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Registration of a Newly Released Bread Wheat (*Triticum aestivum* L.) Variety 'Boku' for High land Areas of Ethiopia

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ABSTRACT

*In Ethiopia, several varieties of bread wheat have been nationally released for large-scale production. However, their yield potential and rust resistance will not last long, mainly due to the stem and yellow rust epidemics. The objective of this experiment was to release and register high-yielding, disease-resistant and stable variety. Boku was selected from the introduced CIMMYT materials with the pedigree of REEDLING #1//KFA/2*KACHU. Under multi-location, the variety had performed better than all genotypes and checks. This variety is a late maturing cultivar but earlier than variety Galan; it takes an average of 74 days from planting to heading and requires 139 days to mature. Yield performance of variety Boku ranged from 5.3 to 7.2 t/ha on the research field and 4.9 to 6.8 t/ha on farmers' fields. Based on stability analysis, variety Boku was identified as the most stable. Additionally, depending on seedling and field evaluation for stem rust and yellow rust, Boku was found to be resistant to both yellow and stem rusts (seedling and field) for the existing rust races. The result of TKW, HLW, quality gluten and protein indicates that the variety has the best quality that is acceptable by food factories as its quality meets the required standard. Therefore, variety Boku was fully released for the highlands of Bale and similar agro-ecologies because it has high grain yield and quality, stable yield across environments.*

Keywords: *Bread wheat (Triticum aestivum L.), Variety release, Grain yield stability, Rust resistance, Stem rust, Yellow rust, CIMMYT germplasm, Highlands of Bale, Multi-location evaluation, Grain quality traits.*

1. INTRODUCTION

Bread wheat (*Triticum aestivum* L.) is one of the world's most important cereal crops, supplying nearly 20% of the calories and protein consumed globally [1]. Ensuring its productivity, stability, and adaptability across diverse agro-ecological environments remains central to global food security. As climate variability intensifies and biotic and abiotic stresses become more prevalent, the development and identification of high-yielding, resilient wheat varieties become increasingly essential [2].

In Ethiopia, bread wheat has assumed a central role in national food security, rural livelihoods, and agrarian economies. Bread wheat (*Triticum aestivum*), which accounts for 95% of the global wheat production area, was introduced to Ethiopia in the early 1940s and since the 1970s, it has been the dominant wheat type covering currently more than 90% of the total wheat production area in Ethiopia [3; 4].

Regional multi-location evaluations are a critical component of modern wheat breeding and cultivar evaluation programs. These trials assess the performance of advanced breeding lines and commercially available cultivars across multiple environments, enabling breeders and agronomists to quantify genotype × environment (G×E) interactions, determine yield stability, and identify genotypes best suited to specific production zones [5]. By conducting replicated, multi-location trials, researchers gain insights into adaptation patterns, stress tolerance, disease resistance, and end-use quality attributes necessary for varietal recommendation and release.

In bread wheat improvement pipelines, Regional Variety Trials (RVTs) bridge the gap between experimental breeding nurseries and national performance trials. They provide a robust evidence base for selecting superior candidates for farmer adoption, thus accelerating genetic gain and supporting sustainable intensification of wheat production systems [6]. Given the economic importance of wheat and the ongoing demand for improved cultivars, well-designed regional variety trials are fundamental for maintaining productivity and ensuring food system resilience.

Despite its importance and wide cultivation, wheat productivity in Ethiopia remains below global potential. Several factors contribute to this productivity gap, among them, disease pressure is a constant threat. For instance, fungal diseases such as yellow rust, stem rust, and Septoria tritici blotch (STB) have been documented in wheat production, leading to serious yield losses when susceptible varieties are planted. So far, several varieties of bread wheat have been released for large-scale production [4]. However, their yield potential and rust resistance will not last long, mainly due to the stem and yellow rust epidemic [7; 8].

