

AKAW 5100: New High Yielding Climate-Resilient Wheat Variety for Peninsular India

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Wheat (*Triticum aestivum* L.) is the most widely cultivated staple food crop in the world, providing both food and livelihood security to millions of people. Globally, it makes a significant contribution to daily caloric intake and serves as a cornerstone of food security. In India, it holds a prominent place in the agricultural landscape, being the second most important food crop after rice. During 2024–25, wheat was cultivated on 32.76 million hectares, producing 117.5 million tonnes with an average productivity of 3587 kg ha⁻¹ (Anonymous, 2026).

The Peninsular Zone has emerged as an important region for wheat cultivation in India. Characterized by warmer climates and diverse soil types, this zone faces unique challenges such as terminal heat stress, intermittent drought, and limited irrigation facilities. In the context of climate change, the development of climate-resilient wheat varieties has become a pressing need. Rising temperatures, unpredictable rainfall patterns, and frequent occurrences of drought and late-season heat stress continue to threaten wheat productivity and stability. Therefore, varieties that combine high yield potential with tolerance to drought and terminal heat are crucial for sustaining production and ensuring food security in vulnerable regions like Peninsular India.

To address this need, the Wheat Research Unit of Dr. Panjabrao Deshmukh Krishi Vidyapeeth (PDKV), Akola, India, released a new high-yielding and climate-resilient wheat variety, AKAW 5100, in 2024. This variety recorded

a mean grain yield of 4940 kg ha⁻¹ and demonstrated a potential yield of up to 8400 kg ha⁻¹. Notably, it combines drought tolerance (DSI: 0.93) and late heat tolerance (HSI: 0.75), making it highly suitable under climate change scenarios. With its dual advantage of superior productivity and stress resilience, AKAW 5100 offers farmers in Peninsular India a reliable option for sustainable wheat cultivation and long-term food security.

Breeding Methods

AKAW 5100 is developed by Pure line selection method, which is a selection made from the NATP-2002-03 having name DL-9 of 74-3 of NATP -2002-03 in the year 2011-12. For next three years, plant to row progenies was grown and inferior ones were rejected. Next two years eye ball selection was made and superior progenies were selected (Johannsen, 1903). During 2016-17 and 2017-18 the seed was bulked and multiplied. During 2018-19 and 2019-20, entry was evaluated in station trials at Wheat Research Unit, Dr. PDKV; Akola. Further it was evaluated in Preliminary yield trial with local checks at three different locations of university jurisdiction during 2020-21. During the same year; it was tested in Indian Plant Pathology Screening Nursery for screening against stem and leaf rust. The genotype was evaluated in National Initial Varietal Trial- 2 (NIVT) under timely sown irrigated condition at six locations during 2021-22 in simple lattice design with plot size (7.2 m²) along with two zonal checks *viz.*, GW 322 and MACS 6222. On the basis of



performance, the genotype was advanced to Advance Varietal Trials and it was evaluated at 9 and 7 locations during 2022-23 and 2023-24 respectively. The complete flow chart of development of variety is shown in Fig 1. The entries were sown in randomized block design with four replications and plot sizes of 14.4 m² against three zonal checks *viz.*, GW 322, MACS 6222 and MP 1378. AKAW 5100 and the check varieties were screened for stem and leaf rust throughout the yield evaluation process under artificial conditions. Rust severity and response in the field was scored following 0-100 scale (Loegering, 1959). For statistical analysis the rust reactions were converted into a coefficient of infection (COI) as used by Loegering (1959). Gene postulation for rust resistance genes was done after multipatho type testing at seedling stage scoring 0-4 scale of Stakman (Stakman *et al.*, 1962). The average coefficient of infection (ACI) for both the rusts was calculated following (Saari and Wilcoxson, 1974) by multiplying disease severity and constant values of infection type. The constant values for infection types were used based on the following: R = 0.2, MR = 0.4, M = 0.6, MS = 0.8 and S = 1.0. The seedling resistance test for gene postulation using pathotypes matching techniques against 21 races of stem rust and 23 races of leaf rust was carried out. Quality attributes such as grain appearance score, hectoliter weight, protein%, sedimentation value, grain hardness, Chapati quality, bread loaf volume, bread quality, biscuit spread factor, wet and dry gluten %, gluten index, Fe and Zn content and high molecular weight subunits were determined as per standard procedures and protocols (ICAR-IIWBR, 2024d). Characterization for Distinctness, Uniformity and Stability of the genotype was carried out as per standard varietal identification procedures in wheat (Gupta *et al.*, 2017). Statistical analysis was carried out using (SAS Institute, 2011).

