

Participatory Varietal Selection of Bread Wheat Cultivars (Triticum Aestivum L.) for Moisture Stress Environment of Somali Regional State of Ethiopia

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Abstract
The centralized plant breeding techniques of the green revolution have yielded good results in the more favorable agricultural environments. However, most low-resource farmers in marginal areas have not benefited from these varieties. As an alternative to centralized breeding, farmer participatory approaches using participatory varietal selection (PVS) and participatory plant breeding (PPB) can be used. In participatory varietal selection, farmers are given a wide range of new cultivars to test for themselves in their own fields. Participatory variety selection (PVS) trials were conducted in 2015/16 growing season of Tulugule woreda of Somali region to evaluate and determine suitable high yielding varieties of bread wheat. Twenty improved varieties and one local check (local variety) were used for the study at two farmer villages: Tuluguled woreda of fafen zone. The experiment was laid out in a randomized complete block design and the trials were replicated three times. Data were collected on Days to maturity (DTM), Plant height (PH), Number of tillers (NT), Lodging index (%), Grain yield (GY), Biomass yield (BY) and Harvest index (HI). The results of analysis revealed that a non-significant difference among the varieties for most the agronomic traits recorded except for days to maturity, grain yield and harvest index which is significant. Variety Shorima, Pavon-76, Hoggana and Mekelle-3 gave the highest grain yield of all the test varieties respectively, while ETBW 5879, UTQUE96/3/PYN/BAU//MILLAN, Danda'a and Local variety (check) variety showed the smallest grain yield respectively. Grain yield had strong significant positive correlations with harvest index (HI, $r=0.89^{**}$) and grain yield per day (GYPD, $r=0.99^{**}$), but number of tillers (NT, r = -0.03 was negatively non-significantly correlated with grain yield. The results also revealed that farmers' preferences in some cases coincide with the researchers' selection. However, in general farmers have shown their own way of selecting a variety for their localities. These parameters include earliness, high yield, plant height, moisture stress tolerance, physical appearance, and tiller number. Hence, it is a paramount important to include farmers' preferences in a variety selection process. Therefore, based on objectively measured traits, farmers' preferred Pavon-76 with a rank of (1.95), followed by Ogolcho, Kakaba and Mekelle-3.
Keywords: participatory varietal selection, varieties, farmers' preference

1. Introduction

Wheat is believed to originate in southwestern Asia where it has been grown for more than 10 000 years. Related wild species still now grow in Lebanon, Syria, northern Israel, Iraq, and eastern Turkey (Poehlman and Sleper, 1995; Quisenberry, 1967; Peterson, 1965). The modern hexaploid bread wheat (T. aestivum L. em. Thell.) evolved later and became abundant about 8 000 years ago (Curtis, 2002).

Bread wheat (*Triticum aestivum* L.) is one of the most important small cereal crops widely produced in Ethiopia. It grows on 1.5 million ha with a total production of 3.78 million tons and ranks fourth both in area and production among cereal crops in different regions of Ethiopia (CSA, 2012). Smallholders are major producers and suppliers of bread wheat, accounting for more than 89% of the market supply (USAID, 2010). Wheat is one of a major cereal of choice in the country, due to its higher productivity, broader adaptation and input responsive high yielding improved varieties (Tarekenge *et al*., 1995). With global production of around 600 million metric tons, wheat gets the lion share (28.5%) of the cereal market. Its popularity comes from the versatility of its use in the production of a wide range of food products, such as the many kinds of breads, pastas, cookies, etc. (Pena, 2002). In addition it has high nutritive value (>10% protein, 2.4% lipid, and 79% carbohydrates) and it accounts for about 20% of the caloric intake of the human diet (Khanna, 1991; Gooding and Davies, 1997).

Wheat is harvested on a total of more than 6.7 million hectares; of these, about 2.6 million hectares (40%) are irrigated and about 4.1 million hectares (60%) are rain-fed (Jalal Kamali *et al*., 2012; Mohammadi and Karimizadeh, 2012). Drought stress, which has a great impact on agricultural production and causes yield reduction, is one of the most important tools for plant breeders to seek for high tolerance genotypes by using useful stress indices (Jamaati-e-Somarin and Zabihi-e-Mahmoodabad, 2012; Pirasteh-Anosheh *et al*., 2013). Selecting different genotypes under environmental stress conditions is one of the main tasks of plant breeders for exploiting the genetic variations to improve the stress tolerant cultivars (Talebi *et al*., 2009; Lopes *et al*., 2012).