In this context, the release and registration of new, improved bread wheat varieties, such as the variety 'Boku', for potential areas is of paramount importance. Improved varieties that are better adapted to the agro-ecological conditions, more resistant to pests and diseases, and capable of stable yields under variable highland environmental conditions, can play a decisive role in raising national wheat productivity, enhancing food security, and reducing import dependence.

Therefore, the development and registration of 'Boku' reflects a strategic response to Ethiopia's agronomic, socio-economic, and food security challenges. In particular, for highland areas where wheat has a competitive advantage and where smallholder farmers depend heavily on stable cereal yields, such a variety can contribute significantly to sustainable wheat production. So, the objective of this paper present the overall performance of the newly released bread wheat variety Boku, suitable for optimum areas of Bale Zone and similar agro-ecologies of Ethiopia.

2. MATERIALS AND METHODS

2.1. Experimental Materials

The experiment consisted of twenty (20) genotypes of bread wheat along with three standard checks: Wane, Galan, and Meda Walabu. These genotypes were evaluated to determine their agronomic performance and stability across multiple environments.

2.2. Study Area and Experimental Period

The study was conducted for two consecutive main cropping seasons, 2020 and 2021, at four locations representing major wheat-growing agro-ecologies of southeastern Ethiopia: Sinana, Agarfa, Goba and Bore. These locations differ in altitude, temperature, and rainfall distribution, providing diverse environments suitable for multi-location performance evaluation.

Table 1: Environmental description of the study area of 20 bread wheat Genotypes

Locations	Geographical position			Temperature (^{0}c)		Annual Rainfall (mm)	
	Latitude	Longitude	Altitude	Min.	Max.	Min.	Max.
Sinana	07°07′ N	40°10′ E	2400	7.3	20.7	750	1400
Agarfa	07°26′ N	39°87′ E	2510	9.6	22.8	1000	1451
Goba	07 o 01′N	40 o 00′E	2565	8.0	20.0	1,076.6	2,249
Bore	06 o 24'N	38 o 34'E	2736	10.1	20.0	1400	1800

2.3. Experimental Design and Field Layout

The trial was laid out in a Randomized Complete Block Design (RCBD) with three replications at each location and year. Each experimental unit consisted of standard plot sizes appropriate for wheat: Row length: 2.5 m, row spacing: 20 cm, number of rows per plot was 6 rows and all management practices were kept uniform across locations.

2.4. Crop Management Practices

A uniform seed rate of 150 kg ha^{-1} was used for all genotypes and checks. Similarly, fertilizer rate used was applied at the recommended rate of: 150 kg ha^{-1} NPS and 150 kg ha^{-1} Urea. All fertilizer rates were applied at ones during planting time following local agronomic recommendations. Weeds were controlled using a combination of chemical and manual methods: 2, 4-D (OD formulation) applied at the recommended rate during early plant tillering stage. Pallas herbicide applied as needed for grass and broadleaf weed control. Supplementary hand weeding conducted to maintain weed-free conditions throughout the season. All essential cultural and crop protection measures were uniformly applied across locations. Seeds were drilled by hand and harvesting was performed manually at physiological maturity.

2.5. Data Collection

Standard agronomic and phenological data were collected, including: Days to heading and maturity, plant height, spike length, number of effective tillers, grain yield, thousand kernel weight and disease data such as; yellow rust, stem rust and other were collected and evaluated across environments.

2.6. Statistical Analysis

Data were subjected to combined analysis of variance (ANOVA) to determine the effects of genotype, environment, and genotype × environment interactions using SAS software.

3. RESULTS AND DISCUSSION

3.1 Varietal Origin

The bread wheat variety Boku (REEDLING #1//KFA/2*KACHU) originated from CIMMYT and was introduced to Sinana Agricultural Research Center as part of the 2017/18 CIMMYT-IWIN screening nursery.

Following its superior performance, the genotype was advanced to the observation nursery in 2018 and subsequently to the Bread Wheat Preliminary Yield Trial (BWPYT-19), which included 64 genotypes. Based on its promising performance, it was further promoted to the Bread Wheat Regional Variety Trial (BWRVT-20) and finally Boku was verified over location along with standard checks which was evaluated by variety releasing committee (NVRC).

