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Evaluation of Sorghum (Sorghum bicolor (L.) Moench) Varieties, for Yield and Yield Components at Sorrobo, Southern Ethiopia

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Abstract
A field experiment involving seven improved sorghum [Sorghum bicolor (L.) Moench] varieties and one local check was carried out at sorobo farmers' training center during the 2015 main cropping season to identify the best performing variety to the lowlands of segen areas people zone at konso woreda. The sorghum varieties included in the field experiment were seven improved (Melkam, Seredo, Meko-1, 76TI#23, Teshale, Gubiye, Dekeba) and a local check. The experimental design was a randomized complete block design (RCBD) with three replications. Phenological and growth parameters such as yield and yield components, total biomass and harvest index were studied. The result showed that all phenological and growth parameters were significantly affected by variety except number of tillers and panicle length per plant. There was a proportional increment on the number of tillers per plant observed for the improved sorghum varieties over the local check. Grain yield, total biomass, 1000 seeds weight and harvest index were significantly affected by variety. Grain yield advantages of 75.28%, 50.74% and 50.37% were obtained from the improved sorghum varieties melkam Teshale and 76T1#23, respectively over the local check. The highest grain yields of (2.67 t ha^{-1}) and (1.34 t ha^{-1}) were recorded for the varieties Melkam and Teshale, respectively. Therefore, it can be concluded that use of the improved sorghum varieties such as Melkam or Teshale 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.
Keywords: Growth Parameters, Phenological Parameters, Sorghum Variety, Yield Components, Yield.

1. Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is a viable food grain for many of the World's most food insecure people who live in marginal areas with poor and erratic rains and often poor soils [1] It is the fifth most important cereal crop in the world [2, 3]. Sorghum is cultivated in wide geographic areas in the Americas, Africa, Asia and the Pacific. It is the third important cereal (after rice and wheat) in India. It is the second major crop (after maize) across all agro ecologies in Africa. Sorghum is a major cereal crop in arid and semi-arid areas of the world. It is a staple crop of semiarid sub-Saharan Africa. In West Africa, farmers grow mainly guinea race landraces that are especially adapted to the harsh and unpredictable conditions of the sub-Sahelian zone [4]. In West Africa, especially in Burkina Faso, it is the staple crop and produced in low-input cropping systems [5]. Sorghum is a major food and nutritional security crop to more than 100 million people in Eastern horn of Africa, owing to its resilience to drought and other production constrains [6]. It is a staple food crop on which the lives of millions of poor Ethiopians depend. It has tremendous uses for the Ethiopian farmer and no part of this plant is ignored [7]. Besides being a major source of staple food for humans, it serves as an important source of feed and fodder for animals. Sorghum exhibits a wide geographic and climatic adaptation. It also requires less water than most cereals; hence it offers great potential for supplementing food and feed resources [8]. Sorghum grows in a wide range of agro ecologies most importantly in the moisture stressed parts where other crops can least survive and food insecurity is rampant [7].

Sorghum is one of the leading traditional food crops in Ethiopia comprising 15-20% of the total cereal production in the country [9, 10]. It is the fourth most important food crop after maize, wheat and Tef and also the most important in the drier parts of the country [1]. Ethiopian national average yield was 1.302 t ha-1 [11]; whereas, the world average yield was 2.3 t ha-1 [12]. The low productivity of sorghum in Ethiopia could be attributed to biotic and edaphic factors affecting directly and indirectly sorghum production. Sorghum is becoming a high potential crop in Southern region in general and segen area people zone in particular. It is the dominant crop in the low land areas of Southern Ethiopia, especially Segen people Zone and South Omo Zone. Sorghum production is increasing in Segen people Zone of Southern Ethiopia, but there are a number of production constraints with this crop. Even though, the crop is important in the target area, a number of factors constrained productivity of sorghum in the target areas. This is associated with the lack of improved varieties associated with edaphic and biotic factors that have been appreciated as one of the primary sources of lower sorghum production in the target areas. There had no trend of using improved of sorghum varieties in the existing production system, so that it was the bottle neck problem in the study area. Hence; there is need to

introduce improved sorghum varieties to the target area is crucial for sorghum production and productivity. Therefore, this study is aimed at and initiated with the objective of selecting the best performing sorghum varieties to the target area.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was conducted at sorrobo farmer's training center at konso woreda.it is located at 036o 40.259' E longitude and 05o 38.332' N latitude and at an altitude of 1208 meters above sea level (masl). Geographically, sorobo is situated in South Ethiopia at about 597 kms from the capital Addis Ababa. The long term weather data of the area revealed that the mean annual rainfall of the area is 69.54 mm with a range of 42.55 to 125.76 mm. The experiment was conducted during the main cropping season (March to July, 2015) under rain fed conditions.