Performance Characteristics

Varietal descriptors

AKAW 5100, a bread wheat variety with semi-erect growth habit, flowers in 61 days, matures in 109 days (Table 1). It has pale green foliage and medium waxy attributes at the time of ear emergence. The ears are white in colour, tapering shaped with dense appearance, having light brown colored and medium spreading awns. The peduncle is having bent attitude and medium length. The glumes have elevated shoulder shape, narrow shoulder

width with long beak length. Grains are amber colored, elliptical shaped with hard texture having average test weight of 37 g. (ICAR 2021, 2022 and 2023a Progress report of AICRP on Wheat and Barley).

Yield evaluation

During 2021-22 in NIVT-2, AKAW 5100 with an average yield of 54.7 q ha⁻¹ significantly out-yielded the check varieties GW 322 (49.7 q ha⁻¹) and MACS 6222 (49.4 q ha⁻¹). It recorded numerically higher grain yield than the best yielding check HI 1544 (51.7 q ha⁻¹) under timely sown irrigated condition (Table 2). During the year 2022-23, the genotype was advanced and was included Advance Varietal Trial of Peninsular Zone where it performed well and recorded the grain yield of 51.2 q ha⁻¹. In the second year (2023-24) of its evaluation in Advance Varietal Trail, once again proved its superiority and recorded grain yield of 42.3 q ha⁻¹. The average grain yield of the variety AKAW 5100 over three years was 49.4 q ha⁻¹. It recorded a potential yield of 84.0 q ha⁻¹ which was higher than all the check varieties: (ICAR 2022, 2023 and 2024a).

Resistance to rusts

AKAW 5100 showed resistance to leaf and stem rusts with ACI values of 5.7 and 4.5 respectively artificial epiphytotic conditions. Gene postulation analysis suggested the presence of a *Sr30* + and *Sr37* + 2 + gene combination conferring stem rust resistance in AKAW 5100. It also exhibited the presence of *Lr13* + 10 + 1 + and #*Lr26* + genes conferring leaf rust resistance (Table 3) (ICAR 2024b).

Unique variety with both heat and drought tolerance

AKAW 5100 exhibited the both Heat Susceptibility Index (HIS=0.75) and Drought Susceptibility Index (DSI=0.93) less than one (Table 4 and Table 5), which suggest that under heat stress, the genotypes AKAW 5100 showed lowest HIS (0.75) with minimum yield reduction and drought condition, showed lower DSI (0.93) with minimum yield reduction under drought condition which means that wheat variety AKAW 5100 can tolerate to the climate change scenario (ICAR 2024c).

Quality parameters

The quality characteristics of AKAW 5100 were evaluated along with check varieties, it recorded better *chapati* quality score (7.9), good bread loaf volume (608 mL). Protein



content of the variety AKAW 5100 was 12.47 % with Glu-1 score (8.1) indicating better protein quality. It contains 38.7 ppm iron and 38.9 ppm Zinc. The other quality parameters of the variety are acceptable as per the prescribed standards (ICAR 2024d).

