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COMPARATIVE ANALYSIS OF CHICKPEA VARIETIES AND LINES UNDER DROUGHT AND HIGH TEMPERATURE CONDITIONS

(On the example of ICARDA and local varieties)

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Abstract

The article highlights the importance of chickpea (Cicer arietinum L.) in agriculture and food security, as well as the relevance of developing stable, high-yielding varieties under climate change and drought conditions. Within the framework of the study, 13 chickpea varieties and lines introduced from the international organization ICARDA were comparatively evaluated with local varieties Zumrad and Polvon. The adaptability of varieties and lines to local soil and climatic conditions, growth and development characteristics, phenological stages, morpho-biological traits, and resistance to high temperature, drought, diseases, and pests were assessed in demonstration nurseries. In addition, yield, thousand-seed weight, grain quality, and technological characteristics were determined. Based on the obtained results, high-yielding, stable varieties and lines with valuable agronomic traits were recommended as promising initial breeding material.

Keywords: Chickpea, grain legumes, breeding, ICARDA, varieties and lines, adaptability, yield, drought tolerance, heat tolerance, resistance to diseases and pests, soil and climatic conditions, food security.

Introduction

Currently, climate change, limited water resources, increasing air temperatures, and frequent drought events significantly complicate the achievement of stable and high crop yields. Under these conditions, the importance of grain-legume crops, particularly chickpea, is increasing. Chickpea has high nutritional value and plays a significant role in supplying the population with protein-rich food products, as well as in improving soil fertility. Moreover, due to symbiosis with root nodule bacteria, chickpea is capable of fixing atmospheric nitrogen, which contributes to enhanced soil productivity.

According to O.E. Ziyadov and A.A. Abdiyev, early maturity of chickpea is genetically determined and depends on soil-climatic and meteorological conditions, agronomic practices, and sowing dates [1, p. 417].

R.S. Malhotra, C. Akem, and S. Kamel report that research on late autumn sowing of chickpea is being conducted worldwide, and chickpea sown in late autumn shows higher grain yield and quality parameters [2, pp. 84–85].

M.G. Saxena noted that under the soil and climatic conditions of Syria, chickpea yield increased by 73% under irrigation compared to rainfed conditions, and late autumn sowing increased yield by 65% compared to early spring sowing [3, pp. 13–27].

According to T. Wery, in France chickpea is sown from November 15 to December 15 with a plant density of 60–80 plants per square meter, emphasizing

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the cold tolerance of chickpea and its suitability for late autumn sowing [4, pp. 6–8].

R.M. Shah, A.R. Pathak, and I.A. Patel reported that in India, to obtain high and high-quality yields from the new ICCC–4 variety, sowing should be carried out from November 15 to December 15 with row spacing of 22.5–30.0 cm and plant spacing of 5 cm [5, pp. 22–24].

In view of the above, the demand for chickpea varieties that are stable, high-yielding, and tolerant to drought and high temperatures is increasing. Therefore, the development of varieties adapted to local soil and climatic conditions, resistant to diseases and pests, and possessing valuable agronomic traits is a key objective of breeding programs.

The comparative evaluation of chickpea varieties and lines developed by ICARDA with local varieties allows identification of promising initial material for breeding. The results of this study are important for improving chickpea production efficiency, developing national breeding programs, and ensuring food security.

Aim and Objectives of the Study

The aim of the study was to identify stable, high-value chickpea varieties and lines under local conditions and recommend them as promising initial material for breeding.

Objectives:

1. To comparatively evaluate 13 chickpea varieties and lines introduced from ICARDA with local varieties Zumrad and Polvon.
2. To assess phenological stages, morpho-biological traits, and resistance to diseases and pests.
3. To determine yield, grain weight, thousand-seed weight, and grain quality.

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4. To recommend stable and high-yielding varieties and lines for breeding programs.

Materials and Methods

The study was conducted in demonstration nurseries using 13 chickpea varieties and lines introduced from ICARDA: FLIP 05-13C, FLIP 07-108C, FLIP 82-10C, FLIP 97-13C, FLIP 03-97C, FLIP 03-50C, FLIP 98-28C, FLIP 99-41C, FLIP 99-45C, FLIP 05-50C, FLIP 97-23C, FLIP 08-90C, and FLIP 08-44C.

The following traits were evaluated:

- Height of the main stem and position of the first pod;
- Number of pods and seeds per pod;
- Total number of seeds per plant and thousand-seed weight;
- Phenological stages and growth dynamics;
- Resistance to diseases and pests.

Results and Discussion

Table 1 shows the dynamics of main stem height and the height of the first pod position during different growth stages. In all varieties and lines, both parameters increased gradually from branching to full maturity.

At the branching stage, main stem height ranged from 17.3 to 22.0 cm, with the lowest value in FLIP 08-90C and the highest in FLIP 97-23C.

