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Evaluation of Introduced Wheat Varieties Under Tropical Agro Ecosystem Environment Of Mogadishu, Somalia.

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ABSTRACT *Wheat (Triticum aestivum L) is the most extensively grown cereal crop in the world, covering about 237 million hectares annually, accounting for a total of 420 million tonnes and for at least one-fifth of man's calorie intake. Wheat is an annual grass growing to between ½ to 1 ¼ meters in height, with a long stalk that terminates in a tightly formed cluster of plump kernels enclosed by a beard of bristly spikes. It is used in the production of bread, biscuits, feeds, confectionary, amongst many, utilization (OYEWOLE, C.I,2016).This study aimed to investigate and compare the growth and yield output of four Turkish wheat varieties "EDDESA", "GÜNDAŞ", "CEYHAN99", and "KAŞIFBEY" cultivars that were grown in Somalia-Mogadishu, which were imported from Turkey. Two of them were Bread wheat, and the other two were Drum wheat. As well as to choose a high-yield variety of wheat, that is ecologically adapted to Somalia's environment, and to determine the morphological characteristics of these four imported wheat crops. The main objectives of the study were to explore Evaluation of Introduced Wheat Varieties under Tropical Agro Ecosystem Environment of Somalia, and to assess the morphological traits of the introduced wheat varieties, as well as to evaluate the yield and yield components of the introduced wheat varieties. The experiment was conducted at The Agricultural Experimental and Research center, Faculty of Agriculture of Zamzam University of Science and Technology which locates around Garasbaaleey area. The experiment started at the beginning of (Xagaa) season during July- 2019 up to November 2019.The experiment was laid out in a Randomized Complete Block (RCB) Design with four replications. In terms of morphological traits "GÜNDAŞ" was exhibited the best Morphological traits among the varieties, followed by "EDDESSA", and "CEYHAN99" displayed intermediately, whereas the lowest morphological traits among the varieties was recorded by "KAŞIFBEY".As well as in terms of Yield and yield components "GÜNDAŞ" was recorded the best yield and yield components among the varieties, followed by "EDDESSA"and "KAŞIFBEY" showed midway, while the lowest yield and yield component among the varieties was documented by "CEYHAN99".*