Notification and seed production

Cultivar (AKAW 5100) was released and notified by the Central Sub-Committee on Crop standards, Notification, and Release of Varieties in India *vide* notification number S.O.2128 (E), dated 13th May, 2025 in the official gazette. Wheat Research Unit of Dr. Panjabrao Deshmukh Agriculture University (PDKV), Akolais the maintainer and will be responsible for production of the nucleus and breeder seeds of this cultivar.

Fig 1. Flowchart showing details of development of bread wheat variety AKAW 5100

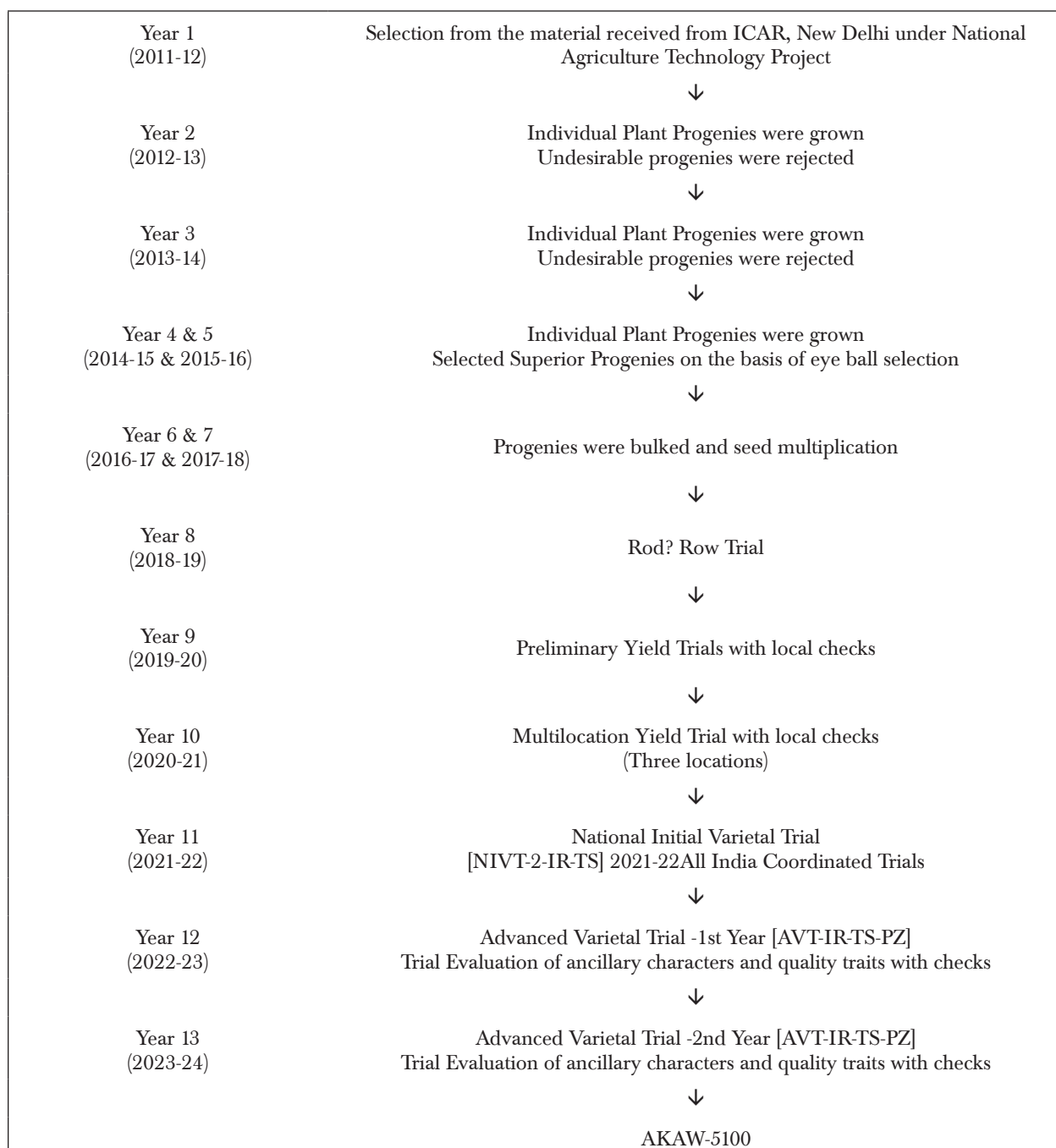


Table 1. Ancillary and DUS Traits of AKAW 5100

Ancillary Traits	Description
Heading Days	62 (54-68)
Maturity Days	109 (97-120)
Plant Height (cm)	90 (81-95)
1000-grains weight	37 (32-43 g)
DUS Traits	Description
Growth Habit	Semi-erect
Anthocyanin pigmentation (Coleoptile, Leaf Sheath, Auricle)	Absent
Foliage Colour Boot Stage	Pale green
Waxiness at ear emergence (Flag leaf, leaf sheath, ear and peduncle)	Present
Peduncle length and Attitude	Medium and Bent
Awns	Medium length and light brown colour
Ear	White colour, tapering shape and high density.
Glume	Glumes are with elevated shoulder shape, narrow shoulder width, long and straight beak