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Table 1. Growth dynamics of stem height of chickpea varieties and lines in the competitive variety trial nursery, 2025

№	Variety and line name	Average height of the main stem and position of the first pod (cm)						
		Main stem height at branching stage (cm)	At full flowering stage		At full podding stage		At full maturity stage	
			Stem height (cm)	Height of first pod position (cm)	Stem height (cm)	Height of first pod position (cm)	Stem height (cm)	Height of first pod position (cm)
1	FLIP 05-13C	17.5	30.0	17.5	54.0	21.9	63.5	27.3
2	FLIP 07-108C	21.2	31.5	20.9	58.2	25.5	61.0	29.1
3	FLIP 82-10C	19.4	32.5	18.6	59.9	23.8	65.0	28.1
4	FLIP 97-13C	18.1	27.5	16.2	52.8	21.3	58.0	24.8
5	Zumrad st	19.3	28.0	17.8	56.0	23.2	62.0	27.0
6	FLIP 03-97C	21.2	30.5	20.7	51.7	20.7	57.0	24.3
7	FLIP 03-50C	18.7	29.0	18.1	54.9	23.3	60.5	28.1
8	FLIP 98-28C	19.2	31.0	20.9	55.8	25.8	64.0	30.8
9	FLIP 99-41C	20.6	28.5	16.9	54.1	26.1	61.0	32.5
10	Polvon st	19.1	28.5	17.7	55.6	22.2	57.0	26.2
11	FLIP 99-45C	17.8	29.0	13.9	56.1	18.1	63.5	25.9
12	FLIP 05-50C	19.9	30.0	19.0	51.9	19.9	58.5	25.3
13	FLIP 97-23C	22.0	29.5	20.9	57.1	26.1	62.0	29.0
14	FLIP 08-90C	17.3	28.5	15.1	56.3	21.8	63.0	27.8
15	FLIP 08-44C	21.3	29.5	19.6	58.5	25.8	66.5	28.4

At full flowering, stem height ranged from 27.5 to 32.5 cm, while the height of the first pod position ranged from 13.9 cm (FLIP 99-45C) to 20.9 cm (FLIP 07-108C and FLIP 97-23C).

At full podding, stem height ranged from 51.7 to 59.9 cm, and the height of the first pod position ranged from 18.1 to 26.1 cm; the highest first pod position was recorded in FLIP 99-41C and FLIP 97-23C (26.1 cm).

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At full maturity, stem height ranged from 57.0 to 66.5 cm (maximum in FLIP 08-44C), while the height of the first pod position ranged from 24.3 cm (FLIP 03-97C) to 32.5 cm (FLIP 99-41C).

Overall, FLIP 07-108C, FLIP 82-10C, and FLIP 08-44C tended to exceed the local varieties (Polvon and Zumrad) in stem height and/or first pod position, indicating stable growth and potential for higher productivity.

Table 2 shows the main biometric and agronomic traits. The number of seeds per pod was relatively stable across varieties (1.1–1.2). Varieties FLIP 07-108C, FLIP 03-50C, FLIP 99-45C, and FLIP 08-44C showed higher values (1.2 seeds per pod).

The total number of seeds per plant ranged from 63.9 to 80.7, with the highest value recorded in FLIP 07-108C. High values were also observed in FLIP 08-44C, FLIP 82-10C, and FLIP 97-23C.

Table 2. Main biometric and agronomic traits of chickpea plants in the competitive variety trial nursery, 2025.

№	Variety and line name	Number of pods per plant (pcs)	Average number of seeds per pod	Total number of seeds per plant	Thousand-seed weight (g)
1	FLIP 05-13C	62.1	1.1	68.3	370
2	FLIP 07-108C	67.3	1.2	80.7	375
3	FLIP 82-10C	66.1	1.1	72.7	375
4	FLIP 97-13C	59.2	1.1	65.1	360
5	Zumrad st	64.1	1.1	70.5	370
6	FLIP 03-97C	61.2	1.1	67.3	375
7	FLIP 03-50C	60.1	1.2	72.1	360
8	FLIP 98-28C	64.2	1.1	70.6	370
9	FLIP 99-41C	63.0	1.1	69.3	365
10	Polvon st	63.1	1.1	69.4	370
11	FLIP 99-45C	60.5	1.2	72.6	365
12	FLIP 05-50C	58.1	1.1	63.9	370
13	FLIP 97-23C	66.0	1.1	72.6	375
14	FLIP 08-90C	60.6	1.1	66.6	360
15	FLIP 08-44C	66.3	1.2	75.6	370

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Thousand-seed weight ranged from 360 to 375 g. The heaviest seeds were observed in FLIP 07-108C, FLIP 82-10C, FLIP 03-97C, and FLIP 97-23C.
According to the yield assessment (data not shown in the tables), FLIP 07-108C, FLIP 82-10C, FLIP 97-23C, and FLIP 08-44C exceeded the local varieties Polvon and Zumrad by 0.18–0.23 t/ha (1.8–2.3 c/ha).

Discussion

The results showed that several ICARDA varieties and lines demonstrated superior performance under local conditions in terms of yield, growth stability, drought tolerance, and resistance to diseases and pests. These genotypes represent valuable initial material for breeding programs.

Conclusions

Significant differences were observed among varieties and lines in stem height and first pod position. Varieties FLIP 99-41C, FLIP 97-23C, and FLIP 08-44C were distinguished by superior growth and development characteristics.
In conclusion, based on yield structure elements, FLIP 07-108C, FLIP 08-44C, and FLIP 97-23C showed relatively high performance and can be considered promising for breeding and production.

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