In Somali regional state different farmers in different area are producing bread wheat varieties. However, the yield is low mainly due to moisture stress, cultivation of late maturing variety and old disease susceptible variety in most of the wheat growing areas and shifting of wheat cultivation to more marginal lands. In this situation, it is very important to increase wheat yield and production in the region through use of appropriate varieties. Wheat Research Centre (WRC) of Ethiopia Agricultural Research center (EARC) has released a lot of varieties developed by traditional breeding approach and many of those are better than the local varieties in yield and other characters under research managed conditions. But, those varieties are not being adopted by the farmers in a satisfactory rate, probably due to improper selection situation (on-station) that does not fit well with farmers' growing conditions, inadequate knowledge of the farmers about the varieties, lack of specifically adapted varieties and some other unknown causes.

Participatory Variety Selection (PVS) can effectively be used to identify farmer-acceptable varieties and thereby overcome the constraints that cause farmers to grow late maturing varieties which is susceptible to drought and old or obsolete varieties (Joshi & Witcombe, 1996; Witcombe et al., 1996). Moreover, participatory research increases the job efficiency of the scientists (Bellon, 2001) and farmers' knowledge that enables to be retained effectively from year to year (Grisley & Shamambo, 1993). Research costs can be reduced and adoption rates increased if farmers are allowed to participate in variety testing and selection (Joshi et al., 1995).

Achieving genetically higher yield under water limited conditions has been recognized to be a difficult challenge for plant breeders, while progress in grain yield has been much higher in favorable environments (Richards et al, 2002). Thus, drought indices, which provide a measure of drought based on yield loss under drought conditions, have been used for screening drought tolerant genotypes (Mitra, 2001). These indices are either based on drought resistance or susceptibility (Fernandez, 1992). Drought resistance is defined as the relative yield of a genotype, compared to other genotypes, subjected to the same drought stress (Hall, 1993; Pirasteh-Anosheh *et al*., 2013); whereas, drought susceptibility of a genotype is often measured as a function of the reduction in yield under drought stress conditions (Blum, 1988).

Recently, researchers in the entire world have conducted series of experiments on response of resistance wheat genotypes for drought and indicators of drought susceptibility genotypes. The response of these trials indicated an increase in wheat yields and net return to the farmers. As far as participatory variety selection of resistant wheat cultivar for water limited area and association among characters in bread wheat genotypes is concerned nothing has been done in Somali region of Ethiopia. Therefore, the present study were undertaken to overcome such limitations with the objective of;

- To involve farmers in selecting their preferable varieties according to their socio-economic needs.
- To select best resistant cultivars for limited water (water stress)
- To estimate the association among the traits and thereby compare the direct and indirect influence of the traits on grain yield

2. MATERIAL AND METHODS

The study was conducted at Tuluglud Woreda of Somali regional state of Ethiopia in 2015/16. The stations have an altitude of 500-1600 m above sea level, respectively. The mean annual rainfall of the areas is 500-600mm with erratic distribution having bimodal pattern increasing from April to August with peak rain section in April to July and the average mean Maximum and Minimum temperature of the area are 16 – 31 °C and 15 – 32 °C respectively. The location is characterized as arid to semi-arid agro-ecology, where crop cultivation is undertaken specially sorghum, wheat, maize and ground nuts. The soil is sandy loams that have the capacity to be grown cereal and other crops (Badel, 2012).

Systematic sampling methods were used to select farmers that are participating in selection methods and experimental studies. Participant farmers were select by discussing with DAs and woreda agricultural office. Sites were selecting by considering major wheat growing areas of fafan zone of Ethiopian Somali.

Farmers' need of variety was identified by participatory rural appraisal (PRA). A 2 member teams were formed from different disciplines, extension and NGO personnel, headed by the researchers. These teams were randomly selected 10 farmers irrespective of wealth, age above 18 years old and sex to collect base line information in relation to present situation, major constraints and future needs of bread wheat as well as agriculture of the area.

