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Registration of "Malkaa"- Ethiopian Musturd (Brassica carinata A. Braun) Variety

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ABSTRACT

A candidate Ethiopian mustard (Brassica carinata) genotype, ACC 20131, was evaluated across multi-location and multi-year trials and demonstrated statistically superior performance in seed yield, oil yield, and associated agronomic traits relative to standard checks. The genotype exhibited stable phenotypic performance and broad adaptability under diverse highland agro-ecological conditions. Based on its consistent superiority, ACC 20131 was advanced to the Variety Verification Trial in 2022, where it underwent formal field evaluation by the Technical Committee of the National Variety Release Committee (NVRC). Following comprehensive agronomic assessment and verification of its distinctiveness, uniformity, and stability, the genotype was officially released in 2023 under the varietal designation 'Malkaa'. The variety expresses moderate to high levels of field tolerance to major diseases, including Alternaria leaf spot, Sclerotinia stem rot, and white rust. 'Malkaa' is specifically recommended for cultivation in the highland agro-ecologies of Bale and similar agro ecologies and is currently maintained by the Sinana Agricultural Research Center as part of its formal breeding and seed maintenance program.

Keywords: *Malkaa, Variety Registration, Oil Content.*

1. INTRODUCTION

Ethiopian mustard (*Brassica carinata* A. Braun), locally known as "Gomenzer" is an allotetraploid oilseed crop (BBCC, 2n = 34) that originated in the Ethiopian highlands through natural interspecific hybridization between *Brassica nigra* (BB) and *Brassica oleracea* (CC) [14]. It is one of the few crops domesticated in Ethiopia and has been cultivated for millennia as a dual-purpose species for edible oil and leafy vegetable production [1,6]. The crop is widely adapted to highland agro-ecologies (1700–2800 m a.s.l.) and plays an important role in smallholder mixed farming systems [2].

Globally, *B. carinata* is increasingly recognized as an emerging industrial oilseed crop due to its high biomass productivity, stress tolerance, and suitability for non-food applications such as biofuel production and sustainable aviation fuel [7, 12]. Its expansion into countries such as Canada, India, Australia, and Spain is driven by its favorable agronomic performance under low-input and marginal environments [13, 14]. Under improved agronomic conditions, yield potential ranges from 2.5 to 3.5 t ha^{-1}, although actual farm-level yields remain significantly lower due to genotype × environment interactions and management constraints [8, 10].

In Ethiopia, oilseed crops are an essential component of agricultural production and rural livelihoods. According to the Central Statistical Agency (CSA) Agricultural Sample Survey (2022/23 Meher season), oilseed crops occupy a considerable proportion of cultivated land, with Ethiopian mustard being one of the major Brassica oilseeds in highland areas [5]. However, national productivity remains low, with average yields of 0.9–1.2 t ha^{-1} under farmer conditions, compared to 2.0–2.5 t ha^{-1} under research-managed environments [5, 10]. This represents a yield gap of more than 50%, indicating substantial untapped production potential.

FAOSTAT data confirm that Ethiopia is among Africa's leading producers of oilseed Brassicas; however, productivity growth has remained stagnant compared to global improvements in oilseed breeding and agronomic intensification [4]. Recent national assessments further indicate a declining production trend of Ethiopian mustard, from over 70,000 tons in 2011/12 to about 12,500 tons in 2020/21, mainly due to land-use competition, limited improved varieties, and weak input delivery systems [11, 12]. Smallholder fragmentation, low fertilizer use, and reliance on rainfed systems further exacerbate yield instability [12].

Despite these constraints, Ethiopian mustard possesses high agronomic and industrial value. The seed contains 27–40% oil, depending on genotype and environment [14, 15]. The oil is characterized by a high proportion of erucic acid (C22:1), often exceeding 40%, making it suitable for industrial applications such as lubricants, surfactants, cosmetics, and biofuel feedstock [12, 14] The seed cake contains 19–28% protein, although its utilization in livestock feed is limited due to high glucosinolate content [1, 3]. In addition, the leafy vegetable form is rich in vitamins A and C, minerals, and antioxidants, contributing significantly to household nutrition security in rural Ethiopia [4, 15].

Genetic studies have demonstrated substantial variability among Ethiopian mustard germplasm for yield, oil content, phenology, and stress tolerance, indicating strong potential for breeding improvement [1, 6, 9]. However, the number of officially released and widely adopted improved varieties remains limited, constraining productivity gains and farmer-level adoption.

Varietal registration is therefore a critical step in the crop improvement process, ensuring that candidate genotypes undergo rigorous multi-location evaluation and meet the standards of Distinctness, Uniformity, and Stability (DUS) and Value for Cultivation and Use (VCU) (OECD seed principles; CSA/EIAR variety release guidelines). The objective of this study was to register the released stable high yielding and good-quality Ethiopian Mustard variety for the highlands of Bale and other similar agro-ecologies.