2.2. Treatments and Experimental Design

The experiment was executed by using seven improved sorghum varieties and one local check. The field experiment was laid out in a randomized complete block design (RCBD) with three replications. Sorghum was sown on March 23, 2015 in four rows per plot with spacing of 75 cm between rows and 15 cm between plants with in a row with gross plot area of 15 m2.

2.3. Data Collection

2.3.1. Phenological Parameters

Phenological parameters such as days to emergence, days to heading and days to maturity were recorded. Days to emergence was recorded when 50% the plants per plot emerged while days to heading was recorded by counting the number of days after emergence when 50% of the plants per plot had the first open flower. Days to maturity were recorded when 90% of heads per plot had mature.

2.3.2. Growth Parameters

At mid flowering stages five plants from each of the plots were selected randomly and uprooted carefully to determine crop growth parameters such as plant height and number of tillers.

2.3.3. Grain Yield, Yield Components, Total Biomass and Harvest Index

Two central rows (5 m x 1.5 m = 7.5 m2) were harvested for determination of grain yield. Grain yield was adjusted to 12.5% moisture content. Five plants were randomly selected from the two central rows to determine yield and yield components, which consisted of number of tillers per plant and thousand seeds weight. Seed weight was determined by taking a random sample of 1000 seeds and adjusted them to 12.5% moisture content. Total biomass yield was measured from the two middle rows when the plant reached at harvest maturity. Harvest index was calculated as the ratio of seed yield to total above ground biomass yield.

2.4. Statistical Analysis

Analysis of variance was performed using the GLM procedure of SAS Statistical Software Version 9.1 [13]. Effects were considered significant in all statistical calculations if the P-values were < 0.05. Means were separated using Fisher's Least Significant Difference (LSD) test.

3. Results and Discussion

According to the result of analysis of variance for mean squares, days to heading was significantly (P<0.001) influenced by varieties whereas; days to maturity and plant height were significantly (P< 0.001) affected by varieties (Table 1). Similar result was reported by the previous work [14]. On the other hand; number of tillers per plant and panicle lengths of sorghum was not significantly affected by varieties (Table 1). Though no significant variations observed for tiller number per plant, but there was relatively highest tiller number per plant recorded for the improved varieties Teshale, melkam and Seredo, respectively than the local check (Table 2). The maximum number of tillers per plant (3), (2.766) and (2.667) were recorded for the improved varieties Teshale, melkam, Seredo, respectively. While; the minimum number of tillers per plant of (2.333) was noted for the local check (Table 2). In this result it was noted that, the improved sorghum varieties were the capacity to produce more tillers than the local check.

The result of analysis of variance for mean squares revealed that there was a significant variation observed among the sorghum varieties for grain yield (Table 3). This finding is in line with the findings of previous work [14]. Total biomass weight of sorghum was significantly (P < 0.01) affected by varieties. Also 1000 seeds weight was significantly (P < 0.001) influenced by varieties (Table 3). The result also showed that there was a significant variation noted among the sorghum varieties for harvest index (Table 3). The maximum 1000 seeds weights of (28.70gm), (27.667 gm) and (27.000 gm) were recorded for the Improved sorghum varieties Melkam, Teshale and Meko, respectively and the minimum 1000 seeds weight of (20.333 gm) was recorded for the local check (Table 4). The maximum grain yields of (**2.67** t ha^{-1}),(**1.34** t ha^{-1} and (1.33 t ha^{-1})

were recorded for the sorghum varieties Melkam,Teshale and 76T1#23 respectively and the minimum grain yield of (**0.66** t ha^{-1}) was noted for the local check (Table 4). Grain yield advantages of 75.28%,50.74% and 50.37% were obtained from the improved sorghum varieties Melkam Teshale and 76T1#23, respectively over the local check in this study. The grain yield advantage obtained from the improved sorghum varieties is related with the increased number yield attributing parameters such as 1000 seeds weight and productive tillers. From the above findings it could be suggested that use of the improved sorghum varieties had brought a proportional yield increment than the local check. The maximum biomass yields of (27.333 t ha-1), (24.000 t ha^{-1}) and (22.333 t ha^{-1}) were noted from the improved sorghum varieties Melkam,Teshale and Gubiye, respectively and minimum biomass yield of (9.00 t ha^{-1}) was recorded from the local check (Table 4). There was also biomass yield advantages of 67.07% and 62.5% and 59.7% were obtained from the improved sorghum varieties Melkam,Teshale and Gubiye, respectively over the local check. The biomass yield advantage observed in this study might be attributed by the enhanced tiller number from the improved sorghum varieties than the local check.

