Registration of 'Kumsa' Finger Millet (*Eleusine coracana*) Variety

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Abstract: Kumsa is a brown-seeded finger millet (*Eleusine coracana* sub spp. *coracana*) variety. Its pedigree is designated by BKFM 0063 (1). It is a selection from fourteen genotypes obtained from the Ethiopian Biodiversity Institute, which had been collected from western parts of the Oromia Regional State, Ethiopia. Kumsa and other pipeline finger millet genotypes were evaluated against a standard check (Gute) for grain yield, disease reaction, and other agronomic traits across two locations (Bako and Gute) for three consecutive years (2014-2016) during the main cropping seasons. Additive main effect and Multiplicative Interaction (AMMI), and Genotype and Genotype by Environment Interaction (GGI) biplot analysis showed that Kumsa is stable, disease tolerant, and high yielder (3.17 t ha^{-1}) with 25.3 % yield advantage over standard check Gute (2.53 t ha^{-1}). Therefore, it was developed and released by Bako Agricultural Research Center for western Oromia and similar agro-ecological areas of Ethiopia in 2019.

Keywords: Additive main effect and multiplicative interaction (AMMI); Disease resistant; Genotype and genotype by environment interaction (GGI); Grain yield; Standard check; Stability

1. Introduction

Finger millet is a climate-resilient crop with highly nutritious and antioxidant properties (Gupta *et al*., 2017). It is grown mainly by subsistence farmers in the drier regions of Africa and serves as a food security crop because of its high nutritional value, excellent storage qualities and as a low input-requiring crop (Dida *et al*., 2008). Despite its importance, it is one of the neglected and underutilized crops (Ayalew, 2015) in Africa. More emphasize of improvement is often directed towards staple cereal crops such as maize, wheat, rice, barley, etc than finger millet. In Ethiopia, finger millet, which is considered as a poor man's crop, is being grown by the rural poor farmers in marginal lands with low yielding potential, mainly in Amhara and Oromia regions (Adugna *et al*., 2011; Ayalew, 2015). Low grain yield due to lack of stable and high yielding varieties with disease resistance is a major problem constraining widespread cultivation and use of finger millets in Ethiopia (Dagu *et al.,* 2009; Dagnachew *et al.,* 2015). Therefore, to address the problem, developing adaptable, stable, high yielding and disease resistant varieties is important.

2. Varietal Origin and Evaluation

Kumsa [BKFM 0063 (1)] was developed through selection from finger millet landrace collections originally from western Oromia regional state, east Wollega zone, Gobu sayo district, Ethiopia. Kumsa and other fourteen finger millet pipeline genotypes were evaluated against the standard check (Gute) for three years (2014-2016) across two districts (locations), namely Bako and Gute. Bako is located at 9°6'N latitude and 37°09'E longitude, and altitude of 1650 meters above sea level. The district receives mean annual rainfall of 1215.45 mm and its mean maximum and minimum temperatures are 14.0 and 28.4°C. Gute is located at 9°01.06'N and 36°38.196'E, altitude 1915 meters above sea level. The district receives mean annual rainfall of 1431 mm and its mean maximum and minimum temperatures of the district are 12.3 and 32.0°C) (Kebede *et al*., 2018).

3. Agronomical and Morphological Characteristics

The released variety, Kumsa [BKFM 0063(1)] is characterized by light brown seed color, average 1000 seeds weight of 3.5 grams, and an average plant height of 85 cm (Table 3).

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4. Yield Performance

The multi-location blast prone areas (Bako and Gute) and multi-year evaluation (2014-2016) data records indicated that Kumsa [BKFM 0063(1)] is a stable and high yield variety which produced 2.5 - 3.2 t ha^{-1} on research station. On-farm (farmers' field) yield evaluation recorded from variety verification plots at Bako and Gute revealed that Kumsa gave an average grain yield ranging from 2.2 - 2.9 t ha^{-1} (Tables 1 and 2).

Table 1. Mean grain yield (t ha^{-1}) and disease reaction across location over years.