2. Origin and Varietal Evaluation

The Ethiopian mustard genotype ACC 20131 ("Malkaa"), along with 14 other genotypes, was obtained from the Holetta Agricultural Research Center under the Ethiopian Institute of Agricultural Research. Genotype ACC 20131 was identified as a promising candidate variety based on combined analysis of variance and comparative mean performance evaluations conducted across testing environments. Subsequently, the candidate genotype, together with the standard check varieties "Shaya" and "Yellow Dodola," was evaluated in variety verification trials for potential release.

The trials were conducted during the 2022/23 main cropping season at two representative locations using plot sizes of 10 m × 10 m and were assessed by the National Variety Release Technical Committee. Based on its superior grain yield performance, yield advantage over the standard checks, and desirable level of resistance to major Ethiopian mustard diseases, including Alternaria leaf spot (*Alternaria brassicae*), Sclerotinia stem rot (*Sclerotinia sclerotiorum*), and white rust (*Albugo candida*), genotype ACC 20131 was officially approved and released as the variety "Malkaa."

3. Varietal Characteristics

The newly released Ethiopian Mustard variety 'Malkaa' is characterized by its yellow flower color; the seed colors are Brown and Yellow. The average number of days required by the variety to reach its 50% flowering and 95% physiological maturity were 73 and 167, respectively, with the average plant height of170 cm. (Table 1).

4. Grain Yield Potential, Stability and Reaction to the Major Diseases

The variety "Malkaa" consistently demonstrated superior grain yield performance over the standard check varieties, Shaya and Yellow Dodola, across the 2018–2020 main cropping seasons at Sinana and Agarfa testing locations.

Across all test environments, Malkaa ranked as the highest-yielding genotype among the evaluated entries, attaining an overall mean grain yield of 1,937 kg ha^{-1}. This represented a yield advantage of 31.21% over the standard check variety Shaya, indicating its strong yield potential and wider adaptation under the agro-ecological conditions of the study areas.

Disease reaction assessments further revealed that Malkaa exhibited a high level of resistance/tolerance to the major Ethiopian mustard diseases prevalent in the target production environments, namely Alternaria leaf spot (*Alternaria brassicae*), Sclerotinia stem rot (*Sclerotinia sclerotiorum*), and white rust (*Albugo candida*). Using the standard 1–9 disease severity rating scale, where lower scores indicate greater resistance, the variety recorded a mean disease score of 2 for all assessed diseases, reflecting its desirable disease reaction and field stability. Comparative disease reaction data for Malkaa and the standard check varieties (Table 2,3,4)

5. Quality Analysis

The Ethiopian mustard variety "Malkaa," characterized by its attractive brown and yellow seed coloration, was highly preferred by both farmers and consumers due to its desirable seed appearance and superior oil yield potential. In addition to its market preference, the variety exhibited excellent oil quality attributes. Laboratory analysis conducted during the present study revealed that Malkaa possessed a high seed oil content of 47.36% (Table 1), indicating its strong potential for edible oil production and industrial utilization.

6. Performance Stability and Adaptation Domain

The Ethiopian mustard variety "Malkaa" was released for cultivation in the highland agro-ecologies of Bale, where it exhibited superior adaptation and performance under altitudinal ranges of 2300–2600 m above sea level and annual rainfall conditions of 750–1000 mm. The variety also possesses potential for wider production in other areas with comparable agro-climatic conditions. Based on multiple stability parameters evaluated across testing environments, Malkaa demonstrated relatively stable and consistent performance, indicating broad adaptability and reliable yield expression under varying environmental conditions (Table 1).

7. Variety Maintenance

The breeder and foundation seed are being maintained by Sinana Agricultural Research Center/ Oromia Agricultural Research Institute.

Table 1: Morpho-agronomic and quality trait description of Malkaa

No	Agronomical and Morphological Characteristics		
1	Adaptation area		Highlands of Bale: Sinana, Goba, Agarfa, Gassera, Adaba, Dodola) and other similar agro-ecologies
2	Altitude (m.a.s.l.)		2300 – 2600
3	Rainfall (mm)		750 – 1000
4	Seed Rate (Kg/ha)		10-12 (for row and broadcasting, respectively)
5	Planting date		End of July
6	Fertilizer Rate (DAP kg/ha)P_2O_5/N_2		69/46
7	Days to Flower		73
8	Days to Maturity		167
9	Plant Height (cm)		170
10	1000 Seed Weight (gm)		4.1
11	Seed Color		Brown and Yellow
12	Flower Color		Yellow
13	Oil content (%)		47.36
14	Yield (Qt/ha)	(Research Field)Average of three years	20-27 on average= 22.88
		On-farm	14-17 = 15.85
15	Disease reaction		Tolerant to Alternaria, Sclerotia Whit Rust
16	Yield advantage over Shaya (%)		31.21
17	Year of Release		2023
18	Breeder and Maintainer		SARC(OARI)