Table: 1 *Mean Square Values for Crop Phenology and Growth Parameters of Sorghum at sorrobo in 2015.*

Source	DF	Days to heading	Days to maturity	Tiller number/plant	Plant height (cm)	Panicle Length(cm)
Replication (R)	2	9.0416667ns	294.125000ns	1.7917*	411.16667	. 1.98ns
Variety(VAR)	7	22.4226190ns	387.300714**	0.5476ns	1714.9940	5.98ns
Error	14	22.279761	123.696429	0.4583	733.26190	9.62

*, ** and *** indicate significance at P< 0.05, P< 0.01 and P< 0.001, respectively and 'ns' indicate non significant.

Table 2. *Crop Phenology and Growth Parameters of Sorghum as Affected By Variety at sorrobo in 2015*

Treatments	**Days to heading**	**Days to maturity**	**Tiller number (plant-1)**	**Plant height (cm)**	**Panicle Length (cm)**
varieties					
Melkam	62.333ba	159.933bc	2.766a	134.67bc	21.867a
Teshale	59.000ba	158.933bc	3.000a	147.00bac	20.600a
Seredo	65.000a	162.267bc	2.667a	162.67ba	18.467a
Gubiye	63.000ba	162.933bc	2.000a	113.33c	20.467a
Dekeba	62.000ba	147.600c	2.333a	153.33bac	17.867a
Meko	60.333ba	166.867bc	2.000a	144.00bc	19.000a
Local	60.667ba	187.400a	2.333a	192.67a	18.867a
76T1#23	56.000b	169.867ba	2.000a	128.67bc	18.000a
LSD 0.05	8.266	19.477	NS	47.421	NS
CV (%)	7.732660	6.762055	28.01	18.41574	16.00

Note: Means with the same letters within the columns are not significantly different at P < 0.05

Table 3. *Mean Square Values for Yield and Yield Components and Total Biomass in Sorghum at sorrobo, in 2015.*

Source	**DF**	**Grain Yield (t ha-1)**	**1000 Seeds Wt (gm)**	**Total Biomass (t ha-1)**	**Harvest Index**
Replication (R)	2	0.04166667ns	1.1754*	34.125ns	0.00189ns
Varieties (Var)	7	3.08928571***	24.2742***	109.5952**	0.01309*
Error	14	0.08928571	0.3135	20.2202	0.00448

*, ** and *** indicate significance at P< 0.05, P< 0.01 and P< 0.001, respectively and 'ns' indicate non significant.

Table :4 *Yield and Yield Components of Sorghum as Affected By Variety at sorrobo in 2015.*

Treatments	Grain Yield (t ha^{-1})	1000 seeds Weight (gm)	Total Biomass Weight (t ha^{-1})	Harvest Index
varieties				
Melkam	2.67a	28.70a	27.333a	0.22065a
Teshale	1.34b	27.667b	24.000ab	0.20477ab
Seredo	0.88c	24.00c	18.667bcd	0.14234abc
Gubiye	0.67c	24.667c	22.333abc	0.16032ab
Dekeba	0.67c	25.000c	13.333de	0.08611bc
Meko	0.88c	27.000b	15.333cde	0.06851c
Local	0.66c	20.333e	9.000e	0.03175c
76T1#23	1.33b	22.00d	16.000bcde	0.14949abc
LSD 0.05	0.5233	0.9805	7.8747	0.1173
CV (%)	17.49115	2.24	24.63	7.09

Note: Means with the same letters within the columns are not significantly different at P <0.05.

4. Summary and Conclusion

Using improved varieties of sorghum could make an important contribution to increase agricultural production and productivity in areas like sorrobo where there is low practice of using improved technologies such as improved crop varieties. To this end, use of improved sorghum technologies such as improved varieties could be one of the alternatives to improve productivity by small farmers. However, the use of improved sorghum varieties is not yet studied in the area. Thus, this research work is initiated to investigate the impact of including improved sorghum varieties on the existing production system is of paramount important.