Genotype	Mean grain yield (t ha^{-1}) and disease reaction (1-5 scale) [a]								
	Bako			Gute			Mean	LBS	HBS
	2014	2015	2016	2014	2015	2016			
203353	1.70	4.92	2.37	3.39	1.17	1.15	2.45	3	2
203360	1.87	4.00	2.96	3.13	0.66	1.47	2.35	3	2
214988	1.78	3.55	2.01	4.13	0.79	1.34	2.27	4	3
214989	1.59	3.47	2.02	3.58	0.78	0.89	2.05	4	4
214997	1.92	4.05	4.52	3.58	0.88	0.99	2.66	4	4
229738	1.66	4.19	3.04	3.27	0.81	2.60	2.59	4	3
230103	1.65	3.12	3.98	3.48	1.17	2.90	2.72	4	2
BKFM0052	2.05	4.03	2.98	4.10	1.28	2.08	2.76	4	3
BKFM0007	1.73	4.10	2.33	4.05	2.52	1.84	2.75	3	2
BKFM0034	1.64	2.72	2.20	3.77	0.39	1.35	2.01	3	2
BKFM0042	1.77	3.91	2.54	4.27	1.51	0.72	2.45	3	2
BKFM0043	1.64	3.81	1.89	3.20	0.81	2.35	2.28	3	2
BKFM0063(1)	1.84	4.61	4.83	3.91	1.90	1.91	3.17	2	2
Gute	1.95	4.25	2.22	4.06	0.60	2.11	2.53	3	3
Local	1.40	2.93	2.20	3.75	1.35	1.27	2.15	3	2
Mean	1.75	3.98	2.67	3.71	1.11	1.66	2.48		
LSD	0.70	1.02	1.19	1.03	0.48	0.63			
CV	23.8	16.7	27.9	18.7	26	22.6			
F-Value	Ns	**	**	Ns	**	**			

Note: [a] *Blast severity (1= highly resistant, 2 = resistant, 3 = moderately resistant, 4 = susceptible and 5= highly susceptible, ** Significant at 0.01 probability level; ns = non-significant; LBS = Leaf blast severity, HBS = Head blast severity, LSD = Least significant difference. CV = Coefficient of variation.*

5. Stability and Adaptability Analysis

Eberhart and Russell (1966) model revealed that Kumasa [BKFM 0063 (1)] variety showed a regression coefficient (bi) closer to unity (Figs 1 and 2) and thus is a more stable and widely adaptable variety than the remaining genotypes. Both GGE biplot and AMMI analysis also indicated that Kumsa [BKFM 0063 (1)] was stable and high yielding, which gave about 25.3% (31.17 t ha^{-1}) yield advantage over the standard check Gute (2.53 t ha^{-1}). Hence, the variety was officially released and recommended for production in the testing locations and areas with similar agro-ecological conditions to boost production and productivity of the crop. Accordingly, Kumsa was recommended for western Oromia areas (Bako, Gute and Bilo) as well as for areas with similar agro ecological conditions.

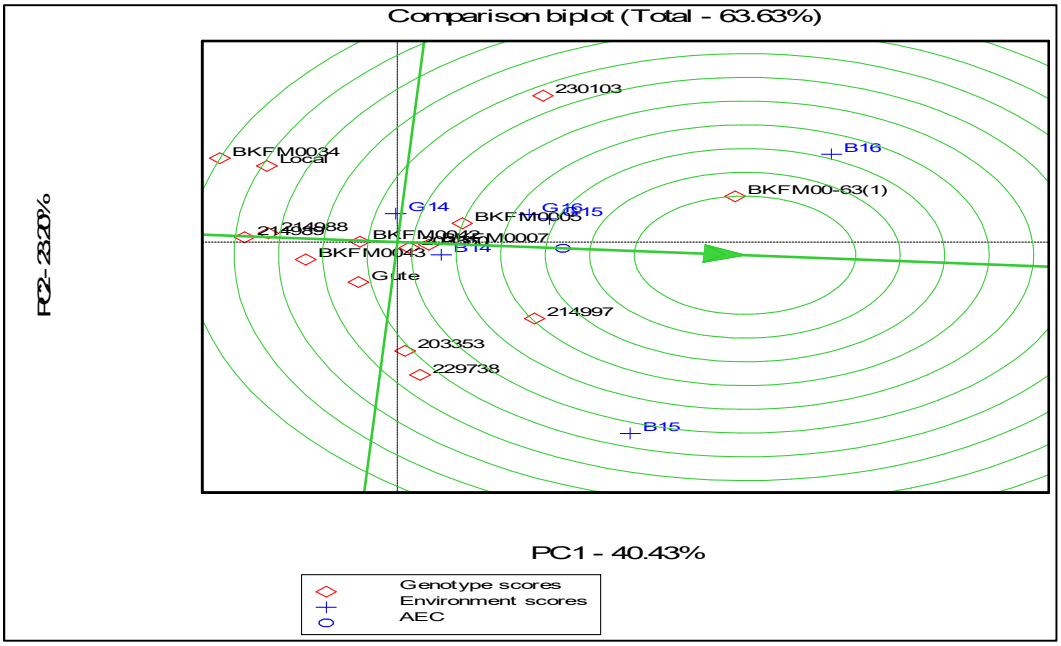

Figure 1. GGE Biplot analysis showing grain yield stability of genotypes and environments.