Keywords: *Wheat, Morphological characteristics, High yield variety*

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I. INTODUCTION

Wheat (Triticum aestivum L) is the most extensively grown cereal crop in the world, covering about 237 million hectares annually, accounting for a total of 420 million tonnes and for at least one-fifth of man's calorie intake . Wheat is an annual grass growing to between ½ to 1 ¼ meters in height, with a long stalk that terminates in a tightly formed cluster of plump kernels enclosed by a beard of bristly spikes. It is used in the production of bread, biscuits, feeds, confectionary, amongst many, utilization (OYEWOLE, C.I,2016). Wheat is the universal cereal of the Old-World agriculture and the world's foremost consumed crop plant followed by rice and maize. It is the most widely adapted crop, growing in diverse environments spanning from sea level to regions as high as 4570 m.a.s.l. in Tibet. It grows from the Arctic Circle to the equator, but most suitably at the latitude range of 30° and 60°N and 27° and 40°S. A crop of wheat is harvested somewhere in the world during every month of the year (Briggle and Curtis, 1987). Cultivated wheat is classified into two major types: (1) the hexaploid bread wheat (2n = 6x = 42, BBAADD) and (2) the tetraploid durum wheat (2n = 4x = 28, BBAA). Currently, at the global level, bread wheat accounts for 95% of all the wheat produced. Based on growth habit, wheat is classified into spring wheat and facultative/winter wheat, covering about 65 and 35% of the total global wheat production area, respectively(Wuletaw Tadesse *et al* ,2016).Durum wheat (Triticum turgidum ssp. durum Desf.) world production was 37 million tons in 2018-19 and 33,9 mil tons in 2019-20, and approximately 10% of this production was generated in Turkey. An annual production of 3.5 and 3.2 mil tons was obtained from almost 1.1 mil ha in 2018-19 and 2019-20, respectively (OZBERK *et al*, 2022). Wheat is a major food crop that provides on average 21% of calories and 20% of protein to more than 4.5 billion people in 94 developing countries. Wheat is the most grown food crop and plays a pivotal role in the life and demand projected to increase 60% by 2050. The production of wheat has fallen behind rice and maize in recent years and 25 to 30% of total wheat production will be lost due to abiotic and biotic stresses (Shree R Pariyar *et al* ,2014).Wheat (Triticum aestivum L.) is indigenous to subtropical environments with an optimal growing temperature about 20 o C. Consumption and demand of wheat flour in Indonesia has increased recently by 6% from 2011 to 2012 and supply mostly depends on the imports. (ADEEL ABDUL KARIM ALTUHAISH *et al*, 2014). The global wheat production was about 735.23 million tons in 2016 (FAO, 2016). In many semi-arid environments, the relative humidity at the beginning of growing season is at the highest level and with increasing temperature, the amount of rainfall decreases. In these regions, wheat grain filling duration is simultaneous with water shortage and increased evaporation of soil surface; Thus, the yield is reduced (Babak Hooshmandi, Ebrahim Khalilv ,2018). About 21% of the world's food depends on the wheat (Triticum aestivum) crop, which grows on 200 million hectares of farmland worldwide. Although wheat is traded internationally and developing countries are major importers (43% of food imports), the reality is that 81% of wheat consumed in the developing world is produced and utilized within the same country, if not the same community in these circumstances, many poor households depend on increased wheat production on their own farms for improved household food security. In the period leading up to 2020, demand for wheat for human consumption in developing countries is expected to grow at 1.6% per annum, and for feed at 2.6% per annum (Rodomiro Ortiz *et al* ,2008). What is less known, however, are the impacts this change may have on social and economic sectors that are important to human well-being, such as agricultural production, water availability, and public health. However, despite its significance in the global wheat market, a fast-rising population, and strongly wheat-based diets, the impact of climate change on production has not been extensively studied in Turkey (M. Özdogan, 2011). Wheat is one of the main food sources in human nutrition and it will become more important in the future considering the consistent growth of the world population. The world wheat cultivation area is 219 million hectares, production rate 758 million tons, and average yield 3450 kg ha-1. Turkey produces 21.5 million tons grain wheat in 7.7 million hectares, and it's yield average is 2800 kg ha-1 (MEHMET KARAMAN, 1990). Historically wheat (Triticum spp.) has played an important role in human nutrition as a dietary staple. Wheat is the most important in food and economical cereal crop around the world it is a principal source of energy, protein, and dietary fiber for a major portion of the world's population. Triticum aestivum is the major wheat species grown throughout the world, which accounting for about 95% of the wheat which are grown annually. Triticum aestivum is a hexaploid species which is usually called "common" or "bread" wheat. Bread wheat is a youngest species, arisen in cultivation about 10,000 years ago, it was relieved to that spontaneous hybridization of cultivated tetraploid wheat with the wild grass Triticum tauschii was the evolutionary reason (Bethlehem, 2019). Wheat yields globally will depend increasingly on good management to conserve rainfall and new varieties that use water efficiently for grain production. Rainfed wheat production in many parts of the world is dependent on stored soil moisture. Wheat production in India and Australia represents a cross section of global spring wheat production(Wasson *et al*,2012). Production of wheat is constrained by drought in many regions of the world. The timing of stress differs among locations and years but can be classified as early season, late season or, where crops are grown with residual moisture, as continuous drought(F.M. Kirigwi *et al*, 2004).Wheat, one of the most important staple food crops, is grown on about 225 million ha worldwide from the equator to latitudes of 600N and 44°S and at altitudes ranging from sea level to more than 3000 m. Approximately 600 million tons of wheat is produced annually, roughly half of which is in developing countries. The world's largest producers of wheat are China, India, and the USA, producing annually 100, 70, and 64 million tons with productivitiesof3.8, 2.6, and 2.9 t/ha, respectively. Only 10% of total wheat produced is sold on the export market, the primary exporting countries are USA, Canada, Australia, and France, and developing countries consume most of the wheat sold on the export market. In some countries, such as those in North America, per capita consumption of wheat is as high as 240 kg(Ravi P. Singh *et al*,2008). China is the largest wheat producer and consumer in the world and wheat ranks as the third leading crop in China after rice (Oryza sativa) and maize (Zea mays). where spring wheat is planted in autumn. Less than 10% is produced in Northeastern and Northwestern China (Zones VI, VII, and VIII), where spring wheat is seeded in spring. Wheat cultivation has a long history in China (Lingan Kong et al,2009). Wheat (Triticum aestivum L.) is the world's most widely cultivated cereal crop. It finds a major place in both time meals of common population in major wheat growing states. At present wheat production in state faces large gap in potential and realized yield(Md. Parwaiz Alam *et al* , 2013). Wheat is one of the most important staple food crops grown over 200 mha in the range of environment throughout the world with an annual production likely to reach more than 650 million metric tons in 2009-10. Despite remarkable growth in food production, the risks were exposed by food crisis in the recent years. Therefore, wheat production must continue to increase by 2% annually, more particularly in developing world including south-east Asia until 2020 to meet future demands imposed by population and prosperity growth(Rajbir Yadav et al,2010) . Wheat is the second most important crop in India and a principal source of calorie intake. It has been under cultivation in the Indian subcontinent from pre-historic times and is an integral part of the country's economy and food security . Wheat is a staple crop in many countries and hence its consumption is directly proportional to the population growth. Consumption of wheat in rural India has increased apparently due to the availability of nutritious cereal(Sendhil Ramdas *et al*, 2012). Wheat is a cereal grain, originally from the Levant region of the Near East and Ethiopian Highlands, but now cultivated worldwide. In 2010, world production of wheat was 651 million tons, making it the third most-produced cereal after maize (844 million tons) and rice (672 million tons). Wheat was the second most-produced cereal in 2009; world production in that year was 682 million tons, after maize (817 million tons), and with rice as a close third (679 million tons) (Asadallah Najafi,2014).Although there is no production of wheat in Somalia, this is due to many environmental factors such as: extreme Temperatures, rainfall sequence, soil properties, pests and diseases that are more destructive in this crop from germination until harvest, other factors include: lack of skills of cultivation practices of this crop. Lack of understanding the economic importance of wheat crop in the world. Despite many studies related to our experiments have been conducted in many parts of the world, however there is a literature gap in the study area, therefore the study is aimed to bridge this knowledge gap and find out the Evaluation of introduced Wheat varieties under tropical Agro ecosystem Environment of Somalia. The purpose of this research was to evaluate the morphological attributes of the Four imported wheat crop varieties to select a high-yield variety of wheat suited to Somalia's environment and to identify their morphological traits.

