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Evaluation of Improved Dessi Chickpea (*Cicer arietinum* L.) Varieties in Golohajo, Somali Region, Ethiopia.

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Abstract

Chickpea (*Cicer arietinum* L.) is an economically important crop cultivated by nearly one million smallholder farmers in Ethiopia. As the largest chickpea-producing country in Africa, Ethiopia contributes approximately 37% of the total cultivated area and 48% of the production. However, the lack of environmentally adapted varieties remains a major constraint to productivity in the study area. A field experiment was conducted during the 2023 cropping season in Fafan Zone, Somali Regional State (SRS), Ethiopia, to introduce and evaluate high-yielding chickpea varieties. Six improved varieties (Esheter, Natoli, Hora, Koka, Dimtu, and Dalota) were tested in a randomized complete block design (RCBD) with three replications. Each experimental plot consisted of five rows. Data on phenological traits, growth parameters, yield, and yield-related components were collected. Analysis of variance (ANOVA) revealed significant differences among the varieties for total yield and key agronomic traits. Natoli (2027 kg/ha) and Dimtu (1495 kg/ha) outperformed the other varieties, demonstrating the highest grain yields. Therefore, these varieties are recommended for local production. Further multi-season and multi-location trials are needed to validate these findings and provide robust recommendations.

Key words: Chickpea, Improved varieties, Adaptation trial, Grain yield

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a vital cool-season food legume predominantly cultivated in arid and semi-arid tropical regions. As the world's second most important legume crop, it plays a crucial role in small-scale agriculture (Varshney et al., 2014). Rich in high-quality protein, chickpea serves as a key dietary staple, particularly for underprivileged populations (Jukanti et al., 2012). Globally, it is grown on 17.85 million hectares, yielding over 17 million metric tons annually (FAOSTAT, 2019). India dominates production, contributing ~70% of the world's supply (Korbu et al., 2020), while Ethiopia leads in Africa, producing more than 500,000 metric tons from ~243,000 hectares—accounting for over 90% of sub-Saharan Africa's output (CSA, 2019; FAOSTAT, 2019; Verkaart et al., 2017). With over 900,000 smallholder farmers engaged in its cultivation (CSA, 2019), chickpea is a cornerstone of Ethiopia's agricultural economy and nutrition.

Ethiopia accounts for 37% of Africa's chickpea area and 48% of its production, with the Amhara and Oromia regions responsible for over 90% of national output (IFPRI, 2010). The crop covers ~233,440 hectares annually, yielding an estimated 312,080 metric tons (CSA, 2010). Nutritionally, chickpea excels among legumes, averaging 23% protein, 47% starch, 5–6% fat, 6% fiber, and essential minerals (zinc, iron, calcium) and vitamins (Munyua, 2013; Güler et al., 2001). Historically, desi-type chickpea dominated Ethiopian production (95%), but kabuli varieties are gaining traction due to export demand (Gaur et al., 2008).

Despite its potential, chickpea cultivation in Ethiopia's Somali region remains underdeveloped. While records of its introduction are scarce, recent expansions into dry lowland areas highlight its suitability for arid climates. Given its drought tolerance and nutritional benefits, chickpea is a promising crop for dryland farming yet adoption in the Somali region remains limited. This study aims to introduce and evaluate high-yielding chickpea varieties to enhance productivity and farmer livelihoods in the region.

MATERIALS AND METHODS

Experimental Sites, Design, and Materials

The study was conducted during the 2022/2023 cropping season at Gola-ajosite, Fafan Center, Fafan Zone, Somali Regional State, Ethiopia. Six chickpea varieties (*Esheter*, *Natoli*, *Hora*, *Koka*, *Dimtu*, and *Dalota*) were evaluated alongside one standard check under rainfed conditions.

The experiment followed a Randomized Complete Block Design (RCBD) with three replications. Each plot measured 3 m in length and 2 m in width, with five rows spaced 0.4 m apart. The central three rows were harvested for grain yield estimation. Adjacent plots and replications were spaced 0.5 m and 1 m apart, respectively.

Data Collection and Statistical Analysis

Agronomic data were collected at both the plant and plot levels. Plant-level measurements included the number of pods per plant, the number of seeds per pod, and plant height (cm), which were averaged from five randomly selected plants within each plot. Plot-level data encompassed days to 50% flowering, days to 90% physiological maturity, and seed yield (g) per plot. The collected data were analyzed using GenSTAT statistical software, and mean separation was performed using Duncan's Least Significant Difference (LSD) test at a 5% significance level to determine significant differences among the chickpea varieties.

RESULTS AND DISCUSSION

Phenological and Growth Parameters

Varieties exhibited highly significant ($P < 0.01$) differences in days to 50% flowering (Table 1). Among the tested cultivars, Natoli reached 50% flowering earliest at 39.33 days, while Koka was the latest at 53.67 days, indicating clear genetic variability among the varieties. These findings are consistent with the results reported by Getachew et al. (2015), who also observed similar variations in chickpea flowering times. Likewise, days to 90% physiological maturity were significantly influenced ($P < 0.01$) by the varieties (Table 1). Natoli was the latest to mature at 123.7 days, whereas Hora reached maturity earliest at 101.7 days, further reflecting the genetic divergence among the chickpea varieties. This result aligns with the findings of Getachew et al. (2015), who reported comparable maturity variations in chickpea genotypes. Plant height also showed highly significant ($P < 0.01$) variation among the varieties tested (Table 1). Dalota

produced the tallest plants, averaging 42.93 cm, while Hora exhibited the shortest plant height at 39.53 cm. These differences are likely attributed to genetic factors, which is in agreement with the findings of Ercan et al. (2013), who reported similar variability in chickpea plant height.

