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RESEARCH ARTICLE

Evaluation of the newly released Adola-01 bread wheat (*Triticum aestivum* L.) variety for stability testing in Ethiopia

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Abstract

The present research was conducted at different locations for two consecutive years 2019 and 2020 during main cropping seasons in the Oromia Agricultural Research Institute Ethiopia. Randomized complete block design with three replications was used as experimental design. Twenty bread wheat genotypes included as testing materials and were evaluated against four standard checks (Kakaba, Kubsa, Ogolcho and Hidase). The variety was developed by Bore Agricultural Research Center of Oromia Agricultural Research Institute. AMMI and GGE biplot analysis, revealed that genotype ETBW8408 (Adola-01) is stable and high yielding (27.33 qt/ha) with a yield advantage of 10.27% over the best standard check Hidase. Thus, this new variety was released in 2020 after decision committees of Ethiopian ministry of agriculture, plant variety release, protection and seed quality control directorate (formerly Ethiopian Agricultural Authority), officially released and recommended for wider productions.

Keywords: Bread wheat, Adola-01, yield performance, stability, resistance

Introduction

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. 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 (CSA and USDA, 2021). 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.

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 (Eberhart and Russel, 1966). Climate fluctuation is challenging and therefore, there is a need to develop climate resilient crop variety. 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.

Materials and methods

Genotypes selected and released from were original screened from ICARDA/CIMMITY hybrid bread wheat pipelines. The pedigree of this variety (Adola-01) is TILILA/MUBASHIIR-1. After conducting nursery observation and preliminary variety/yield trials, advanced and promising genotypes were evaluated against four standard checks (Kakaba, Kubsa, Ogolcho and Hidase) across different locations for two consecutive years (2019 and 2020) to test wide adaptability/stability of the desired genotypes. The experimental unit had 2.5 m length by 1.2m width was used for this trial with an area of 3m2. 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 TILILA/MUBASHIIR-1 was named as Adola1 officially.

Experimental design, field management and data collection

The experimental materials were grown under rain fed condition during the main cropping season in the year 2018-2020 across different 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 3m2 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. 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 (qt/ha): 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%.

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.

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.

Rust disease was scored by well-trained researchers and scored by observation of disease severity (in %) and plant response to disease. Disease severity was scored in resistance (R), moderate (M) and susceptible (S).

Results and discussion

The released variety, Adola-01 (ETBW8408) has amber seed color, average plant height of 75.18cm and average thousand seed weight 50.45g. The same result was reported by (Aliyi Kedir *et. al.,* 2022). The detail agronomic and description of newly released variety is given in table 1 and 2. This newly released variety gave the average yield of 2.73ton/ha (Table 1 and Fig. 1). This makes it best yielder than the remaining genotypes. Aliyi Kedir *et. al.,* (2022) found the same result. Additionally, this newly released variety (Adola-01) gave an average grain yield ranging from 26-30qt ha-1 on farmers field and 27-38qt ha-1 in verification research plots (table 2).

Table 1: Agronomic and morphological descriptors of Adola-01 (TILILA/MUBASHIIR-1)

Variety Name	**Adola-01 (ETBW 8408)**
Adaptation area and released year	Lowlands to Midland of Guji and similar agro ecology during 2019
Altitude (m.a.s.l) and rainfall (ml)	1600-2100; 792- 1126
Urea	50
Seed rate (kg/ha)	150
Days to heading	62
Days to mature	103
1000 seed weight(g)	42.6
Hectoliter weight(kg/hl)	81.40
Plant height(cm):	75.18
Research field	27-38
Farmers' field	26-30
Seed color	Amber
Growth habit	Erect
Grain Protein (%)	13.83
Grain Gluten (%)	28.50
Zeley index (ml)	67.05
Breeder/maintainer	BoARC/OARI

Stability 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 (Eberhart and Russel, 1966). The results can be graphed in a useful biplot that shows both main and interaction effects for both genotypes and environments (Guach, 1997). An ideal genotype has the highest mean grain yield and is stable across environments (Farshadfar, 2012). 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 (Yan, 2006). 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 (Yan, 2003).