II. MATERIALS AND METHODS

Experimental Site and Period

This experiment was conducted at the Agricultural Experimental and Research center in the faculty of Agriculture at Zamzam University of Science and Technology, which locates around the Garasbaaleey area. Garasbaaleey lies on latitude 2.04°N and longitude 45.16°E. Garasbaaleey geographically locates the West direction of Mogadishu-Somalia. The experiment started at the beginning of (Xagaa) season during July2019 up to November 2019.

Research Design and Treatment

The experiment was laid out in a Randomized Complete Block (RCB) Design with four replications. Each replication consists of 4 plots which generally makes 16 plots in all replications. Each plot consists of 4 rows with row length of 4 m and width of 2 m, which brings plot area of 8m2. Between row and plant was 50cm×20cm. The land measurement started 7th July 2019 using by tape the length of the area was 17.5 m and the width 9.5m, and total area was 166.25m2. The land preparation was started at the same day that land measurement began up to 10th July 2019 using by hand hoes, to remove shrubs and residue of the previous crop, and then ploughed by using hand hoes, shovels and rakes. The soil type which wheat grown was a loam soil. The experiment consisted of Four new wheat varieties ('EDDESA' 'GÜNDAŞ' CEYHAN99 and 'KAŞIFBEY') which were imported from Turkey. Two of them were Bread wheat, and the other two were Drum wheat.

