Novelty Journals

ISSN 2394-966X

International Journal of Novel Research in Life Sciences
Vol. 7, Issue 3, pp: (9-14), Month: May - June 2020, Available at: www.noveltyjournals.com

Evaluation of Lowland Released Bread Wheat (*Triticum aestivum* L.) Varieties under Irrigation in Raya Valley Southern Tigray, Ethiopia

[1]Girma Degife, [2]Esuyawkal Demis

Ethiopian Institute of Agricultural Research, Mehoni Agricultural Research Centre, P.O. Box 47, Mehoni, Ethiopia

Corresponding authors E-mail: girmadegife12@gmail.com and esuyawkaldemis@gmail.com

***Abstract:* Wheat (*Triticum aestivum* L.) is one of the most important and strategic staple food crops, globally. Therefore, this study was conducted to identify and evaluate adaptable and high yielding improved wheat varieties for lowland areas of Tigray region northern Ethiopia. A total of 7 released wheat varieties including local variety were tested in a Randomized Complete Block Design (RCBD) at Mehoni Agricultural Research Center during 2016 to 2017 under irrigation. Analysis of variance was performed to contrast the differences within the varieties based on yield and other yield-related traits. The year x variety interaction was highly significant ($P<0.01$) for days to heading, days to maturity and grain yield indicating a different performance of bread wheat varieties over the two years; suggesting the importance of the assessment of varieties under different years in order to identify better performing varieties for a particular location. The analysis also revealed highly significant difference ($P<0.01$) among the different varieties for days to heading, plant height and grain yield. Based on the combined result variety Lucy (6.41 t ha^{-1}) and Gambo (5.79 t ha^{-1}) showed better performance for grain yield and recommended for the study area and similar agro-ecologies of Southern Tigray, Ethiopia.**

***Keywords:* Bread wheat, Varieties, Days to heading, Days to maturity, Grain yield.**

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important and strategic staple food crops for the majority of the world's population. In Ethiopia, wheat is cultivated on 1.7 million hectares of land and has the production of 4.54 million tons with a low rate productivity of 2.67 t ha^{-1} (CSA, 2017) in the country as compared to world average yield (3.34 t ha^{-1}) (FAO, 2017). The total wheat area and production in Tigray region is 107,724.17 hectares and 212,867.26 tons with the average yield of 1.98 t ha^{-1}. In southern zone the area coverage and productivity of wheat were 49,189.20 ha and 101,911.14 tons, with the average yield of 2.072 t ha^{-1} respectively which is lower than the national average (CSA, 2017). In Ethiopia wheat is grown at an altitude ranging from 1500 to 3000 meters above sea level between 6-16^{o} N latitude and 35-42^{o} E longitude. The most suitable agro-ecological zones however, fall between 1900 and 2700 m.a.s.l. (Abu, 2012).

Agronomic, morphological and phenological traits are very important for grouping wheat genetic resources and also are essential and useful for plant breeders seeking to improve existing germplasm by introducing novel genetic variation for certain traits into the breeding populations (Zarkti *et al.*, 2010; Najaphy *et al.*, 2012). Performance of a variety is the resultant effect of its genotype and the environment in which the genotypes are tested. When new wheat cultivars are developed by the breeders in order to increase total production, these new cultivars are tested for their yield performances in different locations. The success of a new wheat variety depends upon its yield and adaptation potential in those

International Journal of Novel Research in Life Sciences
Vol. 7, Issue 3, pp: (9-14), Month: May - June 2020, Available at: www.noveltyjournals.com

locations. The wheat cultivars with high and stable yield are highly esteemed by both farmers and breeders (Boubaker *et al*., 1999). Varieties with different morphological and economic characteristics are now available as breeding stock (Parihar and Singh, 1995). The performance of wheat genotypes is mainly associated with the soil and climatic conditions, application of inputs and other management conditions (Piepho *et al*., 2004). The evaluation of elite wheat varieties and advanced lines is essential for the further improvement of wheat (Ozgen, 1991 and Porfiri *et al*., 2001). Most previous studies were carried out by using a single method and usually described the validity of methods and performance of trials whereas, the performance of genotypes in given environments were seldom reported. However, the performance of a genotype in a given environment is more important for wheat cultivation and improvement (Vaughan and Judd, 2003). Each variety has a genotype-specific ability to maintain performance over a wide range of environmental conditions (Hancock, 2004). This ability is usually referred to as the sensitivity or adaptability of a variety. Such ability is an important property, because farmers naturally want to use varieties which perform well in their own fields (Bajaj, 1990).

