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Research Article

Thal-2020: High Yielding and Stress Tolerance Chickpea (*Cicer arietinum* L.) Cultivar to Mitigate Climate Change Effects

Niaz Hussain[1], Muneer Abbas[1*], Abdul Ghaffar[1], Muhammad Aslam[1], Mudassar Khaliq[1], Khalid Hussain[2], Muahammad Nadeem[1], Muhammad Irshad[1], Zubeda Parveen[1], Fiaz Hussain[3] and Azhar Mahmood Aulakh[4]

[1]Arid Zone Research Institute, Bhakkar, Punjab, Pakistan; [2]Pulses Research Institute, Ayub Agricultural Research Institute, Faisalabad, Punjab, Pakistan; [3]Agronomic Research Station, Karor, Layyah, Punjab, Pakistan; [4] Soil and Water Conservation Research Institute, Chakwal, Pakistan.

Abstract |The continuous development of crop cultivars with desired attributes is crucial due to the vulnerability of crop varieties to various biotic and abiotic stresses over time. This necessitates the replacement of existing varieties with genotypes that exhibit enhanced productivity potential and built-in tolerance against a range of stresses. This study highlights the development of a new desi chickpea cultivar "Thal-2020" using conventional plant breeding procedures. This variety expressed higher yield potential, bold seed size and resistance to various diseases. The breeding process commenced in 2006-07 by crossing two local genotypes, 97086 (female parent) and 950130 (male parent), to create genetic variability for bold seed size. Recombinants having higher yield along with bold grains were selected from the F_2 population raised from the F_1 seed. Subsequent single plant selections (SPS) were accomplished and further advancement from F_3 to F_5 generations were carried out through the plant pedigree selection method, mainly focusing on recombinants possessing high yield potential with bold grains. Uniform lines were selected from F_6 generation and bulked. Ultimately, the promising and uniform line "TG1410" later on named "Thal-2020" was selected from F_7 population during 2013-14. This selected line underwent rigorous evaluation for yield potential and disease resistance during the process of evolution. In various station, adaptation, and national yield trials, this cultivar consistently outperformed standard checks (Bittle-2016, Punjab-2008 and Bhakkar-2011) with higher yield. Notably, the candidate variety TG1410 expressed a potential yield of 4513 kg ha^{-1} in Provincial Yield Trial 2018-19 conducted at Gram Breeding Research Sub-Station, Kallur Kot (Bhakkar), Punjab, Pakistan. The salient features of "Thal-2020" include bold, brown-colored ram-headed grains, with 100-grains weight of 27-28g, semi-erect growth habit, medium canopy, higher yield potential and resistance to *Ascochyta* blight and *Fusarium* wilt diseases. This first report on the "Thal-2020" chickpea variety highlights its promising traits, including high yield potential, disease resistance, and adaptability to various conditions. "Thal-2020" offers future benefits such as enhanced productivity, reduced pesticide use, and improved economic returns for farmers. Its introduction is expected to significantly enhance the sustainability and profitability of chickpea cultivation.

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***Correspondence** |Muneer Abbas, Arid Zone Research Institute, Bhakkar, Punjab, Pakistan; **Email**: m.abbas1902@gmail.com
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Introduction

Chickpea (*Cicer arietinum* L.) is significant source of vegetable protein and it ranks third amongst the grain legumes after common bean and pea worldwide (Sarwar *et al*., 2012; Hirich *et al*., 2014). In Pakistan, the total crop area under chickpea cultivation was about 830 thousand hectares, resulting in a production of 238 thousand tons with 287 kg per hectare average yield during the 2022-2023 (Anonymous, 2023). Punjab alone contributes 80 percent to chickpea production in Pakistan and it is grown nearly 90 percent under rainfed conditions (Hussain *et al*., 2015). Its cultivation is predominant in the rainfed areas of Thal, Punjab, Pakistan. Unfortunately, the crop has been adversely affected by prolonged drought period over the past few years. The major factors for low productivity and instability are moisture deficiency at critical crop growth stages such as reproductive initiation, flowering, pollination, and grain development. Despite this challenge, chickpea is sown under dry conditions in four key districts of Thal: Bhakkar, Khushab, Layyah, and some part of Jhang, typically during the month of October. Thal is traditionally vast area for the production of chickpea, covering approximately 0.724 million hectares. It contributes to over 90% of the chickpea cultivated area and production in the Punjab region (GoP, 2023).