3.2. Agronomic and Morphological Characteristics of Boku

Under tasted multi-locations for two consecutive years Boku (REEDLING #1//KFA/2*KACHU), performed better than all genotypes and checks. Morphological and agronomical characters of Boku; has erect juvenile plant growth, an erected flag leaf with white glumes. The spike is sparse owned, mid-dense and tapering. The kernel is amber color and ovate in shape with angular cheeks and a narrow, mid deep crease. The brush on the kernel has a collar and is medium in length. Boku is relatively medium variety with 87cm height with erected type upright growth habit and high productive tillering capacity. This variety is a late maturing cultivar and earlier that variety Galan; it takes an average of 74 days from planting to heading and requires 139 days to mature in Bale highland (Table 3). The detail of morphological and agronomical character is shown in Table (2).

Table 2: Agronomic and morphological descriptors of the released bread wheat

Characters	Description
Variety name	Bokku (REEDLING #1//KFA/2*KACHU)
Adaptation area	Highlands of Bale and similar agro ecology
Altitude (m.a.s.l)	2000-2400
Rainfall (ml)	750-1500
Fertilizer (kg/ha^{-1})	NPS 100
	Urea 150
Seed rate (kg/ha)	150
Days to heading	74
Days to mature	139
1000 seed weight(g)	42.3
Hectoliter weight(kg/hl)	82.2
Plant height(cm):	87.0
Yield (t/ha)	Research field 5.3-7.2 Farmers' field 4.9-6.8
Seed color	Amber
Seed shape	Oval shape
Growth habit	Erect
Spike density Medium	Medium

Table 3: Mean agronomic performance and disease reactions of Bread wheat genotypes during tested in bread wheat regional variety trial at combined locations

SN	Genotypes	DH	DM	PLH	TKW	GY	HW	SR	YR
1	KAUZ/STAR/3/MUNIA/ALTAR 84//MILAN/4/LEITH-1	71.3	134.4	79.3	30.0	2.5	80.3	40s	20s
2	SKAUZ/2*STAR//ACHTAR/INRA1764/3/TEOCA+.....	71.8	234.1	79.3	29.7	2.0	77.8	40s	30s
3	ATTILA*2/PBW65//PFAU/MILAN	76.9	136.6	77.2	28.1	2.1	79.2	40s	40s
4	SERI.1B//KAUZ/HEVO/3/AMAD/4/FLAG-2	74.3	137.8	83.8	25.3	2.3	74.9	50s	40s
5	TEMPORALERA M 87*2/TUKURU//FAYEQ-2	71.8	134.1	79.3	23.6	1.7	75.8	60s	30s
6	SERI.1B//KAUZ/HEVO/3/AMAD/4/PFAU/MILAN	71.1	135.2	80.9	27.3	2.0	80.1	40s	30s
7	ETBW 9616	71.4	133.9	84.2	25.6	1.5	76.2	80s	10ms
8	ETBW 9626	72.4	138.9	80.7	36.3	2.6	78.5	50s	10s
9	ETBW 9116	74.2	137.2	83.7	36.7	3.3	81.1	15ms	15ms
10	ETBW 9129	72.6	132.6	82.5	30.8	2.5	79.5	50s	10s
11	ETBW 9547	70.3	137.1	81.2	32.3	2.3	78.9	40s	10s
12	**ETBW 9548 (REEDLING #1//KFA/2*KACHU)**	**74.4**	**139.6**	**87.1**	**42.3**	**4.6**	**82.2**	**10ms**	**5ms**
13	FRNCLN*2/TECUE #1/3/2*MUNAL*2//WAXWING...	72.4	137.5	84.1	32.8	3.1	77.7	30s	20s
14	MEX94.27.1.20/3/SOKOLL//ATTILA/3*BCN/4/	71.2	135.3	87.2	36.4	3.0	77.4	30s	30s
15	BABAX/LR42//BABAX/3/ER2000*2/4/COPIO	70.1	133.7	80.6	27.4	1.9	76.1	50s	40s
16	MUCUY	71.6	133.0	84.2	25.8	1.3	75.1	60s	80s
17	BECARD/AKURI/3/KACHU//WBLL1*2/......	75.2	136.8	85.1	28.4	2.6	75.3	40s	40s
18	Wane (National variety check)	71.0	135.3	82.2	29.0	2.2	74.4	40s	40s
19	Galan (Regional variety check)	72.8	136.2	86.7	35.3	2.8	77.8	30s	15s
20	Mada Walabu (Local check)	73.5	138.1	89.3	31.8	1.8	74.4	50s	10s
	Mean	**72.5**	**135.9**	**83.2**	**30.8**	**2.4**	**77.6**		
	CV (%)	**2.00**	**2.10**	**6.20**	**12.00**	**16.10**	**3.90**		
	LSD (5%)	**1.00**	**1.70**	**3.20**	**2.30**	**0.30**	**5.00**		
	SE	**0.70**	**0.90**	**1.60**	**1.10**	**0.20**	**3.00**		