In Ethiopia, a number of improved bread wheat (*Triticum aestivum* L.) varieties have been released by different research centers. In the Southern Zone of Tigray Regional State, at lowland areas, some adaptation trials have been made in wheat genotypes (Gebru and Abay, 2013). Raya Valley (≤ 1600 m.a.s.l.) which is a moisture stress area is the part of this Zone however; nothing has been done for evaluation or introduction of improved wheat varieties. This is due to the insufficient rainfall to support the growth and yield of wheat in the area. But, the dependence on rainfall alone in the area has in recent years been gradually replaced by irrigated crop production. The number of farmers and investors using irrigation and supplemental irrigation is increasing. However, lack of improved varieties for the area remains as one of the major limitations. Therefore, the performed experiment had the aim to identify and evaluate adaptable and high yielding wheat varieties and to recommend the best performing ones for the study area.

2. MATERIALS AND METHODS

Description of the Experimental Area

The experiment was carried out at the research station of Mehoni Agricultural Research Center (MARC) in 2016 and 2017 under irrigated conditions. Mehoni Agricultural Research Center is located about 678 km from the capital city of Addis Ababa and about 120 km south of Mekelle, the capital city of Tigray regional state, northern Ethiopia. Geographically, the experimental site is located at 12° 41' 50" North latitude and 39° 42' 08" East longitude with an altitude of 1578 m.a.s.l. The site receives a mean annual rainfall of 750 mm with an average minimum and maximum temperature of 22°C and 32°C, respectively. The soil textural class of the experimental area is clay loam with pH of 7.9-8.1 (Haileslassie *et al.*, 2015).

Experimental Materials and Design

Seven wheat varieties were used in the experiment namely Fentalle, Werer-1, Lucy, Gambo, Amibera, Werer-2 and local. The seeds of six wheat varieties were obtained from Werer Agricultural Research Center and one local variety was included from the experimental area. The experiment was arranged in a Randomized Complete Block Design (RCBD) with four replicates. Each experimental plot had 8 rows at a spacing of 30 cm, having plot length of 3 m and width of 2.4 m. Spacing between plots was 1 m and the distance between replications was 1.5 m.

Experimental Procedure

The experimental plots were prepared by tractor ploughing and harrowing. Rows were made by hand-pulled row-marker. Fertilizer was applied at the rate of 125 kg DAP ha^{-1} diammonium phosphate (DAP) ha^{-1} during planting and 100 kg Urea ha^{-1} was applied at the seedling stage after two weeks for the black soil type. Sowing was done by hand drilling at the seed rate of 125 kg ha^{-1} (90 g $plot^{-1}$). All appropriate agronomic practices such as weeding, watering and others were conducted uniformly at the experimental field. Irrigation was provided using a groundwater resource to provide the essential moisture for normal growth. Therefore, amount of irrigation water to irrigate each experimental plot was applied using drip irrigation, which was installed in the experimental site and the amount of water was measured using a soil squeezed method to test soil moisture manually by hand.

Data Collection

Crop phenology and growth characters

Data on days to heading and days to maturity were assessed on a plot basis. Plant height (cm) and spike length (cm) were recorded from five random samples of plants previously selected and tagged from the central parts of each plot. Mean values of the five random samples of plants per plot were then used for the analysis of data.

Yield and yield components

Data on thousand kernel weight (g) and grain yield (t ha^{-1}) were assessed on a plot basis.

Data Analysis

All the collected agronomic and growth data were subjected to analysis of variance (ANOVA) using SAS statistical software (9.2) version. Combined analysis of variance over years was carried out and Least Significant Difference (LSD) test was used to compare the mean separations at $P<0.05$.

