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Research Article

Registration of Kabuli Chickpea Variety "Michile" for Highland and Midland Areas of Bale and East Bale, Southeastern Ethiopia

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Abstract

A newly released chickpea (Cicer arietinum L.) variety named Michile, with the pedigree designation FLIP-09-287C, has been officially released by the Sinana Agricultural Research Center in Ethiopia. This variety represents a major stride in Ethiopia's pulse crop improvement efforts, tailored specifically for the country's mid- and high-altitude agro-ecologies, where it thrives at elevations between 1600 and 1950 meters above sea level. Michile was developed through a meticulous breeding and selection process, involving multi-location trials conducted across Sinana, Ginnir, and Goro during the 2021 and 2022 main cropping seasons. These trials were designed to rigorously evaluate its performance under diverse environmental conditions, ensuring broad adaptability and resilience. Michile consistently outperformed standard check varieties, including the widely cultivated Arerti and Harbu, in terms of grain yield, earlier maturity, and agronomic robustness. Its early maturity is particularly advantageous for farmers in regions prone to terminal drought or erratic rainfall, allowing for timely harvests and reduced exposure to late-season disease pressure. Stability analysis across years and locations confirmed Michile yield reliability, making it a dependable choice for smallholder farmers seeking consistent returns. In addition to its agronomic strengths, Michile exhibits moderate resistance to several major chickpea diseases, such as Ascochyta blight, root rot, and Fusarium wilt, which are common constraints in Ethiopian chickpea production systems. Beyond its biological and agronomic merits, Michile holds substantial socioeconomic promise. Its superior yield potential and resilience can contribute to enhanced household food security, increased marketable surplus, and improved farmer incomes, especially in regions where chickpea serves as both a staple food and a cash crop. Given its proven performance, Michile is recommended for wide-scale adoption across Ethiopia's chickpea-growing belts, particularly in mid- to high-altitude areas. Its deployment is expected to play a pivotal role in boosting national chickpea productivity, promoting climate-resilient agriculture, and supporting the livelihoods of farming communities.

Keywords

Chickpea, Disease Resistance, Grain Yield, Variety Registration

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1. Introduction

Chickpea (*Cicer arietinum L.*) is a globally significant food legume, valued for its high protein content and its role in combating protein malnutrition, particularly in low-income regions. As a staple in many diets, chickpea contributes to food security and nutritional diversity, making it a strategic crop in both agricultural and health sectors [7, 8, 15].

Ethiopia stands out as Africa's leading producer, consumer, and exporter of chickpea. The country cultivates the crop on approximately 241,000 hectares, yielding over 515,000 metric tons annually, with an average productivity of about 2 tons per hectare [2, 11, 16]. According to FAOSTAT, Ethiopia ranked fourth globally in chickpea production in 2022, producing approximately 493,000 metric tons, underscoring its strategic importance in the global pulse economy [4, 6].

Despite this substantial output, chickpea productivity remains far below its genetic potential of over 5 tons per hectare. This gap is largely due to a combination of biotic stresses such as Fusarium wilt and Ascochyta blight and abiotic challenges including drought and poor soil fertility [7, 9, 12, 13]. To address these constraints, national chickpea breeding programs have focused on developing improved varieties that offer high grain yield, enhanced quality, resistance to major diseases, and stability across diverse agro-ecologies. These efforts are not only agronomically essential but also economically impactful. Chickpea provides a low-cost source of protein for both human consumption and animal feed, while also serving as a cash crop that contributes to household income and national foreign exchange earnings [2].

However, the national average yield of chickpea remains at 2.05 tons per hectare, significantly below its potential. This underperformance is primarily attributed to the limited genetic capacity of existing cultivars [10]. Therefore, the objective of this study is to register a newly released chickpea variety that demonstrates stable high yield and disease resistance/tolerance, specifically adapted to the highland and midland agro-ecologies of Bale, East Bale, and similar regions in Ethiopia.

2. Varietal Origin and Evaluation

Twelve chickpea genotypes obtained from the Ethiopian Institute of Agricultural Research, Debre Zeit Agricultural Research Center, were evaluated during the 2021–2022 cropping season across three representative locations: Sinana, Goro, and Ginnir. The trials were established using a randomized complete block design (RCBD) with four replications to ensure statistical precision and minimize environmental variability. Each experimental plot comprised four rows, each 4 meters in length, with an inter-row spacing of 0.3 meters, providing optimal plant density for accurate phenotypic assessment.

