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Varietal Release

Rust resistant and high yielding durum wheat genotype: Gujarat Wheat 1353 (GW 1353)

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Wheat crop is severely affected by rust disease and cause heavy yield losses. An attempt was made to develop a rust resistance high yielding durum wheat genotype at Agricultural Research Station, Anand Agricultural University, Dhandhuka. Gujarat Wheat 1353 was developed using cross combination of GW 1205 and GW 1242. The developed genotype was tested against two local cultivated varieties Gujarat Wheat 1 and Gujarat Anand Durum Wheat 3 and two national checks HI 8627 and UAS 466. GW 1353 showed 4.65 % and 2.46 % increase in yield over checks GW 1 and GADW 3, respectively under rainfed condition. It showed 1.75 % increase in yield over check GW 1 under limited irrigation. During 2018-19, it showed 25.47 %, 14.12 %, 49.27 % and 67.57 % increase in yield over checks GW 1, GADW 3, HI 8627 and UAS 466, respectively. It revealed higher test weight (59.47 g) as against checks GW 1 (55.50 g) and GADW 3 (58.67 g). GW 1353 showed immune response for three years against black rust and five years against brown rust. It reported resistant reaction against eight stem rust and nine leaf rust pathotypes. Thus, this genotype may be useful in pre-breeding programmes.

Wheat is the second important cereal crop following rice. It contributes more calories and proteins to human diets in the category of cereal crops. There are total sixteen species or races have been identified in wheat which forms three different groups based on their chromosome numbers i.e. diploid, tetraploid and hexapoid wheat. Among all these, two are wild type and fourteen cultivated races which are commonly treated as species today (Peterson, R. F., 1965). Out of these fourteen species, *Triticum aestivum* L. and *Triticum durum* Desf. are important with their own specificity of consumption. Thus, there is a vast range of species diversity prevailing in nature for wheat crop. Wheat covers the cultivation area of 219 Mha with production of 808 Mt in 2022 worldwide (FAOSTAT, 2024). The world average productivity of wheat during 2022 was 369 $kgha^{-1}$. Wheat production needs to be increased by 2 % annually to cater the need in future (Choudhary *et al.*, 2018) which require lot of work in many aspects. Traditionally wheat improvement aims at three major aspects *viz*., grain yield, disease resistance and quality. Rusts caused by three different species of fungus *Puccinia* are the main biotic impediments in the efforts to sustain and boost production of wheat. Moreover cultivation of resistant varieties is most effective, economic and ecofriendly method of disease management. Looking to the severity caused by rust disease, an attempt has been made to combine disease resistance and higher grain yield in durum wheat.

A cross between two promising genotypes GW 1205 and GW 1242 was made during 2008-2009 with the aim to develop a rust resistant and high yielding genotype. The ascending pedigree selection was attempted up to seven filial generations (D-07-46-3-2-1-1). The developed genotype was named GW 1353. The genotype was tested against two local checks GW 1 and GADW 3 in seven different trials under *rainfed* condition and two trials under

restricted irrigation condition at Dhandhuka centre during 2015-16 to 2021-22 using Randomized Block Design. It was evaluated in one AICRP trial during 2018-2019. GW 1353 was screened against black and brown rust diseases in artificially created epiphytotic condition developed at Wheat Research Station, Sardarkrushinagar Dantiwada Agricultural University, Vijapur by growing infector rows surrounding the genotype under study. Method to record field response or type of disease reaction is shown in table 1. For final reading of rust disease in field, severity and field response reading were combined. The genotype was evaluated against 12 pathotypes of stem rust and 10 pathotypes of leaf rust under glass house condition at Mahabaleshwar during 2018-19.