Table 2: Mean grain yield (kg/ha) of 15 Ethiopian Musturd genotypes across locations and years

Entry	Sinana			Agarfa			Mean	Yield Adv. over St. check
	2018	2019	2020	2018	2019	2020		
ACC 241902	1714	1633	1699	795	1121	1628	1432	
ACC 241895	1621	1237	1041	948	1704	1424	1329	
ACC 243738	1708	1579	1016	681	1314	1849	1358	
ACC 242852	1887	1422	1736	1038	1055	1583	1454	
ACC 242854	1802	1378	1791	981	1199	1958	1518	
ACC 241906	1764	1111	1345	867	1390	1752	1372	
ACC 242855	1772	1113	1336	784	1854	1717	1430	
ACC 241916	1933	1253	1490	1084	1033	1893	1448	
ACC 241909	2013	1185	1111	692	1544	1799	1391	
ACC 20133	1743	1306	2332	1266	1566	1089	1550	
ACC 20131(Malkaa)	**2770**	**1815**	**2280**	**1697**	**1413**	**1645**	**1937**	31.21%
ACC 241904	2219	1370	1926	650	1384	1791	1557	
Yellow Dodola	1659	1599	1817	705	797	1419	1326	
Shaya	1690	1654	1873	1324	1234	1459	1539	
Local check	1008	1120	1244	743	844	1554	1086	
MEANS	1820	1385	1602	950	1297	1637	1453	
5% LSD	757.9	501.1	964.6	456.3	617.8	999.8	339.4	
C.V.	21.0	21.4	21.0	21.3	33.0	22.0	21.2	

Table 3: Mean seed yield other agronomic traits for 15 Ethiopian Musturd genotypes tested in regional Variety trial combined at two locations (Sinana and Agarfa) over three years (2018-2020)

Entry	Days to Flower	Days to Mature	Plant ht. (cm)	Stand %	Diseases Score (0-5 scale)			1000 seed wt. (g)	Seed Yield (kg/ha)
					Alternaria	Sclerotia	White rust		
ACC 241902	71	167	172	82	4	5	4	3.8	1432
ACC 241895	75	167	172	82	5	5	4	3.7	1329
ACC 243738	74	166	172	84	5	5	3	3.8	1358
ACC 242852	73	165	173	83	5	5	3	3.5	1454
ACC 242854	73	167	175	83	5	5	4	3.5	1518
ACC 241906	74	167	174	82	5	4	4	3.4	1372
ACC 242855	75	167	170	83	5	5	4	3.5	1430
ACC 241916	70	167	176	82	5	5	3	3.8	1448
ACC 241909	75	167	164	83	5	5	4	3.7	1391
ACC 20133	72	166	170	81	5	5	4	3.6	1550
ACC 20131(Malkaa)	**73**	**167**	**170**	**81**	2	2	2	**4.1**	**1937**
ACC 241904	72	167	169	80	5	5	4	4.2	1557
Yellow Dodola	71	166	171	82	5	5	4	3.9	1326
Shaya	70	167	164	84	5	4	4	3.9	1539
Local check	71	165	172	82	5	5	4	3.0	1086
Mean	73	167	171	82				3.7	1453
LSD 5%	2.0	4.2	17.7	2.7				0.3	339.4
CV%	4.8	4.4	18.2	5.9				16.5	21.2

Table 4: Mean seed yield, agronomic traits and disease reaction of 'Malkaa' along with standard and local checks tested in two environments at varietal verification levels during 2018-2020 cropping seasons

Entry	Agronomic traits and Disease Reaction (1-9)								
	DF	DM	Stand %	PH (cm)	TSW (g)	SY (kg/ha)	Alternaria	Sclerotia	White rust
ACC 20131(Malkaa)	73	167	81	170	4.1	1937	2	2	2
Yellow Dodola	71	166	82	171	3.9	1326	5	5	4
Shaya	70	167	84	164	3.9	1539	5	4	4
Local check	71	165	82	172	3.0	1086	5	5	4

Note: DF = days to 50% maturity, DM, days to 90% maturity, PH = plant height (cm), TSW= Thousand seed weight (g) and SY = Seed yield (kg).

8. CONCLUSION

The present study demonstrated that the Ethiopian mustard variety "Malkaa" possesses superior agronomic performance, high grain yield potential, and elevated oil content across testing environments. The variety consistently outyielded the standard check variety, Shaya, with a yield advantage of 31.21%. Malkaa also exhibited stable field tolerance to major diseases, including Alternaria leaf spot (*Alternaria brassicae*), Sclerotinia stem rot (*Sclerotinia sclerotiorum*), and white rust (*Albugo candida*), indicating broad adaptation and production stability. Furthermore, its desirable seed characteristics, high oil yield, and suitability for mechanized production enhance its commercial value and seed multiplication potential. Therefore, large-scale promotion and cultivation of Malkaa could substantially contribute to improving Ethiopian mustard productivity, oilseed value chains, and market competitiveness.

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