



Release and Registration of AYINAGE Sorghum (*Sorghum bicolor* L. Moench) Variety for West Hararghe zone

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Abstract

Sorghum is the most important crop in Ethiopia especially in the west Hararghe zone it is a main staple food. However, the average productivity is far lower than its genetic potential this is mainly because of poor soil fertility, drought, Striga, diseases, and insects as well as a lack of improved variety that is high yielding and widely adaptable. Thus, the current study was conducted to find early mature, stable, high-yielding, and pest-tolerant varieties for increasing production. At multi-environments ten genotypes, which are, collected from west Hararghe by Melkasa Agricultural Research Center and standard check (Dagim) evaluated at two locations namely Hirna and Mechara for three consecutive years (2017-2019). AYINAGE showed relatively tolerant to disease and insect pests as well as high grain yield. As a result, this genotype was promoted to a variety of verification trials for further evaluation. The candidate variety and standard check (Bonsa) it was planted at the farmers' field and on the station. Relative to standard check AYINAGE it was tolerant to stalk borer and leaf bight as well as early mature and their stock stayed green after maturity because of these traits farmers selected this variety. Further, its grain yield is 34.5% higher than the check. As a result, finally national variety release committee approved AYINAGE as a new sorghum variety released for midlands areas of the west Hararghe Zone and similar agro ecologies in Ethiopia.

Keywords: *Ayinage, Disease and Insect Reaction.*

Introduction

Sorghum (*Sorghum bicolor* L.) is the fifth most important cereal crop in the world after wheat, rice, maize, and barley regarding production and planting area FAO (2021). It is drought tolerant and climate-resilient crops can better adapt to climate changes Reddy et al. (2011) as well as requires minimal fertilizers on marginal lands for cultivation Kimber et al. (2013). Furthermore, it is a good source of carbohydrates, vitamins, protein, and minerals Mayer et al. (2008). Due to these, it is a critical crop for poor farmers who inhabit arid, infertile, and marginal lands. As a result, it is widely cultivated in the semi-arid tropical regions of Asia, Africa, and Central America Derese et al. (2018) which serve as a staple food, especially in sub-Saharan Africa Mace et al. (2013). It is consumed in the form of enjera, boiled porridge or gruel, malted beverages, beer, popped grain, and chips Legesse T (2018).

Ethiopia is the largest producer followed by Nigeria and Sudan in Africa FAO (2021). It is the third most important cereal crop after teff and maize in Ethiopia, which accounts for a total area of 12.94% and production of 13.22% allocated to cereal crops CSA (2021). It is the main staple food crop for millions in lowland areas of the country Kebede (1991), especially in the west Hararghe zone ranked first in both area and production CSA (2021). Its grain is mainly utilized as a food crop whereas its stalks have multiple uses such as animal feed, houses, and fences Mengistu et al. (2020). Despite this crop was widely produced as well as a center of origin and diversity in Ethiopia Mekbib (2006). However, the average productivity is 2.69 and 2.3 tha^{-1} in the national and west Hararghe zones respectively CSA (2021) which is by far lower than it is potential 6 tha^{-1} FAO (2017). This is mainly due to poor soil fertility, drought, Striga, and diseases as well as a lack of improved variety tolerant of these pests and high-yielding Lamessa et al. (2016). Therefore,

the current study was conducted to release and register early mature, stable, high-yielding, and pest-tolerant varieties for increasing production.

Varietal Origin and Evaluation

The new sorghum variety AYINAGE (5012) was originally collected from the West Hararghe Zone through Melkasa Agricultural Research Center. At multi-environment trials ten genotypes including the standard check Dagim evaluated for three consecutive years (2017-2019) at locations Mechara (on station) and Hirna sub-site. The candidate regarding grain yield, insect and disease tolerance as well as overall desirability showed relatively better than standard check (Dagim) and the remaining genotypes Table 1. As a result, it was promoted to a variety of verification trials for further evaluation. The candidate variety and standard check (Bonsa) were planted in plots with a size of 10 x 10m at five locations during the 2020 cropping season and evaluated by the national variety release committee. The candidate (AYINAGE) relatively showed better head size, early maturity, and tolerance to grain mold, leaf blight, Stalk borer, and greenness of its stalks after maturity as a result farmers selected AYINAGE. Further, its grain yield is 34.5% higher than the check. Finally, the variety releasing committee approved AYINAGE as the best sorghum variety for the mid-altitude of West Hararghe and similar agroecologies.

Table 1. Combined Mean values of yield and yield-related sorghum genotypes across locations in the 2017 to 2019 cropping season.