The chickpea genotype FLIP-09-287C was selected based on its significantly superior mean grain yield and favorable response to major chickpea diseases, including Ascochyta blight, root rot, and wilt, across all test environments during the 2021–2022 season. In 2023/24, candidate genotypes along with standard checks Harbu and Arerti were verified at six locations, comprising both on-station and two on-farm sites per location, as part of the official release process. Trials were evaluated by farmers and the National Variety Release Committee (NVRC), leading to the release of FLIP-09-287C, officially named "Michile," for national release.

3. Agronomic and Morphological Characteristics

The development of the chickpea variety Michile prioritized enhanced grain yield and improved resistance to major diseases and insect pests, which are critical constraints in chickpea production. Michile demonstrated a flowering period of approximately 72 days after emergence and reached physiological maturity around 135 days, although this varied slightly depending on the growing environment. The plant attained an average height of 52 cm, which was marginally shorter than the standard check variety Arerti, recorded at 56 cm. Despite its shorter stature, Michile maintained competitive agronomic performance.

On average, Michile produced 27 pods per plant, each typically containing a single seed. It belongs to the Kabuli type of chickpea, known for its large, cream-colored seeds with a smooth seed coat. The seeds are bold and attractive, making them suitable for both domestic consumption and export markets. The average 1,000-seed weight was 24.9 grams, indicating a desirable seed size for market preference (Table 1 and Table 3). In addition to its agronomic and morphological traits, Michile has shown promising adaptability across diverse agro-ecological zones, making it a valuable candidate for wider cultivation.

4. Yield Performance

When evaluating the overall seed yield across multiple locations and years, the chickpea variety Michile (FLIP-09-287C) demonstrated superior performance compared to the standard check variety, Arerti. The average grain yield of Michile was recorded at 2805 kg per hectare, which is notably higher than Arerti yield of 2463 kg per hectare, as presented in Table 2. Over a span of three consecutive years, Michile consistently outperformed the standard check in terms of grain yield. This sustained advantage highlights the variety's stability and adaptability across diverse agro-ecological conditions. On average, Michile produced 13.8% more grain yield than Arerti, reinforcing its potential as a

high-yielding cultivar. The chickpea variety Michile (FLIP-09-287C) demonstrated strong yield performance under both research and farmers field conditions. In research fields, where optimal agronomic practices and controlled environments were applied, Michile achieved a grain yield of 3800 kg per hectare, showcasing its maximum production potential. In contrast, under farmers' field conditions, Michile produced a yield of approximately 2400 kg per hectare (Table 1).

5. Disease Reaction

The chickpea variety Michile (FLIP-09-287C) demonstrated moderate resistance to several major diseases affecting chickpea production. Specifically, it showed resilience against Ascochyta blight (Ascochyta rabiei), root rot (Rhizoctonia bataticola), and wilt (Fusarium oxysporum f. sp. ciceri), as detailed in Table 3.

6. Stability Performance

Table 1. *Agronomical and Morphological Characteristics and Agro-ecological Zones of Adaptation of Michile, Kabuli type chickpea variety.*

Variety name:		**Michile (FLIP-09-287C)**
Adaptation area		Goro, Ginir, Sinana, Dellomena, Berbere and other similar agro-ecologies
Altitude (m.a.s.l.)		1600 – 1950
Rainfall (mm)		550 –650
Seed Rate (Kg/ha)		120-140
Planting date		End of September to Early October
Days to Flower		72
Days to Maturity		135
Plant Height (cm)		52
Growth habit		Erect
100 Seed Weight (gm)		24.9
Seed Color		Light white
Cotyledon Color		White
Flower Color		White
Yield (Qt/ha)	On-station (Research Field)	38
	On-farm	24
Disease reaction		Tolerant to Aschochyta blight, root rot and wilt
Yield advantage over Arerti (%)		13.88
Year of Release		2024
Breeder and Maintainer		SARC (IQQO)

A comprehensive study was conducted to evaluate the yield stability of twelve distinct chickpea genotypes over a period of three consecutive years across three agro-ecologically diverse locations. The primary objective was to assess the consistency of grain yield performance under varying environmental conditions. To quantify stability, statistical parameters were computed following the method outlined in reference [1, 3, 5, 14] which involves regression analysis of genotype performance across environments. Among the genotypes tested, 'Michile' demonstrated a regression coefficient (bi) approximating unity, coupled with a high mean grain yield. This combination suggests that 'Michile' possesses a stable performance across environments and exhibits broad adaptability, making it a promising candidate for cultivation in diverse agro-climatic zones."