Cultivars were searched according to the needs of the farmers of study areas with some preferred characters, such as earliness, high yield, plant height, moisture stress tolerance, physical appearance, tiller number, etc. Depending on the farmers' preference and some of the characteristics which are important to the local peoples listed in the above was searched from Kulumsa Agricultural Center (KARC) (Table 1).

Table 9. List of experimental materials which was used for the PVS trail

Treatments	Variety Name	Year of release	Source Center
1	ETBW 5879	2014	Kulumsa
2	ETBW 6095	2014	Kulumsa
3	WORRAKATTA/PASTOR	2014	Sinana
4	UTQUE96/3/PYN/BAU//MILLAN	2014	Sinana
5	Hidasse	2012	Kulumsa
6	Ogolcho	2012	Kulumsa
7	Hoggana	2011	Kulumsa
8	Hulluka	2012	Kulumsa
9	Mekelle-3	2012	Mekelle
10	Mekelle-4	2012	Mekelle
11	Shorima	2011	Kulumsa
12	Kakaba	2010	Kulumsa
13	Danda'a	2010	Kulumsa
14	Gassay	2009	Adet
15	Alidoro	2007	Holetta
16	Tay	2005	Adet
17	Sofumar	1999	Sinana
18	Mada-Wolabu	1999	Sinana
19	Pavon-76	1982	Kulumsa
20	Jeferson	----	Kulumsa
21	Local variety (check)	-----	------

Researches were conduct as mother trials (MT) at on-station and farmers' fields, and baby trials (BT) at farmers' fields only. Experiments were conducted in 2015 growing season at Tulugled woreda and on-station site. There was MT with three replications at farmers' field and one MT at on-station with three replications. Each genotypes including the local variety as a check variety was tested in MT. Mother trials were designed by researchers and quantitative data was also taken by the researchers. However, the baby trials were evaluated by 15 farmers at physiological maturity, before physiological maturity and after harvest. Scoring was done for each character as well as for overall preference. Score was from 1 to 5, score 1 was for the best and 5 was for the worst genotype. Researchers and DAs personnel were assist farmers during scoring. The crop was grown with farmers' management at farmers' fields and under recommended management at on-station.

The experiments were conducted in randomized complete block design with three replications at Tuluglud woreda. Total plot size of 2m × 3m consisted of 10 rows per plot and net plot size of 2m × 2.8m with 8 harvestable rows were used. Distance of 20cm and 10cm was used between rows and plants, respectively. Seed rate of 150 kg/ha was used and sown by hand drilling at 20 cm row spacing. All experimental plots for MT were subjected to uniform recommended package of agronomic and plant protection practices to obtain a healthy plants.

Data were collected on Days to maturity (DTM) (days): the number of days from sowing to the date when 75% of the plants became yellow for each experimental unit was recorded, **Plant height (PH) (cm):** an average height of ten plants, tagged in each experimental plot before commencement of tillering was measured in centimeters from ground level to the tip of spike excluding owns, **Number of tillers (NT):** number of tiller in 1m – row length at a randomly taken position from each of randomly selected rows was recorded for each experimental unit and the average of the five observations was used for analysis, **Lodging index (%):** It was recorded using the method of Caldicott and Nuttall (1979). The angle of leaning was scored on a 0-5 scale where "0" stands for completely upright plants and "5" stands for completely lodged (flat on the ground) plants. The severity for each score was recorded as the percentage of the entire plot. Then, the lodging index was obtained as the average of the product sum of each degree of lodging and the corresponding severity percent, **Grain yield (GY) (kg):** Grain yielding/plot at 12.5% moisture content was recorded and converted to kg/hectare, **Biomass yield**: Above ground total biomass of all the plants in each plot was recorded at harvest after sun dried and attained constant weight, **Harvest index:** The ratio of grain yield per plot to biological yield per plot expressed in percent,

Biomass production rate (kg ha^{-1} day^{-1}) $= \dfrac{\text{above ground biomass yield } \left(\frac{kg}{ha}\right)}{\text{number of days to physiological maturity}}$

and **Grain yield per day (kg ha^{-1} day^{-1})** $= \dfrac{\text{Grain yield (kg/ha)}}{\text{number of days to physiological maturity}}$

Each entry was common in both at farmers' field and on-station. The data of those entries was analyzed by RCBD. Mean data of MT was subjected to analysis of variance using procedure of R-software (R Core Team, 2016). Analysis of variance was performing for each variant and each traits following standard procedure given by Gomez and Gomez (1984). Test of mean separation was employed depending on the significance of mean square of each trait using Duncan's Multiple Range Test (DMRT) at 1% and 5% probability level using R-software (R Core Team, 2016).

