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Release and Registration of "*Miju*" Bread Wheat (*Triticum aestivum* L.) Variety

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Abstract: Improved varieties play an important role in enhancing production and productivity of a given crops and there by contributing to the change farmers' livelihood and other organs those engaged with crop production. But, there are different agro-ecologies in Ethiopia, that challenging continues production of crops and crops respond differently to this different range of agro-ecologies. Therefore, there is the need to get high yielding and stable improved varieties across different location by conducting multi-location or multi-environmental trails. By considering this condition, this research experimental activity was conducted at three different locations (Bore, Abayi and AnaSora) for two consecutive years 2020 and 2021 main cropping seasons. Randomized complete block design with three replications was used as experimental design. Twenty (20) bread wheat genotypes included as testing materials and were evaluated against two standard checks (Danda'a and Hidase). The experimental unit had 2.5 m length by 1.2m width was used for this trial with an area of $3m^2$. The best genotype that gave high grain yield and as the same time stable across locations was selected. This newly selected and released genotype with the pedigree of CHEN/AEGILOPSSQUARROSA (TAUS (//BCN/3/BAV92/4BERKUT, was named as MIJU officially. This variety was developed by bore agricultural research center, Oromia Agricultural Research Institute. AMMI and GGE biplot analysis, revealed that genotype ETBW7082 (MIJU) is stable and high yielding (5.9 ton/ha) with a yield advantage of 35% over the best standard check Hidase. Thus, this new variety, MIJU was released in 2022 after decision committees of ministry of agriculture plant variety release, protection and seed quality control directorate officially and recommended for wider productions.

Keywords: Bread Wheat (*Triticum aestivum L.)*, *Miju*, Yield Performance, Stable, Resistance

1. Introduction

About six hundred million metric ton of wheat is produced each year and accounts about 30% of global cereal crops production (www.csiro.au). In Ethiopia out of the total grain crop area, 81.19% (10,538,341.91) hectares) under cereals, wheat took up 12.94% (about 1,679,277.06 hectares), this made wheat the fourth crop in area coverage next to tef, maize and sorghum. As to grain production, wheat took up 16.91% (57,801,305.96 quintals) out of 88.36% (about 302,054,260.58 quintals) that contributed by cereal crops [4, 5].

Ethiopia is known for its diverse/heterogeneous agro-ecology. As a result the performance of genotypes differs within and across environments [1, 7]. When environmental differences are large like in Ethiopia, it may be expected that the interaction of genotypes with the environment will also be higher. This interaction may result in one cultivar having the highest yield in some environments while a second cultivar excels in others [13, 14]. Studies on GxE interaction may help determine whether or not a genotype is stable in performance over a range of environments. Genotype x Environmental Interaction (GEI) is useful to breeders as it can help determine if there is a need to develop cultivars for all environments or specific cultivars for specific target environments [3]. GEI is said to occur when different

genotypes respond differently to diverse environments. G x E interaction is one of the main complications in the selection of genotypes for broad adaptation. The phenotype of an organism is determined by the combined effect of the environment and the genotype which interact with one another.

Numerous studies have shown that a proper understanding of the environmental and genetic factors causing the interaction as well as an assessment of their importance in the relevant G x E system could have a large impact on plant breeding [10]. G x E interaction occurs universally when genotypes are evaluated in several different environments [2, 11, 9]. Presence of significant Genotypes x Environment interactions indicates the inconsistency of relative performance of genotypes over environments.

Development of improved bread wheat variety is one of the most important mechanisms for the increment of production and productivity thereby improving the livelihood of the farmers in our country. Even though many wheat varieties have been released for production in Ethiopia over the past years, most of them were pushed out of production few years after release. This is mainly, due to the newly and existing rust disease virulent races. Additionally, climate fluctuation is challenging and therefore, there is a need to develop climate resilient crop variety. Therefore, pyramiding a minor gene and creating genetic variability by hybridizing locally adapted varieties and/ new introduction of exotic materials is crucial to prolong the duration that a given released varieties can stay in production. Therefore, the objective of this study was to evaluate, release and register stable high yielding disease resistance bread wheat variety for high land of Guji and similar agro-ecologies.

2. Materials and Methods

2.1. Varietal Origin and Evaluation

Genotypes those *Miju,* with pedigree of (CHEN/AEGILOPSSQUARROSA (TAUS (//BCN/3/BAV92/4BERKUT) were originally taken from Kulumsa agricultural research center of Ethiopian agricultural research institute. These pipeline genotypes were evaluated against two standard checks, Danda'a and Hidase across three locations (Bore, Abayi and AnaSora) for two consecutive years (2019 and 2020).

2.2. Experimental Design and Field Management

The experimental materials were grown under rain fed condition during the main cropping season in the year 2018-2020 at three locations. The experimental materials at each location were sown with row planting method (drill) using Randomized Complete Block Design with three replications. The gross plot size of each experimental unit was $3m^2$ with six rows of 2.5 m length and 1.2 m width with 0.2 m spacing between rows. The seed was drilled by hand at seed rate of 125 kg/ha which. Planting was carried out at appropriate time for each location and 100kg/ha NPS and 50kg/ha. Weeding was conducted based on its appearance, twice to three times.