Grain	Amber colour, hard texture, elliptical shape and medium size. Medium brush hair and germ width.

Table 2. Yield Performance of AKAW 5100 in AICRP* Yield Trials (2021-22 to 2023-24)

Items	Year of testing	Trials	AKAW 5100	Check varieties					CD (10%)
				GW 322	MACS 6222	DBW 187	HI 1544	MP 1378	
Yield (q/ha)	NIVT- 2-IR-TS-TAS-PZ [2021-22]	06	54.7	49.7	49.4	--	51.4	--	3.8
	AVT-I- IR-TS-TAS-PZ, [2022-23]	09	51.2	51.0	50.9	44.3	--	51.0	2.0
	AVT-II- IR-TS-TAS-PZ, [2023-24]	07	42.3	46.2	43.3	--	--	51.0	1.7
	Mean		49.4	48.9	47.8	44.3	51.4	51.0	
	Weighted mean		49.3	49.1	48.1	44.3	51.4	51.0	
% Increase /decrease over Checks	NIVT- 2-IR- TS-TAS-PZ[2021-22]		--	9.1	9.7	--	6.0	--	
	AVT-I- IR- TS-TAS-PZ, [2022-23]		--	0.4	0.6	13.5	--	0.4	
	AVT-II- IR- TS-TAS-PZ, [2023-24]		--	-9.2	-2.4	--	--	-20.6	
	Over mean		--	0.9	3.1	10.3	-4.0	-3.2	
	Over weighted mean		--	0.4	2.5	10.2	-4.2	-3.4	
Frequency in 1st NS group	NIVT- 2-IR-TS-TAS-PZ[2021-22]		1/6	0/6	0/6	--	1/6	--	
	AVT-I- IR-TS-TAS-PZ, [2022-23]		4/9	3/9	3/9	1/9	--	3/9	
	AVT-II- IR-TS-TAS-PZ, [2023-24]		0/7	3/7	1/7	--	--	4/7	
	Total		5/22	6/22	4/22	1/9	1/6	7/16	
Yield potential			84.0	71.6	69.6	54.4	58.6	65.9	

*AICRP-All India Coordinated Research Project



Table 3. Evaluation of AKAW 5100 and checks under artificial epiphytotic conditions