Table 1. Mean performance phenological and growth parameters of improved chickpea varieties

Variety	DF	DM	PH(cm)
Hora	48.33c	101.7a	39.53a
Esheter	44.67b	105.0 a	42.33c
Dalota	42.67b	106.3a	42.93c
Koka	53.67d	110.0ab	41.33b
Dimtu	51.00cd	121.7bc	41.20b
Natoli	39.33 a	123.7c	42.40c
LSD _(0.05)	3.249	13.03	0.986
CV (%)	3.8	6.4	1.3

CV: Coefficient of variation, DF: Days to flowering, DM: days to maturity, PH: plant height, LSD:least significance difference, means followed by different letters with in columns are significantly different by Duncan new multiple range test(p:0.05)

Yield and Yield Component Parameters

Number of Pods per Plant

Analysis of variance revealed highly significant ($P < 0.01$) differences among the chickpea varieties in the number of pods per plant (Table 2). The highest number of pods was recorded in Natoli, with an average of 40.40 pods per plant, while the lowest was observed in Hora, which produced 31.57 pods per plant. This variation is likely attributed to genetic differences among the chickpea cultivars. These findings are in agreement with the results of Dan et al. (2016), who reported significant variability in pod numbers among different chickpea varieties. Similarly, the number of seeds per pod was significantly ($P < 0.05$) affected by variety (Table 2). Natoli produced the highest seed count per pod, averaging 1.933 seeds, while Hora, Esheter, and Koka each produced the lowest at 1.333 seeds per pod. This difference in seed number per pod likely reflects underlying genetic divergence among the tested varieties. Supporting these observations, Getachew et al. (2015) also reported comparable variability in seed numbers per pod among chickpea genotypes.

Table 2. Mean performance of Yield and yield component parameters of chickpea varieties

Variety	NPP	NSP	TSW(g)	BY (kg ha ⁻¹)	GY (kg ha ⁻¹)
Hora	31.57	1.333 ^a	0.2800 ^b	4424bc	1393abc
Esheter	36.00b	1.333 ^a	0.2107 ^a	3909ab	1197ab
Dalota	39.33c	1.467 ^a	0.3007 ^{bc}	4414bc	1678c
Koka	36.70b	1.333 ^a	0.1887 ^a	3407a	1188a
Dimtu	35.17b	1.533 ^a	0.2907 ^{bc}	4690c	1495bc
Natoli	40.40c	1.933 ^b	0.3513 ^c	5426d	2027d
LSD _(0.05)	1.994	0.2629	0.06491	726.9	302.8
CV (%)	3.0	9.7	13.2	9.1	11.1

CV: Coefficient of variation, NPP: number of pods per plant, NSP: number of seeds per pod, TSW:thousand seed weight, BY: biomass yield, GY: grain yield, LSD:least significance difference,

Thousand Seed Weight

Variety had a significant ($P < 0.05$) effect on thousand seed weight (Table 2). The highest thousand seed weight was recorded in Natoli, with an average of 0.3513 g, while the lowest was observed in Koka at 0.1887 g. This variation is likely due to genetic differences among the chickpea varieties. These findings are consistent with the results of Dan et al. (2016), who also reported significant differences in thousand seed weight among various chickpea cultivars.

Biomass Yield (kg ha⁻¹)

The analysis of variance revealed significant ($P < 0.05$) differences in biomass yield among the chickpea varieties. Natoli produced the highest biomass yield at 5426 kg ha⁻¹, followed by Dimtu with 4690 kg ha⁻¹, while the lowest biomass yield was recorded in Koka at 3407 kg ha⁻¹. These results highlight the presence of genetic variability among the tested chickpea varieties, contributing to differences in biomass production.

Grain Yield (kg ha⁻¹)

Grain yield was significantly influenced ($P < 0.05$) by variety (Table 2). The highest grain yield was obtained from Natoli, producing 2027 kg ha⁻¹, followed by Dalota with 1678 kg ha⁻¹, while the lowest yield was recorded in Koka at 1188 kg ha⁻¹. This variation in grain yield among the chickpea varieties can be attributed to genetic differences. These findings are in line with the results of Desai et al. (2016), who similarly reported significant grain yield disparities among different chickpea cultivars.

CONCLUSIONS AND RECOMMENDATIONS

The study revealed significant differences in yield-related traits among the chickpea varieties. Natoli and Dimtu demonstrated superior performance across all parameters, with Natoli yielding the highest grain output (2027 kg ha⁻¹) and Dimtu ranking second (1495 kg ha⁻¹).

Natoli and Dimtu are recommended for cultivation by local farmers due to their consistent high performance. Further research across multiple seasons and locations is essential to validate these findings and ensure robust recommendations.

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Authors' Contributions

Mohamed Abdirahman Ismail was responsible for the conceptualization of the study, developing the research methodology, and preparing the original draft of the manuscript. Abdi Husen Meydane carried out the field experiment, managed data entry, and performed the statistical analysis. He also provided supervision, contributed to the interpretation of the data, and critically reviewed the manuscript for important intellectual content. Both authors have read and approved the final version of the manuscript.

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Declarations

Ethics approval and consent to participate: Not applicable for this study.

Consent to publish: Not applicable.

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Ethics approval and consent to participate were not applicable for this study. The authors fully consent to participate in and publish this article. Furthermore, the authors declare that they have no competing interests related to this work.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request. All data used in this research are securely stored and will be made accessible to interested researchers for verification and further analysis, in accordance with institutional and ethical guidelines.

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