Chickpea production is severely affected by various biotic and abiotic stresses. The biotic stresses include Ascochyta blight (*Ascochyta rabiei*), Fusarium wilt (*Fusarium oxysporum* f. sp.*ciceris*), Botrytis grey mould (*Botrytis cinerea*) and dry root rot (*Rhizoctonia bataticola*) diseases, while pod borer (*Helicoverpa armigera*), semilooper (*Thysanopulsia orichalcea*), black aphid (*Aphis craccivora*), black cutworm (*Agrotis ipsilon*), leaf miner (*Liriomyza cicerina*) and *bruchids* are the main pests. Likewise, heat, drought, frost and salinity are the abiotic stresses affecting chickpea production (Jha *et al*., 2014; Maphosa *et al*., 2020). Pod borer, *Helicoverpa armigera* (Hubner) is a major pest and exerts a considerable economic impact (Ahmed and Awan, 2013). From February to mid-March, during late vegetative and reproductive growth stages, conditions favour pod borer attacks. *H. armigera* caused yield losses ranging from 37-50% (Sanap and Jamadagni, 2005) and in severe cases up to 100% reduction (Sarwar *et al*., 2009). This poses a great threat to livelihood and food security of farmers in the affected area as well as at national level. Furthermore, attacks by termites, army worm infestations, and stored grain pests have also led to significant reductions in yield. *Ascochyta* blight (AB) by *Ascochyta rabiei* (Pass.), is the most significant fungal disease of chickpea (*Cicer arietinum* L.) throughout the world (Singh *et al*., 2022). It results in upto 100% yield losses and the disease can diminish seed quality significantly (Pande *et al*., 2005; Atta *et al*., 2006). It is one of the major limiting factor for chickpea yields in Pakistan, contributing to the overall yield gap in the country (Shahbaz *et al*., 2014). *Fusarium* wilt, another significant fungal disease, is prevalent in almost all chickpea-growing regions worldwide, with its occurrence ranging from 14 to 32% in the Thal region of Pakistan (Islam *et al*., 2017). Early wilt disease has been reported to cause a substantial yield loss ranging from 77 to 94% (Haware and Nene, 1980). Developing chickpea varieties with tolerance to various biological and environmental stresses is the most effective strategic approach. There is an urgent need to develop high-yielding varieties that can perform better under both biotic and abiotic stresses in order to address the yield gap (Rubiales *et al*., 2018). Our existing chickpea varieties have yield potential upto 3600 kgha^{-1}, but actual average yield is very low due to prevailing biotic and abiotic stresses. To tackle these production challenges, initiatives were being made to evolve high yielding varieties with tolerance to wilt and blight through utilization of genetic variability of the germplasm available at Arid Zone Research Institute, Bhakkar. Continuous breeding endeavors are crucial for the creation of innovative, improved, and more productive chickpea varieties (Talebi and Rokhzadi, 2013; Islam *et al*., 2017). With continuous efforts, this Institute has released several chickpea varieties including Thal-2006 and Bhakkar-2011 (Arshad *et al*., 2008; Aslam *et al*., 2013) as well as Star Channa and TG Striker. There is a dire need to enhance the productivity and profitability of chickpea cultivation in the country, aiming to reduce the import bill by introducing new climate-resilient chickpea varieties for growers in the target area. The new genotype TG1410 exhibiting tolerance to wilt with bold seed size, iron chlorosis and drought resistant has been developed at Arid Zone Research Institute, Bhakkar through hybridization among two variant lines. The adoption of resistant cultivars is widely recognized as the most cost-effective and environmentally friendly approach for disease control (Koleva *et al*., 2018). TG1410 out yielded its check variety Bittle-2016 in Chickpea National Uniform Yield Trial consistently for two years during 2017-18 & 2018-19. Maximum yield of this proposed variety was documented as 4513kgha^{-1} in Provincial Yield Trial during 2018-19. The approval of TG1410 as a commercial chickpea variety has the potential to reduce the existing yield gap and contribute to the socio-economic uplift of the local population.