2.3. Collected Data

All agronomic, yield and yield related data were collected from the middle four rows of each experimental unit.

Days to heading: The number of days from date of emergence to the stage where 50% of the spikes have fully emerged from the flag leaf.

Days to maturity: The number of days from emergence to the stage when 90% of the plants in a plot have reached physiological maturity (is stages at which the crop stops physiological activities, green parts of the plant turned to yellow and grain becomes hard/ dough stage of grain development).

Grain yield (ton): Grain yield obtained from the central four rows of each plot and converted to tons per hectare at 12.5% moisture content.

1000-kernel weight: Weight of 1000 seeds in gram at moisture content of 12.5% (standard moisture level for bread wheat).

Plant height: The average height in cm from ground level to the base of the head/spike.

Spike length: The average spike length in cm from its base to the tip excluding awns.

2.4. Statistical Analysis

Analysis of Variance All measured parameters were subjected to the analysis of variance (ANOVA) using GenStat 18th edition and R software to assess the difference among the tested genotypes. This was carried out to determine the effect of genotype, location and their interaction on various traits, assuming the location effects as random and genotype effects as fixed.

3. Result and Discussion

3.1. Agronomic and Morphological Characteristics

The released variety, *Miju* has amber seed color, average plant height of 86.94cm and average thousand seed weight 47.76g. The detail agronomic and description of newly released variety are given in table 1 and 2.

3.2. Yield Performance

Miju, marked as ETBW7082, was gave average yield of 5.9ton/ha (Table 1). As observed from multi-location and multi-year evaluation records, this newly released variety has a stable and gave high yield under rust disease hot spot (especially for stem and yellow) of high land areas. Additionally, this newly released variety (*Miju*) gave an average grain yield ranging from 5.7-6.0 ton/ha in verification research plots and 3.1-5.2ton/ha on farmers field (Table 1).

Table 1. *Agronomic and morphological characteristics of the released bread wheat.*

Varity name	Miju (ETBW 7082)
Adaptation:	High lands of Guji and similar agro ecologies
Altitude (m.a.s.l):	2400-2800
Rain fail (mm):	> 875
Fertilizer rate (kg/ha):	
SPS:	100
UREA:	50
Seed rate (kg/ha):	150
Planting date:	Late June to early August in Guji high lands and similar agro ecologies
Days to heading:	73.61
Days to maturity:	145.2
Plant height (cm):	86.94
Growth habit:	erect
Seed color:	amber
Thousand kernel weight (g):	47.76
Moisture (%):	12.85
Crop pest reaction*:	
Grain yield (ton/ha):	
Research field:	5.7-6.0
Farmer's filed:	3.1-5.2
Year of release:	2022
Breeder/maintainer:	BoARC/OARI

Table 2. *Means value of grain yield, agronomic traits and disease reaction of 19 bread wheat genotypes tested across six environments (three locations for two years).*

SN	Genotypes	GY (ton/ha)	GYR	DH	DM	PH (cm)	SL (cm)	TKW (gm)	YR	SR
1	Danda'a	2.34	18	72.56	142.0	87.87	8.322	40.11	40S	10MR
2	ETBW6892	3.35	7	72.11	150.1	84.71	8.783	51.51	20S	T
3	ETBW6929	3.65	5	71.17	150.1	86.66	8.528	53.18	10S	10S
4	ETBW6940	3.84	3	74.44	143.8	83.53	8.294	47.04	10MS	5S
5	ETBW7008	2.93	12	71.94	153.8	86.94	8.549	42.58	20MS	T
6	ETBW7037	3.19	9	71.39	142.0	88.33	9.292	45.17	30S	T
7	ETBW7038	2.53	15	70.94	140.1	80.76	8.141	42.11	30S	T
8	ETBW7042	3.90	2	73.00	147.9	94.40	9.009	49.87	40S	10S
9	ETBW7049	3.35	7	73.00	146.5	82.52	8.619	46.66	30S	5S
10	ETBW7074	2.46	16	71.89	142.1	83.68	8.398	41.16	20MS	T
11	ETBW7081	2.74	14	70.67	140.5	82.32	7.885	43.81	20MS	T
12	ETBW7082	5.90	1	73.61	145.2	86.94	8.976	47.99	10MS	10MS
13	ETBW7087	3.42	6	72.39	143.5	85.34	8.917	51.47	20MS	0
14	ETBW7098	2.88	13	71.94	147.7	82.89	8.520	44.16	40S	20S
15	ETBW7103	2.44	17	72.11	146.4	83.83	8.355	40.56	10MS	T
16	ETBW7108	2.11	19	73.94	146.4	79.94	8.692	42.02	10MS	T
17	ETBW7131	3.08	10	72.94	145.4	85.61	8.804	49.39	20MS	T
18	ETBW7120	2.94	11	72.17	146.8	90.67	9.577	44.00	30S	T
19	Hidase	3.80	4	74.83	144.1	83.10	7.847	44.60	40S	10S
	Means	3.14		72.48	145.49	85.27	8.61	45.65		
	LSD%	5.476		0.4755	1.102	3.359	0.4779	5.122		
	CV%	26.55		1.00	1.15	6.00	8.46	17.08		

Where; GY = Grain yield, DE = Days to emergence, DH = Days to heading, DM = Days to maturity, PH = Plant hieght, SL = Spike length, TKW = Thousand kernel weight, YR=Yellow rust and SR=Stem rust.