Table 2: Combined mean performance of grain yield performance and agronomic traits, yield stability parameters and major rust disease reactions

Genotype	Yield (qt/ha)	Days to heading	Days to maturity	Plant height	Spike length	1000 kernel weight	bi	Pi
Danda'a	15.85	69.67	119.44	76.71	7.51	39.24	0.68	217.00
ETBW8369	20.58	67.78	120.94	74.59	7.81	38.40	1.08	167.59
ETBW8370	19.48	74.50	116.17	74.60	7.20	40.18	0.86	154.91
ETBW8373	16.72	67.33	117.00	74.77	7.81	36.41	0.84	222.29
ETBW8383	22.87	69.06	111.56	75.76	7.16	39.74	1.41	113.48
ETBW8407	24.69	66.50	101.50	76.66	8.31	37.20	1.15	116.77
ETBW8408	27.33	60.17	122.89	75.18	7.50	39.31	1.15	94.77
ETBW8412	23.81	67.67	116.22	77.17	8.03	39.09	0.92	115.86
ETBW8413	30.60	66.83	163.94	76.74	7.08	37.38	0.15	14.72
ETBW8415	26.01	76.89	117.67	75.59	6.85	36.42	1.37	102.87
ETBW8420	24.77	67.83	122.06	71.77	7.21	34.98	1.15	122.35
ETBW8427	20.77	67.67	119.39	70.71	7.80	39.16	1.09	160.17
ETBW8428	20.27	68.78	115.17	70.62	7.30	34.96	1.34	182.62
ETBW8444	24.38	63.50	117.83	73.52	7.62	37.82	1.01	108.71
Hidase ©	24.78	67.17	116.50	75.62	11.46	38.18	1.12	127.02
Kakaba ©	24.99	66.83	119.33	74.49	6.94	39.82	1.03	99.48
Kubsa ©	21.26	70.83	116.33	71.05	7.14	35.01	1.01	134.45
Ogolcho ©	20.01	68.33	118.56	65.99	6.71	36.02	0.97	160.26
PBW-343	25.63	68.61	119.67	74.42	6.97	42.56	0.67	110.35
Mean	22.88	68.21	119.59	73.99	7.60	37.99		
LSD	5.02	2.58	6.05	6.85	0.57	6.48		
CV	18.13	0.60	1.72	6.27	6.50	16.91		

A genotype is more desirable if it is closer to 'ideal' genotype (Mitrovic, 2012). From Eberhart and Russell (1966) concept, it revealed that the best yielding variety, Adola-01 (ETBW8408), showed regression coefficient (bi) closer to unity (1.15) and thus stable and widely adaptable variety then the remaining genotypes (Table 2, Fig. 1 and 2). Both environment-focused biplot and genotype focused comparison of the tested genotypes revealed that Adola-01 (ETBW8408) closest to central circle, indicating its high yield potential and relative stability compared to the remaining genotypes (Fig. 1). Generally, GGE biplot analysis, AMMI and Eberhart and Russell (1966) model revealed that Adola-01 (ETBW8408) was stable and high yielding (27.33qt ha-1) variety with yield advantage of 10.27% over the best standard check Hidase (24.78 qt ha-1) and therefore, official released and recommended for production under targeted areas. Generally, GGE biplot analysis, AMMI and Eberhart and Russell (1966) model revealed that Adola-01 (ETBW8408) was stable and high yielding (27.33qt ha-1) variety with yield advantage of 10.27% over the best standard check Hidase (24.78 qt ha-1) and therefore, official released and recommended for production under targeted areas. Performance of variety for major rust disease reactions is shown in table 3. Rust disease was scored in the severity (%) and plant response to disease. Disease severity was scored in resistance (R), moderate (M) and susceptible (S) also 10 ms means, the plant is severed 10% and plant response is moderately susceptible and 40S means the plant is severed 40% and the plant is susceptible to this disease. T (t) = trace, means the disease percentage is below 5% (<5%) shown by the test variety.