3. RESULTS AND DISCUSSION

Crop Phenology and Growth Characters

Days to heading and maturity

Analysis of variance indicated that days to heading varied highly significantly ($P<0.01$) in different wheat varieties (Table 2). The variation with respect to days to heading and days to maturity ranged from 62 to 79 and 100 to 117 respectively; indicating considerable range of variation among the varieties for heading and maturity. The varieties Amibera, Fentalle and Gambo were early heading, which took 62 to 65 days on the average for heading. This early heading character also made these varieties to mature early within 102, 101 and 103 days on the average. Late heading was recorded for three varieties namely, Lucy (68 days), Local (70 days) and Werer-1 (79 days) whereas, Local and Werer-1 were late for days to maturing which took 107 and 117 days, respectively. Comparative results were reported by Alemu (2016) that range for days to heading at Tongo was 46 to 70 days, with minimum values in the genotypes ETBW 8518 and maximum in ETBW 6940 with an average value of 55 days. However, days to maturity at Tongo varied from 97 (ETBW 7101) to 117 (ETBW 6940) days respectively, with an average value of 105 indicating that the tested genotypes were early to medium maturing category.

Plant height

Analysis of variance showed that the differences in plant height of the wheat varieties studied were highly significant ($P<0.01$) between varieties and for variety x year interaction (Table 2). Data for plant height ranged from 80.92 cm to 99.97 cm with a mean value of 91.52 cm. Among wheat varieties, plant height was maximum (99.97 cm) in Gambo followed by 96.50 cm and 96.40 cm in Lucy and Fentalle respectively. The lowest plant height of 80.92 cm and 82.55 cm were determined in Werer-1 and Werer-2 respectively. This indicates that Gambo variety proved to be one of the promising varieties for future planting in Raya Valley as regards its plant height. Longov *et al.* (2014) reported the presence of significant ($P<0.05$) difference among five promising wheat varieties in the case of plant height.

Spike length

Spike length was influenced significantly ($P<0.05$) by varietal differences (Table 2). Mean for spike length of varieties ranged from 6.15 cm to 10.15cm with the mean value of 8.83 cm and coefficient of variation of 6.59%. Among the varieties the maximum spike length (10.15 cm) was recorded for Fentalle and Amibera, while the lowest spike length (6.15 cm) was recorded for Werer-1. These results in relation to spike length are consistent with the findings of Voltas *et al.* (2005) reported that tillering capacity and spike length were genetically influenced by the breeding material. A similar result was reported for bread wheat genotypes by Adhiena *et al*. (2015) who found that the mean value of spike length was 7.29 cm with maximum of 8.87 cm and minimum of 5.87 cm for ETBW7864 and Digalu respectively. However, combined interaction exhibited a non-significant difference for spike length and thousand kernel weight. Tewodros *et al*. (2014) reported highly significant differences among thirteen bread wheat genotypes for grain yield, days to heading, days to maturity and thousand seed weight.

International Journal of Novel Research in Life Sciences
Vol. 7, Issue 3, pp: (9-14), Month: May - June 2020, Available at: www.noveltyjournals.com

Table 1. Mean values of evaluation of low land released wheat varieties (combined analysis of 2016 and 2017)

Variety	DH (days)	DM (days)	PHT (cm)	SL (cm)	TKW (g)	GY (t ha^{-1})
Fentalle	62.20^{e}	101.25^{d}	96.40^{b}	10.15^{a}	33.60^{c}	4.80^{c}
Werer-1	79.25^{a}	117.12^{a}	80.92^{d}	6.15^{d}	43.85^{a}	3.48^{d}
Lucy	68.50^{c}	100.75^{d}	96.50^{b}	8.00^{c}	37.95^{b}	6.41^{a}
Gambo	65.37^{d}	103.25^{c}	99.97^{a}	9.80^{ab}	42.45^{a}	5.79^{b}
Amibera	62.12^{e}	102.00^{cd}	92.80^{c}	10.15^{a}	34.95^{bc}	4.83^{c}
Werer-2	64.00^{d}	102.37^{cd}	82.55^{d}	8.05^{c}	34.05^{c}	4.68^{c}
Local	70.25^{b}	107.87^{b}	91.47^{c}	9.52^{b}	33.65^{c}	5.04^{c}
Range Min.	62.12	100.75	80.92	6.15	33.60	3.48
Range Max.	79.25	117.12	99.97	10.15	43.85	6.41
Mean	67.38	104.95	91.52	8.83	37.21	5.01
CV (%)	2.19	1.70	3.10	6.59	8.36	7.95
LSD (5%)	1.49	1.79	2.84	0.59	3.15	0.43

Column of means with the same letter (s) are not significantly different at $P < 0.05$; where, CV= coefficient of variation, LSD= least significant difference, DH= days to heading, DM= days to maturity, PHT (cm) = plant height in centimeter, SL (cm) = spike length in centimeter, TKW (g) = thousand kernel weight in gram, GY= grain yield in tone per hectare (t ha^{-1}), Max= maximum and Min= minimum.