Materials and Methods

Newly developed chickpea variety Thal-2020 was evolved by crossing two desi type of chickpea strains i.e. 97086 and 950130. Both strains were selected for hybridization on the basis of better yield potential, seed size, disease and drought tolerance. Entry coded as 97086 being semi spreading, bold seed size, wilt and blight resistant used as female parent. The local promising line named as 950130 with erect in nature, tolerant to iron chlorosis and drought was used as male parent.

Hybridization (F_0): Diversified crosses were endeavored during 2006-07 at Arid Zone Research Institute (AZRI), Bhakkar, Punjab, Pakistan to create genetic variability. Genetic variations among parental material confirms maximum chances for researchers to formulate required breeding strategies (Wang *et al*., 2017; Annicchiarico *et al*., 2018; Boukar *et al*., 2019; Ojiewo *et al*., 2019). For optimum synchronization, both parents were sown in equal row lengths and by keeping 30cm plant to plant and 60cm row to row distance. Immature and unopened flowers of female plants were emasculated manually through forceps and then pollinated during the month of February and March (Dixit *et al*., 2022). The pollens from male parent plants were collected and powdered on female parent plants. This practice was performed from 9:00 am to 11:00 am, at temperatures ranging from 14°C to 16°C, with a humidity level of 50-60 %. Successful crosses were harvested manually on physiological maturity and threshed to obtain F_0 seeds. Evolutionary history of newly developed chickpea desi variety Thal-2020 (TG1410) is revealed in Table 1.

Advancement of filial generations (F_1 to F_7): F_0 seeds were planted to advance phenotypically uniform and heterogeneous F_1 hybrid plants during Rabi season 2007-08. F_0 seeds were planted between parental lines with 4m length. Seeds were sown by dibbler and P-P 20cm and R-R 30cm distance were maintained, respectively. Regular irrigation was applied to maintain soil moisture, particularly during flowering and pod development. To control pod borer, Emamectin Benzoate was used @ 500 ml per hectare. F_1 seeds from each single plant were harvested and bulked. Then, F_2 population were raised in subsequent cropping season. Single plant selections were completed upto F_6 generation on the basis of appropriate attributes such as disease resistance, high yield, ideal plant height and structure, superior seed quality, and optimal flowering time. Bulk and pedigree plant selections methods were employed during the various development-stages. Uniform and pure lines were selected from F_7 generation and bulked for further evaluation in various yield trials.

General experimental details: One bag of DAP fertilizer per acre was mixed in soil at the time of land preparation. The soil was sandy loam with a pH of 8.2. Sowing was completed during second week of October. Uniform agronomic practices were applied to all genotypes. All yield assessment and plant protection trials were conducted in randomized complete block (RCB) design. Row to row and plant to plant distances were kept as 30cm and 15cm in all research trials. Two seeds were placed in each hole to ensure optimum plant population per plot. After 20-25 days of germination, thinning was carried out to maintain the vigorous plant seedling. Plot size was maintained as 4×1.2 m^2 for preliminary, advanced and adaptation yield trials. Plot size (4×1.8 m^2) was maintained for national uniform yield trials (NUYTs). Each trial was consisted of one to two checks for evaluating the yield potential of test entries.

Pathological studies: For *Fusarium* wilt studies, chickpea genotypes were cultivated under moisture stress conditions at the Arid Zone Research Institute, Bhakkar. Each plot maintained as 4 meters in a single row layout. The susceptible variety AUG 424 was included as a standard check and its planting was repeated after every two test entries to ensure sufficient inoculum pressure. In month of September, pathogen mass culture was incorporated into the soil, and prior to sowing, the seed germplasm was also treated with this pathogen culture. All susceptible lines exhibited complete wilt attack, indicating a high level of field infestation. Wilt incidence was initially recorded 30 days after sowing with subsequent recordings made every 10 days until crop maturity. The resistance and susceptibility of each genotype to *Fusarium* wilt were evaluated using the disease-rating scale (DRS) developed by the scientist (Srivastava *et al*., 2021).