Table 3: Performance of variety for major rust disease reactions

Genotype	Yellow rust	Stem rust	Leaf rust
Danda'a	10s	15s	0
ETBW8369	10s	0	0
ETBW8370	0	0	10s
ETBW8373	40s	0	t
ETBW8383	30s	20ms	10ms
ETBW8407	30s	0	0
ETBW8408	5ms	t	t
ETBW8412	20ms	0	0
ETBW8413	30s	0	15s
ETBW8415	20s	0	t
ETBW8420	10s	0	t
ETBW8427	20s	0	t
ETBW8428	40s	0	0
ETBW8444	t	0	0
Hidase ©	10ms	15s	0
Kakaba ©	10ms	0	10s
Kubsa©	60s	10s	0
Ogolcho©	10s	10s	5ms
PBW-343	t	0	0

Fig 1. GGE biplot analysis showing stability of genotypes and test environments E1 and E5 = Gobicha year one and two, E2 and E4 = Dufa year one and two, E3 and E6 = Wadara

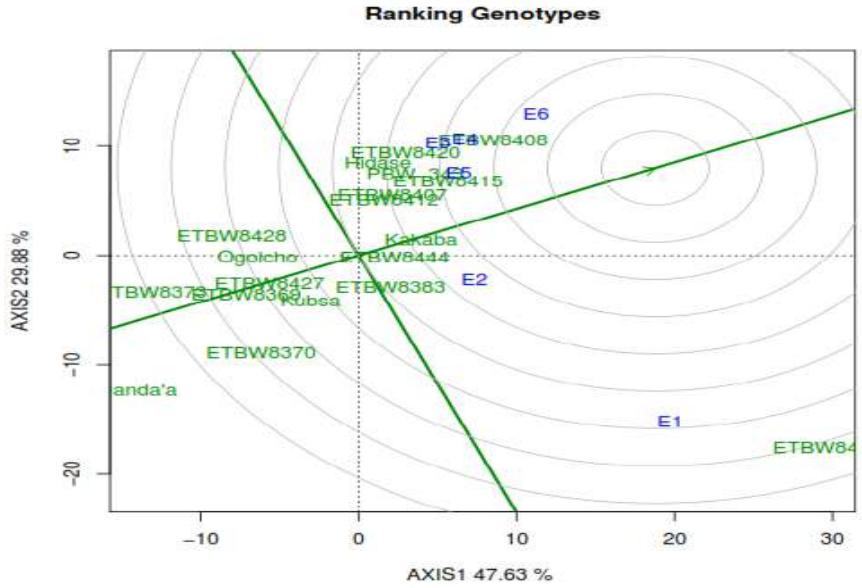
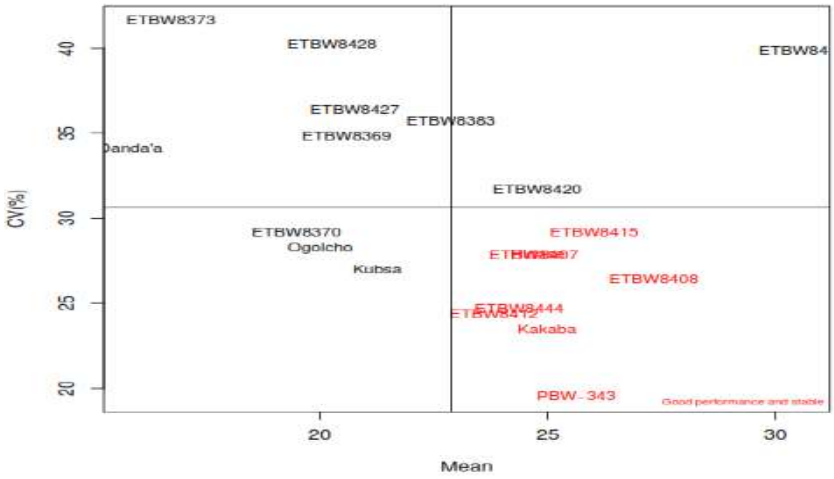


Fig 2: Matrix plot of genotypes mean grain yield (qt hac-1) versus coefficient of variation (CV %) indicating stability and yield performance of the test genotypes.



Hence, in conclusion, the newly released bread wheat variety, Adola01 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 mid land Guji of Southern Oromia and areas with similar agro-ecologies can grow Adola01 variety with its full agronomic and other management recommendations.

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