Experimental Procedure

The installation of irrigation system was done on 21st July 2019, which was drip irrigation system. Application of Farmyard manure (FYM) was done on 14th July 2019 as basal application with the amount of 25kg, as well as the application of Di Ammonium Phosphate (DAP) and Urea was done 22thJuly 2019, with the amount of 104g and 90gr per plot respectively as Side Dressing before sowing. The first irrigation was done on 23rd July 2019 for the purpose of mixing FYM, DAP and Urea with the soil. The Sowing was done 25th July 2019 as direct sowing with manual method. The germination sequence was different, where the two varieties of bread wheat were begun on 28th July 2019, and the other two for Durum wheat were germinated on 29th July 2019. The first-hand hoeing was started on 3rd August 2019 and the second-hand hoeing was on 17thAugust 2019 and the latest was on 25th October 2019. There were two thinning processes done during the cultivation of wheat, the first one was done on 14th Augusto 2019, and the other thinning was done on 1st September 2019.The first insect attacked on the wheat was a White fly on 31th July 2019 which was controlled by using insecticides of Alfas and malathion with the rate of 10ml and 20ml respectively with a tank of 20L of water, and the method was a Foliar application. Stink bug (green stink bug) was the 22 second insect attacked on the wheat crop which was controlled by using insecticide known as Syngenta with the rate of 80ml in 2 tanks of 20L of water as spraying. The diseases that affected the wheat were Leaf blight on the date of 29th September 2019 which was controlled by a fungicide called Piper Tox84.0 at the rate of 330g in one tank of 100L of water. The other diseases attacked on the wheat were Rust, sooty mildew, and fusarium head blight on the date of 17th October 2019 which was controlled by a fungicide called Piper Tox84.0 at the rate of 180g in one tank of 100L as foliar application. The finally was done harvesting operation on 12th November 2019 as manual harvesting method, and followed by the postharvest practices which includes threshing and cleaning which also was done as manual method.

Data Collection Method

Ten mature plants were randomly picked from each plot and measured for plant height, number of tillers per plant, Panicle length, Grain per panicle, Effective tillers, non-effective tillers, thousand grain weight, Grain yield, Straw yield, biological yield, and Harvest index. The average height of each plant was recorded in centimeters, from the ground to the top of the plant's head. The number of tillers per plant was recorded form ten randomly selected plants from each plot, and their average value was recorded. Panicle length was measured from the basal node of the rachis to the apex of each panicle per spike from randomly selected ten plants from each plot. And their average length was recorded in cm. Grain per panicle was counted as the number of spikelets from ten randomly selected plants from each plot, and average value was recorded. The total number of effective tillers were counted as the number of panicles bearing tillers. Data of effective tillers were counted from ten randomly selected plants at harvest, from each plot. And average value was recorded. The Non-effective tillers per plant was recorded which is the non-panicle bearing tillers from ten selected plants of each plot. One thousand cleaned seed were counted randomly from each sample and weighed by using Digital Electric Balance and recorded in gram. Grain yield was recorded from each plot after threshing, and cleaning, and weighed by using Digital Electric Balance, grain yield was recorded into Kg/Plot, and finally converted into t/ha. The straw yield was recorded from each plot, weighed by using Digital Electric Blanca. The biological yield was recorded into **Kg/plot**, and finally converted into **t/h**.

the biological yield was calculated by using the following formula:

biological yield = Grain yield+ Straw yield.

Harvest Index was recorded in percentage by using the following formula:

$$\textbf{HI (\%)} = \frac{\text{Grain Yield}}{\text{Biological yield}} \times 100$$

After we finished collecting the data was analyzed the data using **MSTATC** Master of Statistics, and treatment mean comparison were used Duncan's Multiple Range Test (**DMRT**) Method.

III. RESULTS AND DISCUSSION

Table 1. Morphological parameters

VARIETIES	Plant Height (cm)	Number of Tillers per Plant	Panicle Length(cm)	Effective Tillers	Non-effective Tillers
EDDESSA (1)	73.55 B	25.22 B	4.42 B	28.95A	0.45 A
CEYHAN (2)	75.20 AB	30.65 A	7.40 A	21.05 C	2.62 A
KAŞIFBEY (3)	72.5 B	27.95 AB	7.20 A	23.25BC	0.62 A
(GÜNDAŞ) (4)	83.00 A	28.57 AB	4.77 B	28.77AB	0.12 A
LEVEL OF SIGNIFICANCE	**	*	**	**	n. s
CV (%)	4.68	7.91	3.02	9.80	124.25

** = highly significance at 1% level, * = significant at 5% level, n. s= non significance, CV= coefficient variation. Values having same letter (s) do not significantly differ.