***Note**: * DTH: days for heading, DTM: days to maturity, PHT: plant height (cm), TKW: thousand kernel weight (cm), HLW: test weight (kg/hl), GYLD: grain yield (t/ha), Sr: stem rust(%), Yr: yellow rust (%),S: Susceptible, MS: moderately susceptible, Mr: Moderately resistant, Tr: Trace, R: Resistant, CV(%): Coefficient of variations, SE: standard error of the mean, LSD: Least significant differences, ns: non-significant differences, **: Means within each genotype highly significant at 0.01 probability level and *:Means within each genotype highly significant at 0.05 probability level*

3.3. Grain Yield Performance of Genotypes

Boku was evaluated across four locations (Sinana, Agarfa, Goba, and Bore) for two consecutive years (2020–2021). Research field yields ranged from 5.3 to 7.2 t/ha^{-1} and farmers' field yields ranged from 4.9 to 6.8 t/ha^{-1}. The variety demonstrated a yield advantage of 109.1% over the standard check Wane and 64.3% over Galan. Across eight environments, Boku maintained the highest mean grain yield, ranging from 2.8 to 6.2 t/ha. Combined ANOVA revealed highly significant ($P < 0.01$) effects of environment (E), genotype (G), and genotype × environment interaction (GE). Across locations and years, mean grain yield of genotypes ranged from 0.61 t/ha (Sinana 2020) to 6.2 t/ha (Goba 2021), with an overall mean of 2.4 t/ha. Genotype G12 (ETBW 9548-Boku) (REEDLING #1//KFA/2*KACHU) produced the highest combined mean yield (4.6 t/ha).

Table 4: Mean grain yield of twenty (20) bread wheat genotypes at eight locations, tonha^{-1}