Disease score = Severity (%) + Type of reaction

Table 1: Method of recording field response to wheat rust disease

Symbol	Reaction	Host response	Response value
0	Immune	No visible infection on plant	0.0
R	Resistant	Visible chlorosis or necrosis, no uredia are present	0.2
MR	Moderately Resistant	Small uredia are present and surrounded by either chlorotic or necrotic areas	0.4
MS	Moderately Susceptible	Medium sized uredia are present and possible surrounded by chlorotic areas	0.8
S	Susceptible	Large uredia are present, generally, with little or no chlorosis and no necrosis	1.0

Table 2 shows seed yield performance of genotype GW-1353. In Preliminary Yield Trial it showed non-significantly lower yield compared to check variety GW 1 in 2015-16. However, in next year it showed numerically higher seed yield (1233 kgha^{-1}) than check GW 1 (1167 kgha^{-1}) in Small Scale Trial under *rainfed* condition. Although Small Scale Trial-2017-18 revealed significantly low yield (1780 kgha^{-1}) than two checks GW 1 (1901 kgha^{-1}) and GADW 3 (1964 kgha^{-1}), in Large Scale Trials under *rainfed* condition conducted during 2018-19 and 2019-20, the genotype GW 1353 showed significantly higher seed yield than both the checks. In 2018-19, it reported 1525 kgha^{-1} seed yield as against 1302 kgha^{-1} and 1332 kgha^{-1} seed yield of check GW 1 and GADW 3, respectively. During 2019-20, as high as 1927 kgha^{-1} seed yield was observed against 1745 kgha^{-1} and 1763 kgha^{-1} for checks GW 1 and GADW 3, respectively. The genotype showed numerically higher yield in Large Scale Trial under *rainfed* condition than both the checks during 2020-21 (1358 kgha^{-1}) and 2021-22 (1988 kgha^{-1}). The genotype was also evaluated under limited irrigation condition during 2017-18 and 2021-22 (Table 3). On average, it showed 1.75% yield increase (2883 kgha^{-1}) in comparison to check GW 1 (2833 kgha^{-1}). The yield performance of GW 1353 was observed in one AICRP trial NIVT-5B under restricted irrigation condition at Dhandhuka station. The genotype yielded 3281 kgha^{-1} which was 25.47%, 14.12%, 49.27% and 67.57% increased over GW 1 (2615 kgha^{-1}), GADW 3 (2875 kgha^{-1}), HI 8627 (2198 kgha^{-1}) and UAS 466 (1958 kgha^{-1}), respectively. Lozhkin A. G. *et al.* (2019) reported high seed yielder Bezenchuk Niva (3.41 t/ha) variety of spring durum wheat in Russia. Shibeshi and Kassa (2021) recorded the highest average grain yield in Hitosa variety (4446 kgha^{-1}) of durum wheat in highland area of southern Ethopia. The average test weight was recorded higher (59.47 g) in GW 1353 as compared to check varieties. Average days to heading, days to maturity and plant height recorded in the genotype was 62.50 days, 103.67 days and 68.23 cm, respectively (Table 5).

The genotype was screened against black and brown rust diseases in artificially created epiphytotic condition at Wheat Research Station, SDAU, Vijapur (Table 6). GW 1353 showed immune response during 2017-18, 2020-21 and 2021-22 for both black and brown rust diseases. In other years of testing, the genotype ranged between 5-10 % levels of tracely resistance or moderately resistance or resistance for either black or brown rust disease. During 2018-19 only the genotype reported tracely susceptible for black rust and susceptible with 20 % severity for brown rust disease. Check varieties GW 1 and GADW 3 were

Table 2: Seed yield performance (kgha-1) of genotype GW-1353 in comparison to checks under timely sown rainfed condition

Testing Year	Name of Trial	GW 1353	Check varieties		CD at 5%	CV %
			GW-1	GADW 3		
2015-16	PYT-RF	775	875	-	240	15.6
2016-17	SST-II (RF)	1233	1167	-	220	10.2
2017-18	SST-I (RF)	1780	1909	1964	161	4.21
2018-19	LST-RF	1525	1302	1332	181	9.6
2019-20	LST-RF	1927	1745	1763	160	6.22
2020-21	LST-RF	1358	1275	1288	166	8.88
2021-22	LST-RF	1988	1843	1860	265	9.7
Mean of 7 test		**1512**	**1445**	-		
Mean of 5 test		**1682**	-	**1641**		
% Increase over checks		-	**4.65**	**2.46**		

Table 3: Seed yield performance (kgha^{-1}) of genotype GW-1353 in comparison to checks under restricted irrigation condition