Plant height were highly significant variations among the varieties (Table 1), the maximum plant height among the varieties (80.0) was recorded from the variety4 "GÜNDAŞ", followed insignificantly by variety2 "CEYHAN99", (75.20) and variety1 "EDDESSA" displayed midway (73.55), whereas the minimum grain per panicle (72.5) was verified from variety 3 "KAŞIFBEY" Similar result was found by (FIDA MOHAMMAD *et al*,2011). plant height showed highly significant difference which is supported by (Dongcheng Liu *et al*,2022).

Panicle length were highly significant variations among the varieties (Table 1), the maximum Panicle length among the varieties (7.40) was recorded from the variety2"CEYHAN99", followed insignificantly by variety3 "KAŞIFBEY", (7.20) and variety4 "GÜNDAŞ", displayed midway (4.77), whereas the minimum Panicle length (4.42),) was verified from variety1"EDDESSA" showed highly significant differences ($p \leq 0.01$) for Panicle length (Muzaffar Ahmed Longove *et a*l,2014**)** who also reported highly significant differences for Panicle length.

Number of tillers per plant were highly significant variations among the varieties (Table 1), the maximum Number of tillers plant among the varieties (30.65) was recorded from the variety2"CEYHAN99", followed insignificantly by variety4 "GÜNDAŞ", (28.57) and variety3"KAŞIFBEY", displayed midway (27.95), whereas the minimum Number of tillers plant (25.22,) was verified from variety1"EDDESSA" These results support the findings of the following study by (Falaki A. M *et al* ,2009).

Effective Tillers There were non-significant variations among the varieties (Table 1), variety 4 "GÜNDAŞ" (27.20). Variety 1 "EDDESSA" (27.10), variety 3 "KAŞIFBEY" (25.30), and finally variety 2 "CEYHAN99" (25.00) (Javaid Iqbal *et al* ,2012) there is highly significant among effective tillers produced a greater number of tillers (503.40) because the used nitrogen. y Santosh. reported that grain per panicle was significant These results are further supported by (MIR MOHAMMAD SALIM ,2010). due to genetical and environmental influences as well as management practices.

Non-effective tillers There was not any significant among the varieties (Table 1) according to Non effective tillers. Variety 2 "CEYHAN99" (1.60), variety 3 "KAŞIFBEY" (1.10), variety1 "EDDESSA" (0.60) and finally variety 4 "GÜNDAŞ" (0.00). There are similar results were reported by this research (UMMA MUSARRAT MISU,2021).There are highly significant variation among this research (MIR MOHAMMAD SALIM ,2010).

Table2. Yield Parameters

VARIETIES	Grain per Panicle	1000 grain Weight (gr)	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
EDDESSA (1)	29.40 A	30.00A	2.24 AB	2.53 A	4.77 AB	46.94 A
CEYHAN (2)	28.90 A	27.50 A	1.38 C	2.76 A	4.14 AB	33.40 B
(KAŞIFBEY) (3)	23.88 B	30.00A	1.79 BC	2.11 A	3.90 B	46.10 A
(GÜNDAŞ) (4)	23.67 B	32.50 A	2.41 A	2.98 A	5.40 A	45.06 A
LEVEL OF SIGNIFICANCE	**	n. s	**	n. s	*	**
CV (%)	6.20	22.22	12.54	14.91	13.03	6.53

** = highly significance at 1% level, * = significant at 5% level, n. s= non significance, CV= coefficient variation. Values having same letter (s) do not significantly differ.

Grain per Panicle were highly significant variations among the varieties (Table 2), the maximum grain per panicle among the varieties (29.40) was recorded from the variety1 (EDDESSA), followed insignificantly by variety2 (CEYHAN99), (28.90) and variety3 (KAŞIFBEY) displayed midway (23.88), whereas the minimum grain per panicle (23.67) was verified from variety 4 (GÜNDAŞ).(Naeem Sarwar *et al* ,2010) found a regional variation in wheat output of (4.74% and 3.91%)) as measured by grain per panicle and concluded that all interactions between regions were crucial to maximizing output (Amjed Ali *et al*,2011) found that in 2011 the greatest grain per panicle for was(40.95a).

