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Adaptability of Durum Wheat Varieties at Mid-Altitude Areas of Central Ethiopia

Solomon Shibeshi[1*]
[1]Sidama Region Agricultural Research Institute, Hawassa Agricultural Research Center, Hawassa, Ethiopia

Abstract: Ethiopia's wheat productivity is rising annually as a result of the government's concentration on wheat production. However, a number of issues, chief among them the absence of better adapted varieties for particular regions, impede crop yield. The purpose of this experiment was to determine which durum wheat varieties in the research area performed the best. Using a randomized complete block design with four replications, the experiment was conducted in the Meskan woreda Misrak Meskan kebele in the central Ethiopian for two years in a row (2014 and 2015E.C). Eight improved durum wheat varieties were used in the experimental treatment. The Combined analysis of variance showed significant *(P<0.05)* difference among tested varieties on the agronomic traits considered indicating the presence of adequate variability. Mangudo variety produced the highest (5399.4 kg/ha) average grain yield, while the Utuba variety recorded the lowest (3559.6 kg/ha). Plant height, number of seed spike^{-1}, and biomass all showed significant positive relationships (P<0.01) with grain yield.

Keywords: Durum Wheat, Grain Yield, Genetic Variability, Variety.

Research Paper

***Corresponding Author:**
Solomon Shibeshi
Sidama Region Agricultural Research Institute, Hawassa Agricultural Research Center, Hawassa, Ethiopia

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1. INTRODUCTION

Smallholder farmers have historically grown durum wheat on the heavy black clay soils of the highlands at elevations between 1800 and 2800 meters above sea level and with rainfall distributions ranging from 600 to 1200 mm annually in central, northwest, and northeastern Ethiopia (Zemede, 2019; Kamil, 2020). Durum wheat makes up only 8% of the world's total wheat producing regions. The Mediterranean region is where about 75% of it is grown (Tidiane *et al*., 2019; Ceglar *et al*., 2021). Ethiopia is the major producer of wheat in sub-Saharan African (SSA) countries (Wuletaw *et al*., 2019). Rain-fed production systems are used to grow both durum and bread wheat in Ethiopia and form the total wheat cultivated areas of 1,605,654 only 561,979 hectares of land is covered by durum wheat (Tadesse *et al.,* 2022). The productivity of durum wheat in Ethiopia is less than 2.2 t/ha (Temtme *et al.,* 2018).

Durum wheat is mostly grown in Ethiopia's highlands where it was introduced 5000 years ago. Today, due to shifting rainfall and increasing temperature, the cultivation of durum wheat requires greater diversity of traits, which would, in turn, provide options for adaptation to new conditions. Durum wheat generally including various shapes and sizes of spaghetti, macaroni, flat or corrugated sheets, used in lasagna, nodules, and other pasta shapes. Other products produced from durum wheat in Ethiopia include 'injera' (thin bread),'dabo' (Ethiopian bread), 'Dabo-kolo' (ground and seasoned dough shape and deep-fried), 'genfo' (Ethiopian porridge), 'kinche' (crushed kernel, very similar with couscous),' Nifro' (boiled whole grain sometimes mixed with pulses),' kolo' (roasted grain), and other food types and local beverages. The straw is mainly used as a source of animal feed. Lack of improved durum wheat varieties is a major factor limiting durum wheat production in Ethiopia. Limited access to improved varieties, Farmers have low adoption of durum wheat technologies due to a lack of high-yielding varieties and difficulty accessing them. The national seed system is unable to reach more areas. Thus, this research was conducted with the aim of evaluating the performance of durum wheat varieties at mid-altitude areas under rain-fed production system.

2. MATERIALS AND METHODS

2.1 Plant Materials and Experimental Designs

Eight durum wheat varieties obtained from Debrziet and Sinana gricultural research center were evaluated for the experiment (Table 1). The varieties were grown in a randomized complete block design with three replications. Plot size was 3m^2, 6 rows with 2.5 m long, and 1.2 cm between rows. Where 4 rows harvested to estimate grain per plot and then converted to kg ha^{-1}.

At harvest, grain yield and other yield parameters were determined for each genotype.

The seed was drilled by hand at a seed rate of 125 kg/ ha which is equivalent to 45gm/3m^2 and planting depth was ~5cm. planting carried out at appropriate planting time. Fertilizer was applied per recommendation equally for each variety uniformly.