Table 2. Mean grain yield (kg/ha) of 12 Chickpea genotypes across locations and years (2021-2022).

Entry	Ginnir		Goro		Sinana		Means	Yield Adv. over St. check
	2021	2022	2021	2022	2021	2022		
DZ-2012-CK-0262	3165	2212	1680	1008	2031	1786	1980	
FLIP-09-155C	3485	1669	2600	1538	2593	2500	2398	
DZ-2012-CK-0278	3187	1662	1769	732.1	2514	1858	1954	
FLIP-09-159C	3220	2247	2388	2096	2201	1736	2315	
FLIP-09-287C	3986	2417	2633	2618	2942	2232	2805	13.88%
FLIP-85-17C	2577	401.8	1860	2821	2291	1744	1949	
DZ-2012-CK-0259	3742	1054	1761	1531	2083	2607	2130	
FLIP-93-58C	3482	773.6	2178	1068	1560	1763	1804	
FLIP-09-93C	2646	887.4	1474	2072	1507	1566	1692	
ILC-1929	3136	761.2	1413	1183	2477	1985	1826	
Harbu	2971	1306	1574	2135	2012	2278	2046	
Arerti	3721	2192	1873	2382	2724	1885	2463	
MEANS	3277	1465	1934	1765	2245	1995	2113	
5% LSD	1243.0	1147	1485	1047	502.9	527.5	500.9	
C.V.	24.0	21.6	24.2	22.8	16.0	18.0	21.7	

Table 3. Mean seed yield and other agronomic traits of 12 chickpea genotypes, Kabuli type, tested in the regional variety trial combined for three locations (Ginir, Goro and Sinana) over two years (2021-2022).

Entry	Days to Flower	Days to Mature	Stand%	Plant ht. (cm)	No. Pod/pl	No. Seed/pod	Disease score (1-9 scale)			100 seed wt (g)	Seed Yield (kg/ha)
							AsB	Root Rot	Wilt		
DZ-2012-CK-0262	63	136	72	53	27	1	5	7	7	25.7	1980
FLIP-09-155C	65	136	75	58	24	1	6	6	6	32.5	2398
DZ-2012-CK-0278	66	135	74	57	26	1	6	6	6	31.4	1954
FLIP-09-159C	66	136	74	52	25	1	5	5	5	32.6	2315
FLIP-09-287C	72	135	73	52	27	1	4	4	4	24.9	2805
FLIP-85-17C	72	137	75	62	28	1	5	5	6	30.1	1949
DZ-2012-CK-0259	66	136	77	57	30	1	6	6	6	30.7	2130
FLIP-93-58C	69	136	73	55	26	1	5	6	6	26.6	1804
FLIP-09-93C	66	136	73	59	32	1	6	7	7	24.8	1692
ILC-1929	68	136	72	59	28	1	6	6	6	27.8	1826
Harbu	69	136	74	60	23	1	5	6	6	32.8	2046
Arerti	62	135	73	56	24	1	5	6	6	30.7	2463
MEANS	67	136	74	57	27	1				29	2113

Entry	Days to Flower	Days to Mature	Stand%	Plant ht. (cm)	No. Pod/pl	No. Seed/pod	Disease score (1-9 scale)			100 seed wt (g)	Seed Yield (kg/ha)
							AsB	Root Rot	Wilt		
5% LSD	4.20	7.04	5.67	8.44	7.33	0.05				1.68	500.9
C.V.	11.0	9.1	13.5	16.2	18.3	8.2				10.1	21.7

7. Conclusion

Michile stands out as a high-performing Kabuli chickpea variety, combining superior yield potential with remarkable stability across diverse environments and growing seasons. Its resistance to prevalent chickpea diseases and insect pests enhances its reliability for farmers in major production zones. Agronomically, Michile excels with a higher number of pods per plant, increased seed output, and robust branching traits that contribute to its overall productivity and farmer preference over local varieties. Beyond field performance, Michile offers notable industrial and nutritional advantages, making it a valuable asset for both commercial processing and dietary enrichment. Following rigorous multi-location trials and stakeholder validation, Michile has been officially released for large-scale cultivation in Ethiopia's key chickpea-growing regions.

8. Variety Maintenance

The breeder and foundation seed will be maintained by Sinana Agricultural Research Center/ Oromia Agricultural Research Institute.

Abbreviations

CSA	Central Statistical Agency of Ethiopia
FAO	Food and Agricultural Organization
ICRISAT	International Crop Research Institute for Semi-Arid Tropic
NVRC	National Variety Release Committee

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

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