Table 2. Mean square from the first year (2016) and second year (2017) combined analysis of variance for the wheat varieties

Source of Variation	DF (days)	DH (days)	DM (days)	PHT (cm)	SL (cm)	TKW (g)	GY (t ha^{-1})
Rep	3	7.90*	13.16**	46.25**	0.43^{ns}	8.29^{ns}	0.17^{ns}
Year	1	380.64**	795.02**	60.49**	3.21**	2.57^{ns}	5.89**
Variety	6	289.66**	275.12*	419.27**	17.85**	150.52**	6.81**
Year x variety	6	91.02**	47.80**	88.48**	0.08^{ns}	20.59^{ns}	1.12**
Error	39	2.19	3.15	7.87	0.34	9.68	0.16
CV (%)	-	2.19	1.70	3.10	6.59	8.36	7.95

*ns= non-significant, *=significant, **= highly significant, at $P<0.05$, DF = Degree of freedom, CV=Coefficient of variation, DH= days to heading, DM= days to maturity, PHT (cm) = plant height in centimeter, SL (cm) = spike length in centimeter, TKW (g) = thousand kernel weight in gram and GY (t ha^{-1}) = grain yield tone per hectare.*

Yield and yield components

Thousand kernel weight

Thousand kernel weight was highly significantly (*P<0.01*) due to varieties; but the interaction between year and variety was non-significant (Table 2). The mean value of thousand kernel weight ranged from 33.60 g (Fentalle) to 43.85g (Werer-1) with an average value of 37.21g. The varieties Werer-1, Lucy and Gambo had weights higher than the mean weight of 37.21g. According to data reported by Obsa (2014) thousand seed weight ranged from 25g to 46.67g; with the average weight of 39.67g showing high genetic variability among the genotypes. However, in contrast to this non-significant difference between genotypes for seed weight has also been reported (Khan *et al.*, 2011).

Grain yield

Grain yield was highly significantly (*P<0.01*) due to varieties as well as interaction between year and variety (Table 2). The maximum grain yield (6.41 t ha^{-1}) was recorded for variety Lucy, followed by variety Gambo (5.79 t ha^{-1}) and they have a better grain yield advantage of 27 and 15 over a local check respectively (Table 1). The lowest grain yield was recorded in variety Werer-1 (3.48 t ha^{-1}). The grain yield of Lucy was markedly higher than the rest of the tested varieties. This higher grain yield might be associated with adaptability and the genetic make-up of the parental material of these varieties since under similar soil, climatic, input and crop management conditions the grain yield differed significantly.

The result is in line with Falaki *et al.* (2009) reported different responses of wheat varieties in respect to the yield and yield components examined and suggested that it could be due to their varied genetic composition and adaptation to the soil and climatic conditions under which the study was conducted.

4. CONCLUSION

Highly significant differences among wheat varieties were observed for days to heading, plant height, spike length, thousand kernel weights and grain yield, while there was a significant difference for days to maturity. The combined analysis showed highly significant differences for days to heading, days to maturity and grain yield indicating differential performance of bread wheat varieties over the consecutive two years. This suggests the importance of the assessment of varieties under different years, in order to identify better performing varieties for a particular location. From the results of this study, it can be concluded that wheat varieties Lucy and Gambo which have been identified as higher yielders than the other varieties, could be recommended for the conditions of Raya Valley and similar areas.

REFERENCES

[1] Abu T (2012). Grain and feed annual report. Grain report number: ET1201, Addis Ababa, Ethiopia. Research in Plant Biology, 3(1): 33-36.

[2] Adhiena M, Mohammed W, Dessalegn T (2015). Estimation of Heritability and Genetic Advance of Yield and Yield Related Traits in Bread Wheat (*Triticum aestivum* L.) Genotypes at Ofla District, Northern Ethiopia. International Journal of Plant Breeding and Genetics, 10: 31-37.

[3] Alemu D B (2016). Genetic Variability and Association among Grain Yield and Yield Related Traits of Bread Wheat *(Triticum aestivum* L.*)* Genotypes. MSc Thesis Postgraduate Program Directorate, Haramaya University, Ethiopia.

[4] Bajaj Y P S (1990). Wheat. Springer. Pp. 161-63.