Table1: *Developmental history of newly approved chickpea desi variety (Thal-2020).*

Year	Filial generation/ Trial/ Activity	Operation
2006-07	Hybridization	F_0 seed harvested
2007-08	F_1	F_1 seed harvested
2008-09	F_2	Single plant selection
2009-10	F_3	Plant to row progenies
2010-11	F_4	-do-
2011-12	F_5	-do-
2012-13	F_6	Uniform line selected and bulked.
2013-14	F_7	-do-
2014-15	Preliminary Yield Trial	Yield data were recorded.
2015-16	Regular Yield Trial	-do-
2016-17	Micro Yield Trial	-do-
2017-18	Provincial Yield Trial	-do-
2018-19	Provincial Yield Trial	-do-
2017-18	National Uniform Yield Trial	-do-
2018-19	National Uniform Yield Trial	-do-
2018-19	Pathological studies	Reaction to Fusarium wilt & Ascochyta blight
2018-19	Entomological studies	Infestation of gram pod borer
2019-20	Spot Examination (24-03-2020) and seed multiplication	BNS Production
2020-21	54th meeting of Punjab Seed Council (28-01-2021)	Approved for commercial cultivation across Punjab, Pakistan

In the *Ascochyta* blight investigation, chickpea genotypes were planted in plastic tunnel to create conducive environment for the appearance of disease. Each entry was planted in single row measuring one meter in length. The susceptible variety AUG-424 served as a control and was planted following every two experimental entries to ensure the spread of disease inoculum. Temperature and humidity were regulated using a sprinkler system and by covering the tunnels with transparent plastic sheets. Spore suspension was applied at 3-day intervals until the onset of the disease. Maximum blight disease development occurred at temperatures between 14-18°C and humidity exceeding 80%. Disease incidence was recorded using the 0-9 DRS scale (Farahani *et al*., 2019; Gayacharan *et al*., 2020).

Entomological studies: The gram pod borer stands out as a significant insect pest that can lead to significant yield losses reaching economic thresholds. Consequently, studies were devised and carried out to evaluate the extent of pod borer infestation during 2018-19. To determine the percentage of infestation, the total number of pods and the number of infested pods per plant were tallied and the percentage was calculated accordingly.

Results and Discussion

Station / Micro Yield Trials

The advanced line TG1410 undergo evaluation for adaptability and yield potential through multiple trials conducted at different locations over several years. Throughout these trials, TG1410 demonstrated excellent performance. The yield data for TG1410, as well as the control checks, are presented in Table 2. In Preliminary Yield Trial-2014-15, TG1410 showed 13% higher yield over the check Punjab-2008 yielded 907kgha^{-1} and demonstrated an 18% increase in yield over the standard check Bhakkar-2011 which gave grain yield of 869kgha^{-1}. In Regular Yield Trial-2015-16, TG1410 exhibited a 13% increase in yield over the check Punjab-2008 yielded 1613 kgha^{-1}, and demonstrated an 11% increase in yield over the check Bhakkar-2011 which achieved a yield of 1640 kgha.$^{-1}$ In micro yield trial 2016-17, advance line TG1410 showcased a 34 and 212% rise in yield over the check variety Bittle-2016 that yielded 1239kgha^{-1} at Arid Zone Research Institute, Bhakkar and 708kgha^{-1} at Gram Breeding Research Sub-Station, Kallur Kot (Bhakkar). Results of station and micro yield trial conducted during 2014-15 to 2016-17 revealed that strain TG1410 consistently demonstrated a higher yield compared to the check varieties (Punjab-2008,

Table2: *Performance of TG1410 as "Thal-2020" in Station Yield Trials.*

Year	Name of Trial /Location		Yield (kgha^{-1})			+/- Over check (%)
			Checks		TG1410	
2014-15	Preliminary Yield Trial (PYT)-AZRI Bhakkar		Punjab-2008	907	1028	13
			Bhakkar-2011	869		18
2015-16	Regular Yield Trial (RYT)- AZRI Bhakkar		Punjab-2008	1613	1818	13
			Bhakkar-2011	1640		11
2016-17	Micro Yield Trial (MYT)	AZRI Bhakkar	Bhakkar-2011	1354	1661	23
			Bittle-2016	1239		34
		GBRSS, Kallur Kot	Bittle-2016	708	2208	212