Baby trials data were analyzed using simple ranking method in accordance with the given value (De Boef and Thijssen, 2007). Survey data was compiled in Excel sheet. Adoption data of varieties was converted into percentage. Some survey data was analyzed by R- software (R Core Team, 2016). Pearson correlation coefficients among all characters using means of each variety were using R-software (R Core Team, 2016).

3. RESULT AND DISCUSSION

3.1. Mother Trials

Table 2 shows mean square-values of researchers' evaluation of agronomic trait for the varieties and error. Researchers evaluated the varieties based on yield and other agronomic traits. The varieties were revealed non-significant statistical variation in all agronomic traits recorded except days to maturity, grain yield and harvest index which is significant. This finding showed that though the varieties are replicated three times to make the research representative to the study area, they are not significantly different from each other for most of the traits. This indicates that all the varieties responded similarly for most of the traits except three of traits (days to maturity, grain yield and harvest index).

Grain yield, which is an important agronomic parameter, was significantly ($P \leq 0.05$) different for all genotypes. It indicating that the test varieties performed different, this might be due to the breeding effort to develop varieties that perform relatively well over wide range of environment for grain yield potential of bread wheat and varieties were tested for wide adaptation under many zones (locations). Mean grain yield of the bread wheat varieties represented in this study was 658.377 kg ha^{-1} at Tulugled (Table 3). Variety Shorima, Pavon-76, Hoggana and Mekelle-3 gave the highest grain yield of all the test varieties respectively, while ETBW 5879, UTQUE96/3/PYN/BAU//MILLAN, Danda'a and Local variety (check) variety showed the smallest grain yield respectively. However, Variety Shorima is not significantly different from Pavon-76, Hoggana and Mekelle-3.

Mean harvest index of the varieties was estimated to be about 30.24% (0.30). In line with this, high harvest index value (26.79) has been reported in sorghum Mihret (2012). Kebere *et al*. (2006) also found high harvest indices value of 0.57 in haricot bean. The varieties Shorima and Sofumar produced highest harvest index than all the other varieties. The varieties such as ETBW 5879 and UTQUE96/3/PYN/BAU//MILLAN showed lower harvest index than all the other varieties represented in the study (Table 3).

The mean of days to maturity of varieties was 100.16 days (Table 3). Variety Sofumar, Hidasse, Pavon-76 and Hulluka reached physiological maturity lately, although it was not significantly ($P \leq 0.01$) different from most of varieties except Ogolcho, UTQUE96/3/PYN/BAU//MILLAN, Jeferson and Tay. This study is in agreement with study of Fano *et al* (2016), and Yifru and Hailu (2005) reported significantly ($P \leq 0.05$) differences of tef varieties for day to heading and to maturity. Likewise, Mihret (2012) in sorghum and Abel *et al.* (2012) in tef reported significant differences among genotypes for both traits.

In present investigations biomass yield was found to be non-significant (Table 3). Though the varieties are not statistically significant, Jeferson had the highest biomass yield (2333 kg ha^{-1}), while Alidoro had the lowest grain yield (2037 kg ha^{-1}). The possible reason for the observed differences could be variation in their environmental variation.