SNo.	Genotypes code	Year 2020				Year 2021				Mean
		Sinana	Agarfa	Goba	Bore	Sinana	Agarfa	Goba	Bore	
1	KAUZ/STAR/3/MUNIA/ALTAR 84//MILAN/4/LEITH-1	2.1	2.4	3.0	1.7	2.7	2.5	3.7	1.2	2.5
2	SKAUZ/2*STAR//ACHTAR/INRA1764/3/TEOCA+.....	1.3	1.8	2.4	2.3	2.3	1.7	2.4	1.8	2.0
3	ATTILA*2/PBW65//PFAU/MILAN	1.8	2.2	2.6	2.6	1.7	2.6	2.4	1.4	2.1
4	SERI.1B//KAUZ/HEVO/3/AMAD/4/FLAG-2	1.2	2.9	2.7	3.3	2.0	2.2	2.7	2.7	2.3
5	TEMPORALERA M 87*2/TUKURU//FAYEQ-2	1.1	1.1	2.7	3.0	1.4	1.6	2.4	1.8	1.7
6	SERI.1B//KAUZ/HEVO/3/AMAD/4/PFAU/MILAN	1.4	2.1	3.0	2.6	1.3	1.1	3.1	2.1	2.0
7	ETBW 9616	0.9	0.8	1.8	1.0	2.8	2.0	1.6	0.6	1.5
8	ETBW 9626	2.1	2.8	3.0	2.3	2.8	2.1	3.9	1.4	2.6
9	ETBW 9116	2.1	3.3	2.8	3.8	3.4	3.4	4.6	3.9	3.3
10	ETBW 9129	2.2	2.9	2.9	2.3	2.8	2.0	3.5	1.2	2.5
11	ETBW 9547	2.3	2.4	3.0	3.0	2.6	1.7	2.9	1.3	2.3
12	ETBW 9548	2.8	4.2	3.4	4.2	5.8	5.0	6.2	4.6	4.6
13	FRNCLN*2/TECUE #1/3/2*MUNAL*2//WAXWING....	2.6	3.4	4.2	3.9	2.6	2.6	4.0	2.2	3.1
14	MEX94.27.1.20/3/SOKOLL//ATTILA/3*BCN/4/......	2.3	2.9	3.4	3.3	3.7	2.5	3.7	2.4	3.0
15	BABAX/LR42//BABAX/3/ER2000*2/4/COPIO	1.5	1.8	3.1	2.0	2.0	1.4	2.0	1.5	1.9
16	MUCUY	0.6	2.2	2.1	2.5	0.7	0.9	1.5	0.8	1.3
17	BECARD/AKURI/3/KACHU//WBLL1*2/......	1.2	2.6	2.9	3.8	2.2	2.8	2.9	3.5	2.6
18	Wane	1.5	1.9	2.8	2.1	2.6	2.1	2.8	2.0	2.2
19	Galan	2.2	2.9	2.8	2.2	3.4	2.6	4.0	1.8	2.8
20	Mada walabu	0.6	1.8	1.9	1.0	2.0	2.1	2.9	1.6	1.8
Mean		**1.69****	**2.4****	**2.8***	**2.64**	**2.54****	**2.25****	**3.16****	**1.98**	**2.4**
CV%		**24.22**	**15.09**	**22.4**	**21.20**	**13.3**	**19.3**	**15.1**	**21.8**	**16.1**
LSD (5%)		**0.68**	**0.60**	**1.05**	**1.10**	**0.56**	**0.83**	**0.79**	**0.91**	**0.3**
SE		**0.17**	**0.13**	**0.40**	**0.54**	**0.28**	**0.41**	**0.39**	**0.45**	**0.2**

***Note:** Underlined figures indicate highest mean grain yield (t ha^{-1}) at tested environments and highest combined mean yield (t ha^{-1}), CV = Coefficient of variation in percentage, LSD = least Significant difference at 5 percent, SE = standard error*

3.4. Stability Performance

The combined analysis of variance indicated that the main effects of random environments and fix genotypes were significant for grain yield exhibiting the presence of variability in genotypes and diversity of growing conditions at different environments. The combined analysis of variance was conducted to determine the effects of environments (locations), genotype, and their interactions on grain yield of bread wheat genotypes (Table 5). The main effects of environment (E), genotypes (G) and GE interaction were highly significant at P < 0.01. Genotype had the largest effect, explaining 53.0% of total variability, while Environment and GE interaction explained 20.4% and 26.6% of total sum of squares, respectively (Table 5). A large contribution of the genotype indicated that genotypes were diverse, with large difference among genotype means causing most of the variation in grain yield and higher differential in discriminating the performance. GGE biplot analysis identified Boku (G12) as the highest yielding genotype. Stability analysis using the average environment coordination (AEC) method indicated that while Boku had superior yield, genotypes G15, G11, G2 and G14 showed the highest stability. Nevertheless, Boku combined high yield with acceptable stability, making it suitable for broad adaptation. In the GGE biplot, genotypes with high PC1 scores can be considered as genotypes with high mean yield and those with low PC2 scores are considered stable across environments [5].