Table 3: *Performance of TG1410 as "Thal-2020" in Provincial Yield Trial.*

Year	Site/ locations	TG1410	Bittle-2016	Punjab 2008
2017-18	PRI, AARI Faisalabad	3035	3704	3424
	NIAB, Faisalabad	2135	1591	1725
	GBRSS Kallurkot (Irrigated)	885	1028	1142
	AZRI Bhakkar (Irrigated)	2396	2486	2684
	ARS Karor	2861	2802	2680
	RARI Bahawalpur	2708	2292	2222
	GBRSS Kallurkot (Rainfed)	458	358	472
	AZRI Bhakkar (Rainfed)	1485	1028	867
	Mankera Fermer Field	531	576	451
	Average Yield (kgha^{-1})	1833	1763	1741
	Increase over checks (%)		4	5
2018-19	PRI, AARI Faisalabad	1531	1035	1115
	NIAB, Faisalabad	1047	713	632
	GBRSS Kallurkot (Irrigated)	1896	1354	1847
	AZRI Bhakkar (Irrigated)	2274	1792	1986
	ARS Karor	1916	2532	1982
	RARI Bahawalpur	4513	4027	4097
	GBRSS Kallurkot (Rainfed)	1441	1479	986
	AZRI Bhakkar (Rainfed)	1132	1059	1219
	Kallurkot Farmer Field (Rainfed)	750	889	563
	Rakhutra (Rainfed)	115	309	184
	Mankera Farmer Field	656	697	504
	Average Yield (kgha^{-1})	1570	1443	1374
	Increase over checks (%)		9	14

Bhakkar-2011 & Bittle-216) in all replicated Yield Trials), suggesting its competitive performance and potential suitability for cultivation.

Provincial Yield Trial

Provincial yield trial was conducted by the Director, Pulses Research Institute, Ayub Agricultural Research Institute, Faisalabad with the aim to assess the broader adaptability and performance of new strains at the provincial level. In Provincial Yield Trial 2017-18, the average yield for candidate variety TG1410 was 1833 kgha^{-1}, Bittle-2016 was 1763 kgha^{-1}, and Punjab 2008 was 1741 kgha^{-1} as given in Table 3. The percentage increase for TG1410 were 4% and 5% over the check varieties Punjab-2008 and Bittle-2016, respectively. TG1410 generally exhibits competitive yields across different sites, with the highest yields 3035 kgha^{-1} at PRI, AARI Faisalabad. Additionally, TG1410 maintained its lead in rainfed conditions, showcasing its resilience. In Provincial Yield Trial 2018-19,

Table 4: *Performance of TG1410 as "Thal-2020" in National Uniform Yield Trials.*

Year	Site/ locations	TG1410	Bittle-2016	Punjab 2008
2017-18	PRI, AARI Faisalabad	3117	3063	3389
	AZRI Bhakkar	1344	1135	354
	GBRSS, Kallurkot (Bhakkar)	688	240	521
	NIAB, Faisalabad	2134	1177	1483
	BARS Fateh Jang	2358	2334	2361
	Average Yield (kgha^{-1})	1928	1590	1622
	Increase over checks (%)		21	19
2018-19	PRI, AARI Faisalabad	1969	1892	-
	AZRI Bhakkar	2861	2125	-
	AZRI Bahawalpur	1412	1193	-
	BARI Chakwal	1320	1201	-
	GBRSS, Kallurkot (Bhakkar)	2090	1431	-
	NIAB, Faisalabad	1827	1417	-
	BARS Fateh Jang	-	-	-
	Average Yield (kgha^{-1})	1913	1543	-
	Increase over checks (%)		24	-

the average yield for candidate variety TG1410 was 1570 kgha^{-1}, Bittle-2016 was 1443 kgha^{-1}, and Punjab 2008 was 1374 kgha^{-1}.The percentage increase for TG1410 were 14% and 9% over the check varieties Punjab-2008 and Bittle-2016, respectively. TG1410 excelled with the highest yield 4513 kgha^{-1}, emphasizing its strong performance in Bahawalpur. TG1410 consistently outperformed Bittle-2016 and Punjab 2008 across various sites, indicating its adaptability and high yield potential. TG1410 also demonstrated its suitability in different agro climatic conditions, including rainfed areas. The average yields and percentage increase over checks reinforce TG1410 as a preferred chickpea variety for cultivation.