Disease	Year HS	AKAW 5100 GW322										Check varieties										
		ACI	HS	ACI	HS	ACI	HS	MACS 6222	DBW 187	ACI	HS	ACI	HS	HI 1544	ACI	HS	ACI	HS	MP 1378	ACI	HS	
Leaf Rust 2022-23 2023-24	2021-22	20S	8.8	30S	14.4	20S	5.6	20S	20S	30S	10S	3.2	30S	30S	6.1	30S	30S	6.1	30S	30S	6.1	--
	20S	4.3	40S	11.1	20S	8.0	10S	8.0	10S	11.1	3.2	--	--	--	10MS	3.6	--	10MS	3.6	--	10MS	3.6
	10S	4	20MS	7	10MS	4	--	4	4	7	--	--	--	--	10S	2.4	--	10S	2.4	--	10S	2.4
HS & Mean ACI		20S	5.7	40S	10.8	20S	5.9	20S	20S	40S	10S	3.2	30S	30S	6.1	10S	10S	6.1	10S	10S	6.1	3.0
Stem Rust 2022-23 2023-24	2021-22	40S	7.0	20S	8.0	20MS	4.6	20MS	20MS	20S	--	--	10MR	10MR	0.7	--	--	0.7	--	--	0.7	--
	10MS	2.5	20S	9.0	20MS	6.8	20S	6.8	20S	9.0	9.2	--	--	--	20MS	5.0	--	20MS	5.0	--	20MS	5.0
	20S	3.9	40S	18.8	40MS	9.5	--	9.5	9.5	18.8	--	--	--	--	30MS	6.3	--	30MS	6.3	--	30MS	6.3
HS & Mean ACI		40S	4.5	40S	11.9	20MS	7.0	20MS	20MS	40S	20S	9.2	10MR	10MR	0.7	30MS	30MS	0.7	30MS	30MS	0.7	5.7
Gene postulation																						
Leaf Rust	2022-23	Lr13+10+1+	--	Lr24+	--	Lr13+*	--	Lr24+	--	Lr13+*	--	--	--	--	--	--	--	--	--	--	--	Lr13+*
	2023-24	#Lr26+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lr26+
Stem Rust	2022-23	Sr+30+	Sr11+2+	Sr24+R	--	R*	--	Sr24+R	--	R*	--	--	--	--	--	--	--	--	--	--	--	R*
	2023-24	Sr31+2+	Sr11+2+	Sr24+2+	--	Sr31+	--	Sr24+2+	--	Sr31+	--	--	--	--	--	--	--	--	--	--	--	Sr31+

*HS = Highest score, ACI = Average coefficient of infection



Table 4: The grain yield, HSI, DSI and yield reduction percentage of genotype pooled across locations.

Genotype	Grain Yield (Kg/ha)			Yield reduction (%)			
	TS	LS	DR	HSI	DSI	HS	DS
AKAW 5100	1.14	0.94	0.76	0.75	0.93	17.5	33.4
PBW891	1.20	0.88	0.80	1.15	0.93	26.9	33.3
NWS2222	1.17	0.95	0.74	0.83	1.02	19.4	36.5
WH 1306	1.19	0.86	0.75	1.17	1.04	27.4	37.2
DBW443	1.31	1.05	0.89	0.85	0.89	19.8	31.9
DBW187©	1.31	1.01	0.84	0.97	1.01	22.7	36.2
GW-322©	1.17	0.91	0.75	0.96	1.01	22.5	36.3

Table 5: List of wheat genotypes identified as heat/ drought tolerant (HSI/DSI<1.0) in HDTST

Trial	Genotype	
	HIS<1	DSI<1
HDTST	HI1674 (0.65), HD3428 (0.67), DBW386 (0.67), AKAW5100 (0.75) , HD3471 (0.79), NWS2222 (0.83), DBW443 (0.85), HI1669 (0.85), LOK79 (0.94)	HD3428 (0.79), GW543 (0.82), HD3471 (0.89), DBW443 (0.89), PBW891 (0.93), AKAW5100 (0.93) , LOK79 (0.96), HI1669 (0.99), DBW441 (0.99)

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Author contributions

All the authors contributed in the generation of data and development of the variety.

Conflict of interest

The authors declare no conflict of interest.

Ethical Approval

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

Generative AI or AI/Assisted Technologies use in Manuscript Preparation

No

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