Table 5: ANOVA for grain yield of bread wheat genotypes for the AMMI model

Source	d.f.	SS	MSS	Explained SS%
Genotypes	19	239.28	12.59	53.0
Environment	7	19.89	13.13	20.4
Replication	16	21.21	1.33	
Interaction	133	120.16	0.90	26.6
IPCA 1	25	50.59	2.02	42.1
IPCA 2	23	38.27	1.66	31.8
IPCA 3	21	13.84	0.66	11.5
IPCA 4	19	6.82	0.36	5.7
Residual	304	77.48	0.26	

Note: *d.f. = degree freedom, SS = Sum of square, MSS = Mean Sum of square, SS% = Percentage of sum of square, IPCA 1, 2, 3 and 4 = first, second, third and fourth principal component*

3.5. Reaction to Major Wheat Diseases

3.5.1. Disease Reactions

Seedling Stage Stem Rust Response of Boku showed low infection types to races TTTTF (0), TTKTT (;), TKTTF (;1) and moderate reaction to TTKTF (2+). Similarly it showed high infection types to TTKSK (3+) and TTRTF. The infection patterns suggest the presence of unknown resistance genes, requiring further differential testing. Importantly, Boku exhibited low infection to recently detected races that defeated gene Sr24, indicating its potential value in resistance breeding.

3.5.2. Field Reaction to Yellow and Stem Rust

Across multi-location evaluations (2020–2021): Boku showed 5% yellow rust and 5% stem rust severity (moderately susceptible to moderately resistant levels). Checks recorded considerably higher severity: Wane up to 40% SR and 40% YR, Galan: 50% SR, 30% YR, Mada Walabu: up to 50% SR, 40% YR (Table 7). This demonstrates the better field resistance of Boku under high disease pressure.

Seedling test for Boku variety to wheat stem rust races the seedling test was done for Boku variety in comparison with 20 wheat stem rust differential lines (Table 6). The seedling result exhibited that low (IT) infection types were recorded on the TTTTF (0), TTKTT (;), TKTTF (;1), but medium reaction 2+ recorded for TTKTF, high infection types were recorded for TTKSK (Digalu race) (3+) and TTRTF. Based on the IT pattern produced by test genotypes against seven Pgt races; Boku variety was identified to be present in the unknown resistance sr gene. Boku variety had low IT to at least one of the races, but the IT patterns produced on these genotypes did not conform to any of the IT patterns exhibited on tester genotypes. Additional wheat stem rust differential lines would be advisable to identify the resistance gene to be found in Boku (ETBW 9548) variety. The advantage of Boku variety was it had low infection types to recently detected races which broke the most dominant resistance gene in Ethiopia which is sr24 (Zerihun *et. al.*, Thesis (Unpublished)). This indicated Boku (ETBW 9548) variety could enhance the production of wheat by applying one time spray of fungicides for only wheat yellow rust.

Table 6: List of Differential lines used in testing stem rust seedling infection type

Sno.	Sr gene	Genotype	Habit
1	Sr5	ISr5-Ra	Spring
2	Sr21	CnS_T_mono-derivative	Spring
3	Sr9e	Vernstein	Spring
4	Sr7b	ISr7b-Ra	Spring
5	Sr11	ISr11-Ra	Spring
6	Sr6	ISr6-Ra	Spring
7	Sr8a	ISr8a-Ra	Spring
8	Sr9g	Acme	Spring
9	Sr36	W2691SrTt-1	Spring
10	Sr9b	W2691Sr9b	Spring
11	Sr30	BtSr30Wst	Spring
12	Sr17 (+Sr13)	Combination VII	Spring
13	Sr9a	ISr9a-Ra	Spring
14	Sr9d	ISr9d-Ra	Spring
15	Sr10	W2691Sr10	Spring
16	SrTmp	CnsSrTmp	Spring
17	Sr24	LcSr24Ag	Spring
18	Sr21	Sr31/6*LMPG	Spring
19	Sr28	VPM1	Winter
20	SrMcN	McNair 701	Winter