National Uniformyield Trials

The National Coordinator (Pulses) at PARC Islamabad conducted this trial with the aim of evaluating the wider adaptability and performance of new strains at the national level. In National Uniform Yield Trial 2017-18, the candidate variety TG1410 performed better with yield value1928 kgha^{-1} in comparison with check variety Bittle-2016 (1590 kgha^{-1}) and Punjab-2008 (1622 kgha^{-1}) as depicted in Table 4. The percentage increase for TG1410 were 21% and 9% over the check varieties Bittle-2016 and Punjab-2008, respectively. In National Uniform Yield Trial 2018-19, the average yield for candidate variety TG1410 was 1913 kgha^{-1}and check variety Bittle-2016 was 1543 kgha^{-1}.The percentage increase for TG1410 was 24% over the check variety Bittle-2016. New candidate variety TG1410 demonstrated competitive yields across various sites, with outstanding performances at Bhakkar and PRI, AARI Faisalabad during the both crop period 2017-18 & 2018-19, respectively indicating its wider adaptability and higher yield potential in diverse agro-climatic conditions (Yadav *et al*., 2010; Rasool *et al*., 2023). Moreover, TG1410 also maintained its leading position under rainfed conditions, demonstrating its resilience.

Plant Protection

Reaction to Fungal Diseases: Bittle-2016 displayed a blight score of 5, indicating a moderate tolerance to blight under natural field conditions as given in Table 5. Whereas TG-1410 showed a lower blight score of 3, proposing a higher level of tolerance to blight in comparison to the standard check variety. Lower blight score for TG1410 indicates a more favorable disease response, placing it as a potentially resilient chickpea variety against blight under normal growing conditions. *Ascochyta* blight disease can be managed by growing resistant cultivars (Basandrai *et al*., 2007). TG1410 and Bittle-2016 reveal resistance to wilt and root rot. Therefore, both strains were considered as suitable candidates for inclusion as donors in *Fusarium* resistance breeding programs (Srivastava *et al*., 2021). Both TG1410 and Bittle-2016 are also tolerant to iron chlorosis. It means that these varieties have the capability

Table 5: The reaction of TG1410 as "Thal-2020" to Fusarium wilt and Ascochyta Blight.

Fusarium wilt, root rot & iron chlorosis			**Ascochyta Blight**		
Score	Reaction	Genotype	Score	Reaction	Genotype
1	Highly resistant	-	0	Immune	-
3	Resistant	TG1410 Bittle-2016 (Check)	1	Highly resistant	-
5	Moderately resistant	-	3	Resistant	TG1410
7	Susceptible	-	5	Moderately resistant	Bittle-2016 (Check)
9	Highly susceptible	-	7	Susceptible	-
			9	Highly susceptible	-

Table 6: The infestation of gram pod borer on TG1410 as "Thal-2020".

Genotype	**No. Larvae/5 plants**	**Total Pods/5 Plants**	**Damaged Pods/5 Plants**	**Yield/Plot ($kgha^{-1}$)**
TG1410	1.3	184.0	10.7	986
Bittle-2016 (Check)	3.0	229.0	17.0	779
Bhakkar-2011(Check)	2.3	183.0	14.0	728
CV (%)	14.5	7.6	14.5	5.9
$LSD_{0.05}$	0.60	24.82	3.62	73.27

of maintaining normal growth and development in conditions where iron availability is limited. In short, TG1410 is a resilient candidate variety, showcasing resistance or tolerance to wilt and root rot, blight, and iron chlorosis.