Table 10. Mean square of yield and agronomic traits of bread wheat varieties planted at Tuluguled District of Fafen Zone Somali Region (2015/16)

SV.	DTM	PH	NT	LI	GY	BY	HI	BYR	GYPD
Variety (**20**)	16.82^{**}	93.3^{ns}	0.48^{ns}	0	32953^{*}	23457^{ns}	80.01^{*}	2.76^{ns}	2.55^{ns}
Error (**40**)	5.92	81.9	0.81	0	20534	25345	44.66	1.95	1.62
Mean	100.16	65.40	1.80	0	658.377	2203.70	30.24	19.86	5.92
CV	2.43	13.84	25.12	0	21.77	7.22	22.10	7.03	21.54

ns = non-significant, *-Significant at 5%, **- Significant at 1%. (SV. = source of variation, DTM = days to maturity, PH = plant height, NT = number of tillers, LI = lodging index, GY =grain yield, BY = biomass yield, HI = harvest index, BYR = Biomass production rate, GYPD = Grain yield per day).

Table 11: Mean grain yield and agronomic data of bread wheat varieties tested at Tulugled Woreda

Varieties	**DTM**	**GY**	**HI**
ETBW 5879	98[cde]	468.5[d]	20.81[d]
ETBW 6095	100[abcde]	659.3[abcd]	30.59[abcd]
WORRAKATTA/PASTOR	98.33[bcde]	722.2[abcd]	32.2[abcd]
UTQUE96/3/PYN/BAU//MILLAN	97.33[e]	479.6[d]	21.46[d]
Hidasse	104[a]	707.4[abcd]	30.43[abcd]
Ogolcho	97.33[e]	711.1[abcd]	33.09[abcd]
Hoggana	98cd[e]	788.9[abc]	35.5[abc]
Hulluka	103[ab]	638.9[abcd]	28.75[bcd]
Mekelle-3	100.7[abcde]	731.5[abcd]	32.96[abcd]
Mekelle-4	98[cde]	683.3[abcd]	31.19[abcd]
Shorima	100[abcde]	885.2[a]	42.11[a]
Kakaba	100.3[abcde]	609.3[abcd]	29.58[abcd]
Danda'a	102[abcde]	503.7[cd]	22.3[cd]
Gassay	102.3[abcd]	625.9[abcd]	27.27[bcd]
Alidoro	100.3[abcde]	666.7[abcd]	33.33[abcd]
Tay	97.67[de]	622.2[abcd]	29.09[abcd]
Sofumar	104.3[a]	724.1[abcd]	36.46[ab]
Mada-Wolabu	102.7[abc]	648.2[abcd]	30.24[abcd]
Pavon-76	103[ab]	796.3[ab]	35.04[abc]
Jeferson	97.67[de]	609.3[abcd]	26.3[bcd]
Local variety (check)	98.33[bcde]	544.4[bcd]	26.27[bcd]
Mean	100.16	592.54	30.24
CV (100%)	2.43	21.77	22.10

DTM = days to maturity, GY = grain yield (kg), HI = harvest index. Means with the same letter within the same column are not significantly different.

3.1.1. Correlations of the Traits

Grain yield is the most complex trait and it is influenced by genetic and environmental factors that determine productivity of the cultivars. Therefore, understanding of inter-relationships of grain yield and other traits are highly important for formulating selection criteria. The Pearson correlation coefficients among the characters are presented in Table 4. Grain yield had strong significant positive correlations with harvest index (HI, r=0.89**) and grain yield per day (GYPD, r=0.99**), but number of tillers (NT, r = -0.03 was negatively non-significantly correlated with grain yield. Biomass yield and biomass yield per day was positively non-significantly correlated with grain yield. These indicated that the yield increase is attributed to increased harvest index and grain yield per day. These characters contributed positively towards total variation in yield, and should be considered when selecting for high grain yield in drought prone areas. The negative associations of grain yield with tiller number per plant showed that reduced number of tillers in drought prone environments could increase yield, but it is not significant.

Under late moisture deficit conditions, grain yields were positively associated with genotypes that matured early following a short grain filling period and short stature (Van Ginke *et al*, 1998). This statement agrees with the present findings that grain yield was negatively associated with days to maturity and number of tillers. Therefore longer cycle and varieties with profuse tillers had lower grain yield. Earliness is a very important character under low-rainfall conditions. The trait having the most dominant effect on fitting a plant to its environment for maximum productivity is the appropriate phenological development.