Table 1: Durum Wheat varieties used in the study

No	Variety	Year of release	Altitude	Yield, kg/ha	Maintaining Center
1	Almetena	2016	1600-2200	3000-5000	DZARC
2	ET-Cross 21	2021	1800-2600	4000-5000	DZARC
3	Mangudo	2012	1800-2650	5000-6000	SARC
4	Quamy	1996	1800-2600	3000-5000	DZARC
5	Tesfaye	2017	1800-2800	5000-5500	DZARC
6	Ude	2002	1800-2650	3000-5500	DZARC
7	Utuba	2015	1850-2650	4000-6500	SARC
8	Yerer	2002	1800-2650	3000-5000	DZARC

2.2 Description of Experimental Sites

The experiment was conducted at Misrak Gurage Zone meskan woreda misrak meskan kebele in 2014 and 2015 cropping season for two years. The altitude range of the study area was 1820m asl. The soil type of the study is sandy loam soil with ph of 7.2.

2.3 Statistical Analysis

A significance test was adopted by analysis of variance (ANOVA) for Randomized Complete Block Design. The ANOVA was carried out using the General Linear Model of the SAS Version 9.4 procedure. For factors showing significant effects, mean comparisons were made using Least Significance Difference (LSD) at 5% level of significance.

3. RESULT AND DISCUSSION

3.1. Trait Variability among Varieties

The analysis of variance revealed that the mean for varieties for most of the collected traits were significantly varying each other at 5% probability (Table 2). The yield performance of the varieties highly significant difference among each other. The grain yield of the varieties range from 5399.4kg/ha to 3559.6kg/ha. The maximum yield recorded was 5399.4kg/ha from Mangudo variety while the lowest grain yield 3559.6kg/ha was recorded from Utuba variety. The yield of durum wheat varieties in Ethiopia varies depending on the variety, region, and other factors (Amsal *et al*., 1994). The improved varieties had yield potentials of 2.5 - 6 t/ha on farmers' fields under good management conditions, whereas the local landraces produced 1.5 - 2.5 t/ha under similar conditions (Tesemma 1988).

Quamy variety recorded the highest plant height (109.1cm) as compared to other varieties. The tested varieties also significantly vary on spike length and seed per spike which have positively associated with grain yield. The highest number of seeds per spike was recorded 64.5 from tesfaye variety while the lowest was 43.8 from ET-Cross 21 variety. The longest spike length recorded was 6.8cm from Alemetena variety while the shortest 5.9cm recorded from Ude variety. The varieties also significantly vary on thousand seed weight which range from 37.8 to 48.7g. The highest thousand weight (48.7g) recorded from Mangudo while the lowest (37.8g) was recorded from Yerer variety. There was no significant difference on days to maturity and above ground biomass among tested varieties.

Table 2: Mean performance of 8 durum wheat varieties for 7 traits tested at Meskan (Average over two cropping seasons)

Variety	PH (cm)	SL (cm)	SS	DTM	BM (kg/plot)	TSW	GY (kg/ha)
Almetena	77.8b	6.8a	53.3ab	116.3a	2.9a	38.5b	4057.7bcd
ET-Cross 21	79.9b	6.7ab	43.8b	115.0a	2.6a	46.7a	4539.3b
Mangudo	79.2b	6.1bc	53.0ab	116.0a	2.8a	48.7a	5399.4a
Quamy	109.1a	6.7ab	51.2b	116.7a	3.5a	48.0a	4374.4bc
Tesfaye	77.8b	6.6ab	64.5a	114.3a	3.2a	39.0b	4183.5bcd
Ude	77.9b	5.9c	46.8b	115.3a	2.9a	47.0a	3717.6cd
Utuba	82.0b	6.2abc	52.0ab	116.0a	3.1a	49.5a	3559.6d
Yerer	74.9b	6.1bc	54.3ab	115.3a	2.9a	37.8b	4620.1b
Mean	82.3	6.4	52.4	115.6	3.0	44.4	4306.5
LSD (5%)	7.7	0.6	13.1	8.7	1.1	4.7	754.5
CV (%)	5.4	5.4	14.2	4.3	21.3	6.1	10.0

4. CONCLUSION

Shortage of improved varieties accessibility and limited studies in the study area was one of the main problems. This study generally indicated that there is an opportunity in selection of superior varieties on agronomic trait especially for grain yield among tested durum wheat varieties through direct selection at the study locations as short term strategy rather than a lengthy crossing program.

To increase durum wheat production, Ethiopia has implemented policies to improve yields and expand production to new areas. These policies include using improved technologies and best management practices, and expanding production to areas with untapped irrigation potential.

The result showed that the highest grain yield (5399.4 kg ha^{-1}) was obtained from Mangudo variety. This variety performed well in the study location. Therefore the variety should be produced at mid altitude area of Meskan Woreda and other similar agro-ecologies.

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Data Availability

All the data related to this manuscript are included in the manuscript. Additional information is available upon request to the corresponding author.

Conflicts of Interest: The author declares that they have no conflicts of interest.

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