[5] Boubaker M, Ben-Hammouda M, Sakouhi L (1999). Adaptation and Yield Stability of Three Cereal Species in Semi-arid and Sub-humid Regions of Tunisia. Secheresse, 10(4): 273-279.

[6] CSA (Central Statistical Agency) (2017). Report on Area and Production of Major Crops (Private Peasant Holdings, Meher Season). Agricultural Sample Survey 2016/2017. Central Statistics Agency, Addis Ababa, Ethiopia.

[7] Falaki A M, Miko S, Mohammed I B, Abubakar I U, Valencia J A (2009). Evaluation of some Improved Bread Wheat Varieties at Chiyako, Jigawa State, Nigeria. ARPN Journal of Agricultural and Biological Science, 4(4): 40-43.

[8] FAO (2017). Food and Agricultural Organization. CROP PROSPECTS and FOOD SITUATION. Quarterly Global Report, March 2018.

[9] Gebru H, Abay F (2013). Evaluation of Bread Wheat Genotypes for their Adaptability in Wheat Growing Areas of Tigray Region, Northern Ethiopia. Journal of Biodiverse Endanger Species, 1:104.

[10] Haileslassie G, Haile A, Wakuma B, Kedir J (2015). Performance evaluation of hot pepper (*Capsicum annum* L.) varieties for productivity under irrigation at Raya Valley, Northern, Ethiopia. Basic Research Journal of Agricultural Science and Review, 4(7): 211-216.

[11] Hancock J F (2004). Plant Evolution and the Origin of Crop Species. CABI Publishing.

[12] Khan M., Malik T., Abbas S., Abbas Z., Khan A., Malik M. and Asghar S. (2011). Study of genetic variability and correlation among various traits of F5 wheat (*Triticum aestivum* L.) populations. International Research Journal of Agricultural Science and Soil Science, 1(8): 344-348.

[13] Longove A M, Akbar F, Baqa S, Hidayatullah, Sher Azam (2014). Performance Evaluation of Different Wheat Varieties under Agro-Ecological Conditions of Quetta (Balochistan). Journal of Biology, Agriculture and Healthcare www.iiste.org. 4(8): 39-43.

[14] Najaphy A, Parchin A, Farshadfar E (2012). Comparison of phenotypic and molecular characterization of some important wheat cultivars and advanced breeding lines. Australian Journal of Crop Science, 6(2): 326-332.

[15] Obsa C (2014). Genetic Variability among Bread Wheat (*Triticum aestivum* L.) Genotypes for Growth Characters, Yield and Yield Components in Bore District, Oromia Regional State. MSc Thesis Postgraduate Program Directorate, Haramaya University, Ethiopia.

[16] Ozgen M (1991). Yield stability of winter wheat cultivars and lines. Journal of Agronomy. Crop Science, 166: 318-325.

[17] Parihar GN, Singh R (1995). Response of wheat (*Triticum aestivum* L.) genotypes to seed rate sowing method under western Rajasthan conditions. Indian Journal of Agronomy. 40(1): 97- 98.

[18] Piepho HP, Buchse A, Richter C (2004). A mixed modeling approach for randomized experiments with repeated measures. Journal of Agronomy Crop Science. 190: 230-247.

[19] Porfiri O, Torricelli R, Silveri DD, Papa R, Barcaccia G, Negri V (2001). The Triticeae genetic resources of central Italy. Collection, evaluation and conservation. Hereditas, 135: 187-192.

[20] Tewodros T, Tsige G, Tadesse D (2014). Genetic variability, heritability and genetic diversity of bread wheat (*Triticum aestivum* L.) genotype in Western Amhara region, Ethiopia. Wudpecker Journal of Agricultural Research, 3(1): 26 – 34.

[21] Vaughan JG, Judd PA (2003). The Oxford Book of Health Foods. Oxford University Press. Pp. 35.

[22] Voltas J, Lopez-Corcoles H, Borras G (2005). Use of biplot analysis and factorial regression for the investigation of superior genotypes in multi-environment trials. European Journal of Agronomy. 22: 309-324.

[23] Zarkti H, Ouabbou H, Hilali A, Udupa SM (2010). Detection of genetic diversity in Moroccan durum wheat accessions using agro morphological traits and microsatellite markers. Africa Journal of Agricultural Research, 5: 1837-1844.