Biomass yield is the second important character for animal feed sspecially for agro-pastoralist was positive significantly associations with plant height (PH, r = 0.87**), biomass yield rate (BYR, r = 0.97**). It was positive non-significantly associated with grain yield and grain yield per day and it was negative significantly association with day to maturity (DTM, r = -0.4**) and harvest index (HI, r = -0.39*) explained that varieties which matured early and have less ratio of grain yield to biological yield at drought prone areas have high biomass yield.

Table 12. Correlations among the Characters of Bread Wheat (*Triticum Aestivum* L.)

	DTM	PH	NT	LI	GY	BY	HI	BYR	GYPD
DTM	1								
PH	-0.44**	1							
NT	-0.04	-0.14	1						
LI	0	0	0	1					
GY	-0.14	0	-0.03	0	1				
BY	-0.4**	0.87**	-0.17	0	0.07	1			
HI	0.31	-0.39**	0.06	0	0.89**	-0.39**	1		
BYR	-0.6**	0.87**	-0.13	0	0.02	0.97**	-0.42**	1	
GYPD	-0.01	0.08	-0.03	0	0.99**	0.13	0.85**	0.11	1

DTM = days to maturity, PH = plant height, NT = number of tillers, LI = lodging index, GY =grain yield, BY = biomass yield, HI = harvest index, BYR = Biomass production rate, GYPD = Grain yield per day).

3.2. Farmers' Evaluation

The farmers who participated and evaluated the trial were representative to the area and having long experience in farming. Before beginning of the selection process, selected farmers from the villages were asked to set their priority selection criteria. Accordingly, earliness, high yield, plant height, moisture stress tolerance, physical appearance, and tiller number were identified as the most important farmers' selection criteria. Ranking of varieties were done on a scale of 1-5, 1 being very good and 5 being very poor.

Table 5 showed farmers evaluation of the varieties based on the criteria they set. Farmers varietal assessment showed that variety Pavon-76 was ranked highest (1.95), followed by Ogolcho, Kakaba, Mekelle-3 and Mekelle-4 with values of 2.25, 2.50, 2.67 and 2.67 respectively. While, Mada-Wolabu was ranked lowest (4.67), followed by the Local variety (check), Shorima, ETBW 6095, and Gassay with values of 4.50, 4.50, 4.42 and 4.33 respectively. Variety with best score indicates preferred varieties by the local community using the common criteria. Based on this Pavon-76 is the best and preferred by tuluguled woreda farmers. Mada-Wolabu was preferred by only few farmers according to the validated common criterias.

Table 13: Farmers Varietal Assessment Result in Tulugled district

Variety	Criteria								
	Earliness	Yield	Dry-Tolerance	Height	Tiller Number	appearance	Overall score	Average score	Rank
ETBW 5879	5	2	5	4	5	4	25	4.17	15
ETBW 6095	4	5	3.5	4	5	5	26.5	4.42	18
WORRAKATTA/PASTOR	2	2	3	4	5	3	19	3.17	8
UTQUE96/3/PYN/BAU//MILLAN	5	4	3	3.67	5	4	24.67	4.11	13
Hidasse	5	4	3	4	3	4	23	3.83	11
Ogolcho	1	1.5	4	3	3	1	13.5	2.25	2
Hoggana	5	5	4	5	4	3	26	4.33	16
Hulluka	4	1.5	3	4	5	4	21.5	3.58	10
Mekelle-3	1	1	3	3	4	4	16	2.67	4
Mekelle-4	1	2	3	3	3	4	16	2.67	5
Shorima	4	5	4	5	5	4	27	4.50	19
Kakaba	1	2	4	4	3	1	15	2.50	3
Danda'a	1	2	4	3	3	4	17	2.83	6
Gassay	4	5	4	4	5	4	26	4.33	17
Alidoro	1.5	1	4	4	4	3.5	18	3.00	7
Tay	4	3	3	4	3	4	21	3.50	9
Sofumar	5		5	5	5	4	24	4.00	12
Mada-Wolabu	4	4	5	5	5	5	28	4.67	21
Pavon-76	1.67	2	1	1	1	5	11.67	1.95	1
Jeferson	4	1.67	4	5	5	5	24.67	4.11	14
Local variety (check)	2	5	5	5	5	5	27	4.50	20

It is clear that the thirteen participant farmers did have a different preference on the varietal selection. Criteria were set by the participant farmers to evaluate the twenty one experimental materials in the field experiment. Figure 1 and 2 indicates that the average value and their ranks of varieties. Variety that scored smallest value is the best. While varieties with the highest value is the poorest as stated in the methodology part. Accordingly variety Pavon-76, Ogolcho and Kakaba were scored and ranked lowest value that meant they were highly preferred by the participant farmers respectively. Whereas, Variety Mada-Wolabu, local variety (check) and Shorima were scored and ranked highest value, that did not preferred by the participant farmers respectively.

