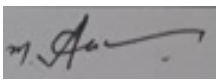
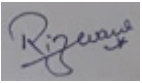
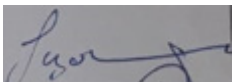
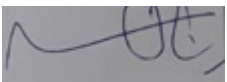
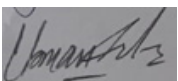
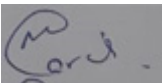
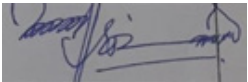
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CONTRIBUTION OF AUTHORS

Sr. No.	Author's name	Contribution	Signature
1.	Ejaz-ul-Hasan	Planned and supervised the experiments	
2.	Mudassar Abbas	Prepared the draft of research paper	
3.	Muhammad Anwar	Conducted the research work	
4.	Rizwana Qamar	Conducted the research work	
5.	Sajida Habibi	Supervised the experiment	
6.	Hafiz Saad Bin Mustafa	Helped in research work	
7.	Hafiz Basheer Ahmad	Reviewed and helped in write up the experiment	
8.	Usman Saleem	Edited the manuscript	
9.	Maria Ghias	Contributed in data analysis	
10.	Muhammad Rizwan Bashir	Contributed in research work	
11.	Ijaz Haider	Contributed in research work	