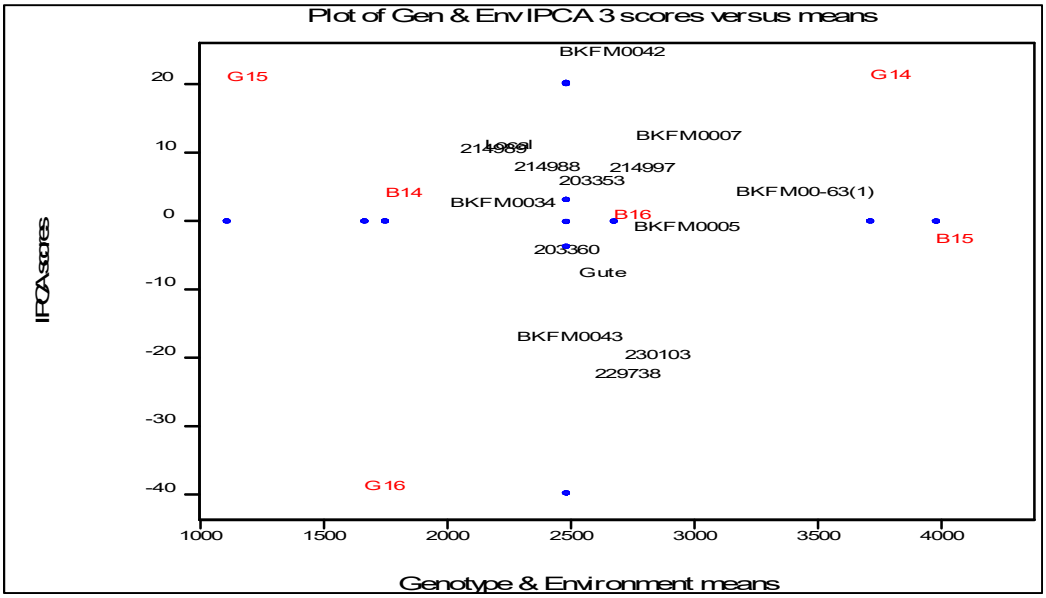

Figure 2. AMMI Biplot showing genotypes grain yield stability and preferential adaptation over environment.

6. Reaction to Diseases

The variety was evaluated in blast prone areas at Bako and Gute. Accordingly, Kumsa is resistant to blast (*Magnaporthe oryzea*), a devastating major disease of finger millet that affect all above ground parts of the plant (Table 1).

Table 2. Agronomic/morphological characteristics of finger millet variety, Kumsa.

Variety name	Kumsa [Acc. BKFM 0063 (1)]
Agronomic and morphological characters	
Adaption areas:	Bako, Gute, Bilo boshe and similar agro-ecologies
• Altitude (m.a.s.l.)[a]	1500-2200
• Rainfall (mm)	1200-1300
Seed rate ($kgha^{-1}$)	15
Spacing (cm)	40 cm x 10 cm
Planting date	Late May to Mid-June
Fertilizer rate ($kgha^{-1}$)	105 for DAP and 65 for UREA, respectively
Days to maturity (days)	144
1000 seed weight (g)	3.5
Plant height (cm)	85
Seed color	Light brown
Growth habit	Erect
Crop disease reaction	Tolerant to blast (leaf and head) finger millet disease
Yield ($t\ ha^{-1}$)	
• Research field	2.5 - 3.2
• Farmers field	2.2 - 2.9
Year of release	2019
Breeder seed maintainer	Bako Agricultural Research Center

Note: [a] *m a.s.l. = meters above sea level.*

7. Conclusions

Kumsa finger millet variety was released for its high grain yield, showed better adaptability and stable performance than the standard check. The variety is also tolerant to blast disease. Therefore, it was released and recommended for smallholder farmers and other finger millet producers at Bako, Gute, Bilo and areas with similar agro-ecologies in the country to boost finger millet productivity.

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