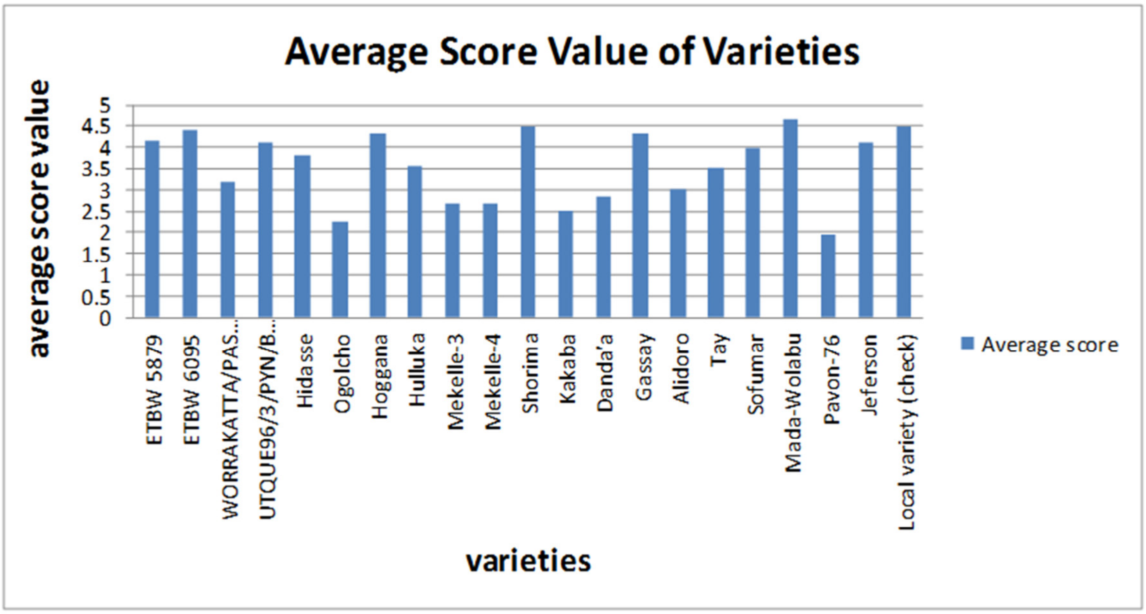

Figure 1. Histogram of varieties with average score values

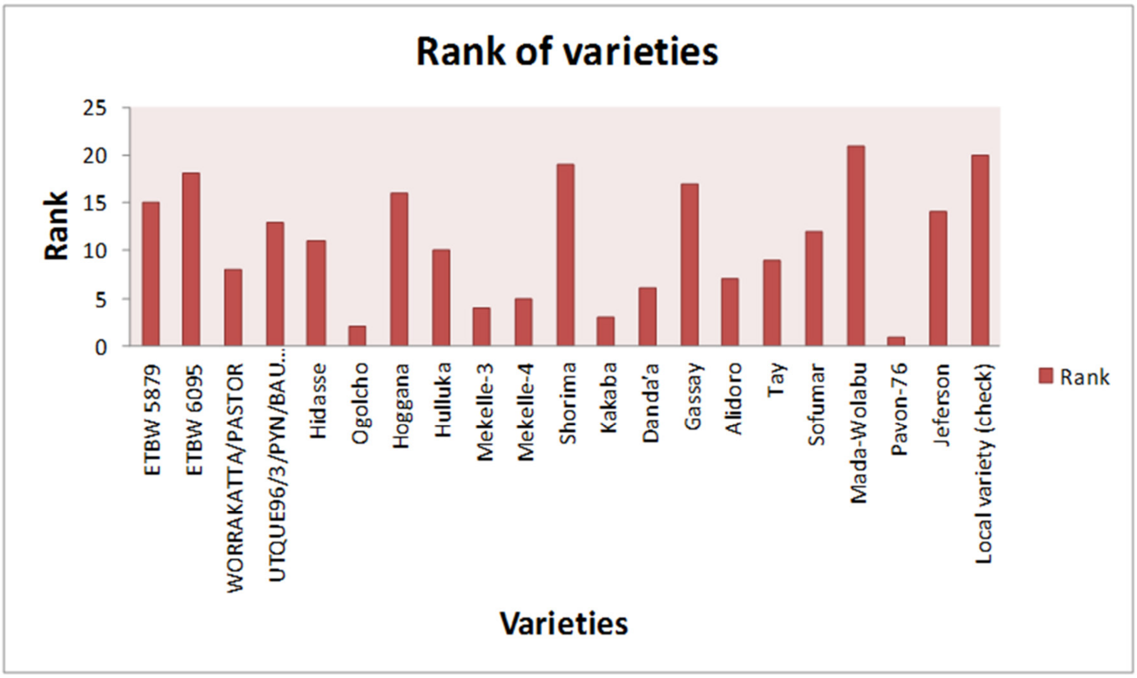

Figure 2. Histogram of varieties with their ranks

4. CONCLUSION AND RECOMMENDATION

Using improved varieties of bread wheat could make an important contribution to increase agricultural production and productivity in areas like Ethiopia Somali region where there is erratic and short rain fall, and low practice of using improved technologies such as improved crop varieties. Most low-resource farmers in marginal areas have not benefited from these varieties. As an alternative to centralized breeding, farmer participatory approaches using participatory varietal selection (PVS) and participatory plant breeding (PPB) can be used. In participatory varietal selection, farmers are given a wide range of new cultivars to test for themselves in their own fields.

To this end, use of improved bread wheat technologies such as improved varieties could be one of the alternatives to improve productivity by small farmers. However, evaluation of improved bread wheat varieties using Participatory variety selection (PVS) is not yet studied in the area. Thus, this research work is initiated to investigate the impact of including improved bread wheat varieties on the existing production system is of paramount important.

Study on bread wheat variety was conducted at Tulugule and Jigjiga woreda of Somali region under rain fed conditions in 2015/16. The objective of the study was to evaluate and determine suitable high yielding varieties of bread wheat for Ethiopian Somali region that will improve bread wheat production and productivity in the target area. The experiment was carried out using the randomized complete block design (RCBD) with three replications at Tulugule and Jigjiga