Response of Candidate Variety Tg1410 Against pod Borer Attack

TG1410 has a relatively low count of larvae (1.3/5-plants) and indicating a lower infestation level by pod borers. Similar results were reported by the researchers (Bhatt and Patel, 2001). The total number of pods per 5 plants is 184.0, suggesting a considerable pod development. The damage to pods is relatively low (10.7/5-plants), indicating a good level of resistance against pod damage. The yield per plot is relatively high (986 $kgha^{-1}$) and suggesting a potentially productive strain. On the other hand, Bittle-2016 has a higher number of larvae (3.0/5-plants) compared to TG1410 and indicating a potentially higher pod borer infestation level. The total number of pods per 5 plants is 229.0, suggesting good pod development, although slightly higher compared to TG1410. The damage to pods is relatively higher at 17.0 per 5 plants, indicating a moderate level of susceptibility to pod damage. The yield per plot is 779$kgha^{-1}$, which is slightly lower than TG1410, suggesting a potential impact of higher pod damage on overall yield. Bhakkar-2011 has a moderate number of larvae (2.3/5-plants), indicating a moderate infestation level by pod borers. The total number of pods per 5 plants is 183.0, suggesting good pod development, similar to TG1410. The damage to pods is moderate at 14.0 per 5 plants, indicating a moderate level of susceptibility to pod damage. The yield per plot is 728$kgha^{-1}$, which is slightly lower than both TG1410 and Bittle-2016, suggesting a potential impact of pod damage on overall yield. In summary, TG1410 appears to have lower larval infestation, lower pod damage and higher yield (Rehman *et al*., 2017) compared to Bittle-2016 and Bhakkar-2011.

Morphological Character of variety Thal-2020

Botanical description**:** Thal-2020 stands out as a bold-seeded, high-yielding, and disease-resistant variety compared to the existing commercial varieties Bittal-2016, Bhakkar-2011 and Punjab-2008. It performs exceptionally well in both irrigated and rainfed conditions and exhibits vigorous growth. The plant is semi-erect, reaching a height of 55-60 cm, with light green stems of moderate hairiness and canopy. The number of primary branches typically ranges from 4-5, with secondary branches numbering between 12-14 and tertiary branches ranging from 15-20, depending on various environmental factors. Its leaves are green, with a rachis length of 4.5 cm and

14-15 leaflets. Leaflet length is 14-15 and width is 12-13mm. leaflet size is medium with acuminate tip and obovate shape.

Flower, pod and seed characteristics: The flowers of Thal-2020 are medium-sized and pink in color. They typically begin flowering 88-91 days after sowing, with a flowering duration lasting around 60 days. The pods are also medium-sized, measuring approximately 3-4 cm in length, 1.6 cm in width and 1.5 cm in thickness, with a beak mucro length of 3-4 mm. Each plant typically produces 68-70 pods, each containing 1-2 seeds and pod shattering is not observed. The seeds are brown, without dots and have a ram-headed shape with a rough texture. Seed is bold having 9.6 mm, length, 7.8 mm width and 7.5 mm thickness. 100-seed weight is 27-28 gm. Potential yield is 3300-3500 kgha^{-1}.

Approval

The Punjab Seed Council (PSC) has granted the approval of this strain TG1410 designated as Thal-2020 for the widespread commercial cultivation across Punjab, Pakistan in its 54th meeting held on 28-01-2021. This development is expected to provide significant benefits to chickpea growers in the region.

Conclusions and Recommendations

Thal-2020 stands out as a high-yielding desi chickpea variety, characterized by bold seeds and inherent resistance to major chickpea diseases such as *Fusarium* wilt and *Ascochyta* blight. This particular variety has consistently demonstrated its efficacy in various trials, including station, adaptation, and national yield assessments, surpassing the performance of comparison varieties by a significant margin. The anticipated widespread acceptance of Thal-2020 within the farming community is attributed to its commendable features. The widespread use of this variety for seed multiplication and cultivation at farmers' fields is expected to play a crucial role in sustaining, stabilizing, and enhancing domestic chickpea production. Moreover, its adoption is likely to contribute significantly to reducing Pakistan's escalating chickpea import bill.

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Novelty Statement

Cultivation and multiplication of this stress tolerant variety at farmers's fields is expected to play a crucial role in sustaining, stabilizing and enhancing domestic chickpea production.

Author's Contribution

Niaz Hussain: Conducted research, data recording and analysis and wrote manuscript.
Muneer Abbas: Conducted plant protection studies.
Abdul Ghaffar, Muhammad Aslam and Mudassar Khaliq: Conducted research and data recording.
Khalid Hussain: Planning and supervision.
Muahammad Nadeem: Proof reading and reviewed literature.
Muhammad Irshad: Assisted in research methodology.
Zubeda Parveen: Reviewed literature.
Fiaz Hussain: Proof reading and reviewed literature.
Azhar Mehmood Aulakh: Assisted in agronomic studies.

Conflict of Interest

The authors have declared no conflict of interest.

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