Genotype	Pedigree	DF	DM	PH	I S	DS	GY tha ⁻¹	OD
Genotype 5003	09BKF ₆ #2002(1)	90.28	153.3	164.3	2.30	2.06	3.69	2.02
Genotype5014	09BK F ₆ #2001(1)	88.22	148.2	150	2.39	1.94	3.62	2.3
Genotype5005	09BK F ₆ #2003	85.33	144.6	145.6	2.49	2.29	3.37	2.38
Genotype5010	09BK F ₆ #2007(7)	87.39	147.1	162.7	2.46	2.11	4.07	2.1
Genotype5007	09BK F ₆ #2006(1)	79.33	145.8	149.9	2.26	2.1	4.21	2.03
Genotype5017	09BK F ₆ #2007(3)	84.11	150	147.2	2.14	2	3.95	2.01
Genotype5008	09BK F ₆ #2007(2)	80.44	143.3	145.4	2.58	2.44	4.00	2.33
Genotype5012	09BK F₆#2007(6)	87.89	146.3	152.9	1.88	1.94	4.11	1.91
Genotype5006	09BK F ₆ #2005(5)	82.17	145.3	179.8	2.10	2.18	3.51	2.02
Dagim(check)		80.28	147.6	177.3	2.55	2.33	3.95	2.21
Grand mean		85	147.1	157.5	2.40	2.1	3.88	2.13
LSD (0.05)		4.1	6.4	13.735	0.31	1.1	1146	0.58
CV		6	5.4	5.4	27.10	31	18.3	16.9

DF: Days to Flowering, DM: Days to Maturity, PH: Plant Height, IS: Insect Score, DS: Disease Score, GY: Grain Yield, OD: Overall Desirability.

Agronomical and Morphological Characteristics

The candidate variety has moderate plant height (153cm), and red seed color and it matures in 146 days Table 3. Because of its early maturity can be produced by the existing short rainy season, which is received from May to August. Further, its leaves and stems are stay-green, which demonstrates the tolerance of post-flowering moisture stress at the sorghum grain filling stage. In Addition to stay greenness and it has sweet juice that makes a high demand for animal feed thus it was selected for both food and feed.

Reaction to pest

AYINAGE was tested for its reaction to insect stem borer and disease leaf blights at testing environments. This variety showed relatively tolerant these pests across testing locations Table 3.

Yield Performance

The mean grain yield of AYINAGE ranged between 3.3 at farmers field to 4.1(th^a) on station whereas standard check Bonsa 2.6 to 2.9 (th^a) respectively Table (2). The overall mean of the candidate is 3.7 while the check is 2.75 th^a. This showed that AYINAGE was 34.5% higher than the standard check (Bonsa).

Table 2. Mean of grain yield data at variety verification in 2020 cropping season

Candidate and check	Grain yield tha^{-1}		Mean	Yield Advantage
	On station	On-farm		
5012(Candidate)	4.1	3.3	3.7	34.5%
Bonsa (check)	2.9	2.6	2.75	

Table 3. Agronomical and Morphological characteristics of AYINAGE (ACC.5012) sorghum variety

Variety Name	AYINAGE		
Adaption areas	Mechara, Hirna, and similar agro-ecologies		
Altitude (m.a.s.l.)	1700-2000		
Rainfall(mm)	800-1500		
Seed rate (kg ha-1)	10-12		
Plant spacing			
Row spacing(cm)	55		
Row spacing between plant(cm)	20-25		
Planting date early to late May	Early to mid-May		
Fertilizer rate kg ha-1			
Nitrogen (N)kg ha (urea)	100		
NPS/NPSBn (kg)	100		
Days to maturity (days)	146		
Plant height in (cm)	152		
Seed color	Red		
Growth Habit	Erect		
Crop disease and insect Reaction			
Leaf blight	1.9		
Stalk borer	2		
Grain Yield(tha^{-1})			
Research field	4.1		
On-farm	3.3		
Year of Release	June, 2021		
Breeder Seed Maintainer	Mechara Agricultural Research Center		

m.a.s.l.=meter above sea level.

Conclusions and Recommendations

Sorghum is a widely cultivated and reliable food crop in Ethiopia, especially in West Hararghe, but its average productivity is by far lower than its genetic potential. This is mostly because of drought, Striga, low soil fertility, diseases, and a lack of varieties that are stable, high-yielding, and resistant to various stresses. The new variety AYINAGE was released to address these problems since it showed high grain yield, consistent performance, and early maturity, as well as tolerant to insect pests and leaf blight relatively. Therefore, farmers of West Hararghe should be using this new variety AYINAGE to boost their production.

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Conflicts of Interest

The authors declare no conflicts of interest.

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