woreda in 2015/16. During the field implementation, twenty improved bread wheat varieties and one local check were used. According to the results of analysis of variance, most of the agronomic traits were revealed non-significant statistical variation except days to maturity, grain yield and harvest index which is significant. This indicates that all the varieties responded similarly for the agronomic traits. Variety Shorima, Pavon-76, Hoggana and Mekelle-3 gave the highest grain yield of all the test varieties respectively, while ETBW 5879, UTQUE96/3/PYN/BAU//MILLAN, Danda'a and Local variety (check) variety showed the smallest grain yield respectively. Grain yield had strong significant positive correlations with harvest index (HI, $r=0.89^{**}$) and grain yield per day (GYPD, $r=0.99^{**}$), but number of tillers (NT, r = -0.03 was negatively non-significantly correlated with grain yield. The results also revealed that farmers' preferences in some cases coincide with the researchers' selection. However, in general farmers have shown their own way of selecting a variety for their localities. These parameters include earliness, high yield, plant height, moisture stress tolerance, physical appearance, and tiller number. Hence, it is a paramount important to include farmers' preferences in a variety selection process. Therefore, based on objectively measured traits, farmers' preferred Pavon-76 with a rank of (1.95), followed by Ogolcho, Kakaba and Mekelle-3. Therefore, it can be concluded that use of the improved bread wheat varieties such as Shorima, Pavon-76, Ogolcho, Kakaba and Mekelle-3 is advisable and could be appropriate for sorghum production in the test area even though further testing is required to put the recommendation on a strong basis.

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