Study on sorghum variety was conducted at sorrobo under rain fed conditions in 2015. The objective of the study was to determine the best performing sorghum variety that will improve sorghum production and productivity in the target area. The experiment was carried out using the randomized complete block design (RCBD) with three replications at sorrobo in 2015. During the field implementation, seven improved sorghum varieties and one local check were used. According to the results of analysis of variance, all the phenological and growth parameters were significantly affected by varieties except number of tillers and panicle length per plant. The maximum number of tillers per plant was noted for the improved sorghum varieties. All the yield and yield components studied in this experiment such as grain yield,1000 seeds weight, and total biomass weight and harvest index were significantly affected by varieties. The highest grain yields of (2.67 t ha^{-1}) and (1.34 t ha^{-1}) were recorded for the sorghum varieties Melkam andTeshale, respectively. Therefore, it can be concluded that use of the improved sorghum varieties such as Melkam or Teshale 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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References

[1] AATF [African Agricultural Technology Foundation]. 2011. Feasibility Study on Striga Control in Sorghum Nirobi,African Agricultural Technology Foundation. ISBN 9966- 775-12-9.
[2] FAO. 2005. FAO STAT statistical data base for Agriculture.
[3] FAO. (1998). Seed Policy And Programmes For Sub Saharan Africa : Proceedings Of The Regional Technical Meetings On Seed Policy And Programmes For Sub Saharan Africa, Abidjan, Cote Devoire 23-27 November, 1998, Rome, Italy: The FAO
[4] Lacy, S.M., Cleveland, D.A., Soleri, D., 2006. Farmer choice of sorghum varieties in southern Mali. Hum. Ecol. 34, 331–353
[5] Kirsten vom Brockea,, Gilles Trouche, Eva Weltzien, Clarisse P. Barro-Kondombo, Eric Gozé, Jacques Chantereau. 2010. Participatory variety development for sorghum in Burkina Faso: Farmers' selection and farmers' criteria. Field Crops Research 119 (2010) 183–194
[6] Gudu S, E.O. Ouma, A.O. Onkware, E.J. Too, B.A. Were, J.O. Ochuodho, C.O. Othieno, J.R. .Okalebo, J. Agalo and S.M. 2013. Preliminary Participatory On-farm Sorghum Variety Selection for Tolerance to drought, Soil Acidity and Striga in Western Kenya. Maina Moi University, Kenya First Bio-Innovate Regional Scientific Conference United Nations Conference Centre (UNCC-ECA) Addis Ababa, Ethiopia.
[7] Adugna Asfaw. 2007. The role of introduced sorghum and millets in Ethiopian agriculture Melkassa

Agricultural Research Center, Nazareth, Ethiopia. SAT eJournal ejournal.icrisat.org Volume 3 Issue 1
[8] KARI (Kenya Agricultural Research Institute). 2000. Proceedings of the 7th KARI Biennial Scientific Conference.
[9] Central Statistics Authority (CSA). 2000. Agricultural sample survey 1999/2000. Report on area and production for major crops (private peasant holdings, main season). *Statistical Bulletin No. 227*. Addis Ababa, Ethiopia.
[10] Wortmann, C.S., Martha Mamo,Girma Abebe, Kaizzi, K., Mburu, C., Letayo, E & Xerinda, S.2006. An atlas of sorghum production in eastern Africa. *http://intsormil.org*. Accessed 15 June 2010.
[11] CSA (Central Statistical Authority) (Federal Democratic Republic of Ethiopia), 2005. Agricultural Sample Survey. Volume IV. Report on land utilization.
[12] Benti, T. 1993. The need and objective of the first national maize workshop. In: T. Benti and J. Ranson (eds.), Proceedings of the first national maize workshop of Ethiopia. 5-7 May 1992, IAR/CIMMYT, Addis Abeba, Ethiopia. 1- 5pp.
[13] SAS (2007) Statistical Analysis Systems SAS/STAT user's guide Version 9.1 Cary NC: SAS Institute Inc. USA
[14] Hussain Nazir , Mohammad Safdar Baloch, Muhammad Yousaf Muhammad Naeem,Abdul Aziz Khakwani and Irshad Begum. 2011. Performance of Sorghum Varieties in Potohar Region. *Gomal University Journal of Research, 27(2). December 2011.*