Testing Year	Name of Trial	GW 1353	Check varieties		CD at 5%	CV %
			GW-1	GADW 3		
2017-18	SST-I-RI	3065	3158	3364	723	11.8
2021-22	LST-RI	2700	2508	2567	248	6.7
Mean		2883	2833	2966		
% Increase over check		-	1.75	-		

Table 4: Yield performance of promising genotype GW-1353 and check varieties in AICRP trial under timely sown restricted irrigation condition

Testing Year	Name of Trial	GW 1353	Check varieties				CD at 5%	CV %
			GW-1	GADW 3	HI 8627 (NC)	UAS 466 (NC)		
2018-19	NIVT-5B-RI	3281	2615	2875	2198	1958	533	10
% Increase over check		-	25.47	14.12	49.27	67.57		

Table 5: Ancillary observations of promising genotype GW-1353 and check varieties

Year	Trial	Entry	Days to heading	Days to maturity	Plant height (cm)	Test weight (g)
2018-19	LST- RF	GW-1353	62	113	58.8	59.5
		GW-1 (C)	61	108	55.9	54.5
		GADW-3 (C)	56	105	58.8	57.5
2019-20	LST - RF	GW-1353	63	101	80.8	60.0
		GW-1 (C)	62	101	79.6	54.5
		GADW-3 (C)	57	100	85.9	59.5
2020-21	LST - RF	GW-1353	-	97	65.1	58.9
		GW-1 (C)	-	111	64.9	57.5
		GADW-3 (C)	-	96	69.4	59.0

Average	**GW-1353**	**62.50**	**103.67**	**68.23**	**59.47**
GW-1 (C)	**61.50**	**106.67**	66.80	55.50	
GADW-3 (C)	56.50	100.33	71.37	58.67	

Table 6: Reaction to rust diseases under artificially created epiphytotic conditions

Year	Location	Check varieties					
		GW 1353		GW -1		GADW 3	
		Black	Brown	Black	Brown	Black	Brown
2014-15	**Vijapur**	**10R**	**10MR**	40S	10MS	-	-
2015-16		**10R**	**10R**	60S	10MS	-	-
2016-17		**5R**	**0**	80S	80S	80S	80S
2017-18		**0**	**0**	80S	80S	80S	80S
2018-19		**TS**	**20S**	60S	40S	60S	40S
2019-20		**TR**	**0**	80S	80S	80S	80S
2020-21		**0**	**0**	60S	60S	60S	40S
2021-22		**0**	**0**	60S	60S	60S	60S

found susceptible with 80 % disease severity for black and brown rust during 2016-17, 2017-18 and 2019-20. Both the varieties reported moderately susceptible or susceptible response with range of 10 to 80 % disease severity in rest of the tested years for black or brown rust disease.

The genotype GW 1353 was tested against 12 selective pathotypes of stem rust and 10 pathotypes of leaf rusts under glass house condition during 2018-19 at Mahabaleshwar (Anon., 2019). It was found resistant against leaf rust at seedling stage under glass house condition. It reported resistant reaction against eight pathotypes of stem rust *viz*., *Pt 11, Pt 24A, Pt 40, Pt 40A, Pt 42, Pt 117A, Pt 117-2* and *Pt 122*. It reported resistant reaction against nine pathotypes of leaf rust *viz*., *Pt 12-2, Pt 12-5, Pt 17, Pt 77-4, Pt 77-9, Pt 104, Pt 104B, Pt 104-1* and *Pt 104-2*. The highest score for adult plant response was tracely resistance against leaf rust in southern Indian region. Habtamu Tesfaye Ayehu (2019) reported four commercial Varieties (Selam, Mossobo, Bekelcha, and Utuba) and a landrace cultivar (Mcd4-32) with high levels of field resistance against wheat leaf rust disease at Debre Zeit Agricultural Research Center, Ethiopia.

Fig: Dark green luster with profuse tillering and heading in GW 1353

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Conflict of interest

Authors declare no conflict of interest.

Author contribution

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Ethical Approval

The article doesn't contain any study involving ethical approval.

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