3.3. Stability and Adaptability Analysis

AMMI is essentially effective where the assumption of linearity of responses of genotype to a change in environment is not fulfilled, which is important in stability analysis. The results can be graphed in a useful biplot that shows both main and interaction effects for both genotypes and environments [8].

An ideal genotype has the highest mean grain yield and is stable across environments [6]. Desirable genotypes are those located close to the ideal. Thus, starting from the middle concentric circle pointed with arrow concentric circles was drawn to help visualize the distance between genotypes and the ideal genotype [15]. The ideal genotype can be used as a benchmark for selection. Genotypes that are far away from

the ideal genotype can be rejected in early breeding cycles while genotypes that are close to it can be considered in further tests [16]. A genotype is more desirable if it is closer to 'ideal' genotype [12].

From GGE biplot analysis and AMMI model, Genotype focused comparison of biplot revealed that Miju ((G15 (ETBW7082)) closest to concentric circle of biplot, indicating its relative stability, and at the same time far away from vertical mean line to right side, showing its high yielding potential compared to the remaining genotypes (Figure 1).

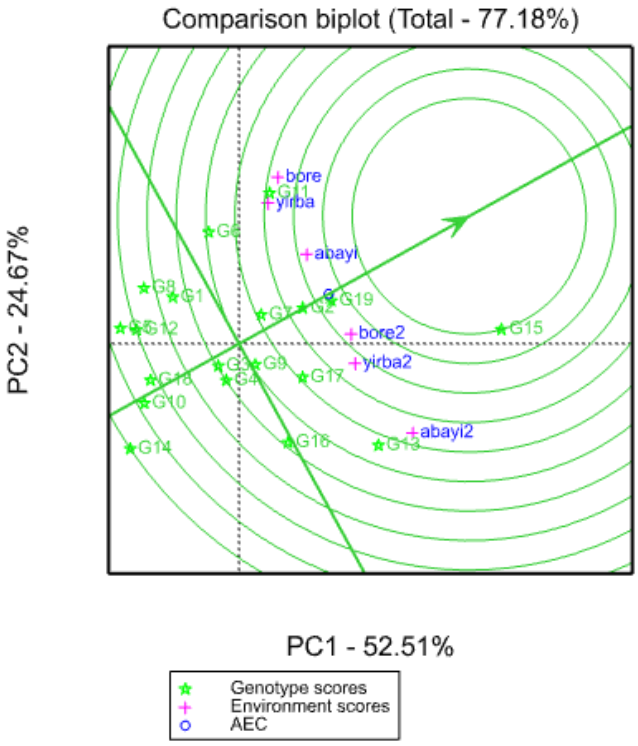

Figure 1. *Genotype focused GGE bi-plot for stability test among bread wheat genotypes.*

Hint: G1=ETBW7098, G2=ETBW6929, G3=Hidase, G4=ETBW7008, G5= ETBW7103, G6=ETBW7049, G7=ETBW6892, G8= ETBW7081, G9= ETBW7037, G10=Danda'a, G11= ETBW6940, G12= ETBW7038, G13= ETBW7131, G14= ETBW7108, G15= ETBW7082, G16= ETBW7120, G17= ETBW7087, G18= ETBW7074 and G19= ETBW7042. While, bore = bore2019, Abayi = abayi2019, yirba = yirba2019, bore2 = bore2020, Abayi2 = abayi2020, yirba2 = yirba2020.

3.4. Reaction to Major Wheat Diseases

The newly released variety, *Miju* is moderately resistance to major wheat rust diseases, yellow rust (*puccinia stiiformi* f. *sp. Tritici*), stem rust (*puccinia graminis* f. *sp. Tritici*) and leaf rust (*puccinia triticina*) that highly affecting grain yield and its quality (Table 2).

4. Conclusion

Bread wheat is among the most important and widely produced crops in Ethiopia. Even though, Since Ethiopia is known for its diverse agro-ecology, a single genotype (improved variety) may not perform similarly to these diverse agro-ecologies of Ethiopia and respond differently to different environments. Even though, Since Ethiopia is known for its diverse agro-ecology, a single genotype (improved variety) may not perform similarly to these diverse agro-ecologies of Ethiopia and respond differently to different environments. Therefore, there is crucial to select and release high yielding and stable varieties performance over a range of environments.

Aiming this in mind, the experimental research consisting of 20 bread wheat genotypes were conducted for consecutive two years at three different locations and Miju, newly released and registered variety was selected.

The newly released bread wheat variety, *Miju* is hereby released for its high yield, stable, widely adapted and resistivity to major wheat rust diseases. Therefore, smallholder farmers and other wheat producers inhabiting high land Guji of Southern Oromia and areas with similar agro-ecologies can grow *Miju* variety with its full agronomic and other management recommendations.

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