Note: *Source from Ambo Manual revised, Getaneh Woldeab (PhD), Endale Hailu, Nestanet Bacha (PhD)*

Table 7: The Yellow and Stem Rust Reaction of variety Bokku and checks in multi-location Variety Year 2020 Year 2021

Varieties	Year: 2020								Year: 2021					
	Sinana		Agarfa		Goba		Bore		Sinana		Agarfa		Goba	
	YR	SR	YR	SR	YR	SR	YR	SR	YR	SR	YR	SR	YR	SR
Bokku	5ms	trms	5ms	trms	5ms	trms	5r	0	5ms	0	5ms	trms	trms	trms
Wane	30s	20s	30s	25s	40s	40s	15mr	10ms	10ms	20s	30s	30s	30s	40s
Galan	25s	20s	25s	20s	15s	50s	20s	0	10ms	20s	25s	25s	30s	20s
M/walabu	40s	20s	30s	20s	10s	50s	40s	10ms	10ms	10s	40s	50s	25s	15s

Note: *SR = stem rust (%), YR= Yellow rust (%), s= susceptible reaction, ms = moderately susceptible reaction, mr = moderately resistance, r = resistance and Tr = trace which means severity < 5%.*

3.6. Quality parameters

Boku showed desirable grain quality traits, including: high TKW (42.3 g), high HLW (82.2 kg/hl), acceptable gluten and protein content, meeting processing standards for flour industries (Table 8).

Table 8: Bread wheat physical and chemical quality Analysis

Varieties	Parameters			
	TKW (gm)	HL (hl/kg)	Gluten (%)	Protein (%)
Boku	5ms	trms	5ms	trms
Wane	30s	20s	30s	25s
Galan	25s	20s	25s	20s
M/walabu	40s	20s	30s	20s

Note: *TKW = thousand kernel weight, HLW = hectoliter weight*

4. DISCUSSION

The evaluation of the bread wheat variety Boku across diverse environments confirmed its superiority in grain yield, stability, disease tolerance, and processing quality. The significant genotypic variance observed indicates the presence of substantial genetic diversity, which enabled the clear differentiation of high-yielding and stable genotypes. Boku's superior performance across multiple environments demonstrates its wide adaptation potential, especially in the Bale highlands.

Its consistent yield advantage over standard checks (Wane and Galan) highlights its suitability for replacing older cultivars. The high contribution of genotype (53%) in the total variability reinforces the strong genetic yield potential of Boku, while the considerable GE interaction (26.6%) reflects environmental influence but did not impede its overall performance.

Morphologically, Boku's erect growth habit, optimal height, and mid-dense spike contribute to effective biomass partitioning and reduced lodging risk. Its medium maturity period fits well within the rainfall pattern of Bale highlands, ensuring reliable grain filling.

Disease resistance remains a critical objective in wheat breeding. Boku's moderate resistance to both stem rust and yellow rust, coupled with low seedling infection to aggressive stem rust races including those virulent to Sr24 suggests the presence of novel or complementary resistance genes. This provides an opportunity for breeders to integrate Boku into resistance improvement programs.

Quality evaluations confirm that Boku meets industrial standards, which enhances its marketability and acceptance by flour processors. The combination of high yield, stability, disease tolerance, and acceptable quality makes Boku a robust cultivar for sustainable wheat production.

5. CONCLUSION AND RECOMMENDATION

Variety Boku has been fully released for the highlands of Bale and similar agro-ecologies because it has high grain yield and quality, stable yield across environments. The variety is rust-tolerant for the recurrent stem rust, yellow rust and other biotic stresses. So, the variety is recommended for smallholder farmers, private, public seed producers and other wheat-growing areas of Arsi-Bale and similar agro-ecology of the country.

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