Thousand grain weight was not any significant among the varieties according to 1000-grain weight presented in table 2. Variety 1 EDDESSA (30.00gr), variety 2 CEYHAN99 (27.50gr), variety3 (KAŞIFBEY) (30.00gr) and finally variety 4 (GÜNDAŞ) (32.50gr). These results corroborate the findings of (M. AKRAM1, 2011) reported that 100- grain weight of the crop is significantly reduced due to different environment (Javaid Iqbal et al 2012).

Grain yield were highly significant variations among the varieties (Table 2), the maximum grain yield among the varieties (2.41 t/h) was recorded from the variety 4 (GÜNDAŞ), followed insignificantly by variety 1 (EDDESSA) (2.24 t/h), and variety 3 (KAŞIFBEY) displayed intermediate (1.79 t/h), while the minimum grain yield (1.38 t/h) was documented from Variety 2 (CEYHAN99). Among cultivars of grain yield was appeared is significantly.(Naeem Sarwar *et al* ,2010) who reported significant effect of environmental impacts KAŞIFBEY (4.40) (Şehin DERE and Metin Birkan YILDIRIM, 2006)**.**

Straw Yield There was not any significant among the varieties (Table 2) according to Straw yield. Variety 1 EDDESSA (2.53t/h), variety 2 CEYHAN99 (2.76t/h), variety3 (KAŞIFBEY) (2.11t/h) and finally variety 4 (GÜNDAŞ) (2.98t/h) **(**MUBSHAR HUSSAIN *et al* ,2012). reported that Straw yield there is highly significant among our results.

Biological Yield were significant variations among the varieties (Table 2), the most biological yield among the varieties (5.40t/h) was recorded from the variety 4 GÜNDAŞ, followed insignificant by 31 varieties 1 EDESSA (4.77 t/h), and 2 CEYHAN99 (4.14 t/h), whereas the least biological yield among the varieties was recorded by variety 3 KAŞIFBEY (3.90 t/h). Similar result was found by (Wajid Ali Shah1, et al ,2016). These results agree with (Javaid Iqbal et al 2012).

Harvest index were highly significant variations among the varieties (Table 2). The maximum harvest index among the varieties (46.94%) was recorded from the variety 1 EDDESSA, followed insignificant by varieties 3 KAŞIFBEY (46.10%), and 4 GÜNDAŞ (45.06%), while the lowest harvest index (33.40%) among the varieties was verified by variety 2 CEYHAN99. found that harvest index was increased by (Babak Hooshmandi and Ebrahim Khalilvand Behrouzyar 2018).Comparable results were found by (FOYSAL AHMED, 2011).

IV. CONCLUSION

Wheat is a major food crop in Somalia and across the globe. Food production falls short of demand because of rising populations and associated increases in per-person consumption; the resulting gap is filled by imports. There is a reliance on imported sunflower seeds in Somalia. The food sector and the nation of Somalia both benefit greatly from an increase in Wheat output. Wheat seed production should be prioritized so that we may become food self-sufficient and lessen our reliance on foreign suppliers. As a result, farmers would benefit from a reduction in the cost of inputs if they could raise Wheat more efficiently. Researchers found that "GÜNDAŞ" and "EDDESA" were the most productive because to their ability to thrive in the harsh conditions of the Somalian countryside. Wheat cultivation is an important skill for farmers to acquire.

In terms of morphological characteristics, "GÜNDAŞ" (83.00 A) had the best Morphological parameters among the varieties, followed by "EDDESSA" and "CEYHAN99" while "KAŞIFBEY" recorded the lowest morphological parameters.

As well as in terms of Yield and yield components, "GÜNDAŞ" (32.50 A) was documented as having the best yield and yield components among the varieties. This was followed by "EDDESSA" and "KAŞIFBEY" while "CEYHAN99" was documented as having the lowest yield and yield component among the varieties.

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