YIELD PERFORMANCE AND BIOMASS DEVELOPMENT OF CHICKPEA (*CICER ARIETINUM* L.) UNDER IRRIGATED AND RAINFED CONDITIONS

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RESEARCH ARTICLE

Abstract
The experiment was carried out at the Research Institute of Nyíregyháza on humus sandy soil. The cv. 'Bori' chickpea (Cicer arietinum L.) variety was used during the 2025 growing season. The experimental field was divided into two parts: irrigated and rainfed (non-irrigated) plots. In the rainfed (non-irrigated) plots, only the natural precipitation was available during the growing season, while in the irrigated plots the rainfall was supplemented with four applications of 30 mm irrigation.
During cultivation, biostimulants were applied twice as foliar fertilizers: once before flowering and once after flowering, but before pod filling. The biostimulants contained algae, silicon, or a combination of algae and silicon.
At the end of the growing season, root length, shoot length, above-ground biomass, and yield were measured.
The results showed that irrigation could nearly double the yield, and biomass production also increased significantly. The effects of the biostimulants have not yet been statistically significant; however, the results of the control and the algae + silicon treatments were similar.

Keywords: chickpea, alternative, climate change, biostimulator, foliar fertilizer
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INTRODUCTION

One of the most important challenges of modern agriculture is to provide an appropriate response to extreme weather conditions caused by climate change. In recent years, the frequency and duration of drought periods have significantly increased in Hungary. This clearly imposes stress on cultivated crops. Persistently high temperatures may shorten the growing season, which affects various growth parameters as well as yield levels (Lawlor, 2005).

Chickpea (*Cicer arietinum* L.) is generally considered a crop with good drought tolerance, as it originates from the Mediterranean region. Only limited literature was available on the water use efficiency of chickpea; however, it has been established that adequate moisture is essential during germination and pod setting stages, that is, during early plant development (Dogan et al., 2013). In addition to uneven emergence, prolonged temperatures below 15 °C during flowering can result in significant yield losses (Siddique et al., 2001).

Dogan et al. (2013) investigated the water requirements of chickpea by applying different irrigation levels over two years. Their results showed that chickpea is capable of producing acceptable yields under dry conditions; however, significantly higher yields were achieved under continuous irrigation. Irrigation also influenced plant height and, consequently, total biomass production.

İrik (2017) didn't focuse on irrigation levels but on irrigation timing, aligning water application with specific phenological stages. The study found that irrigation applied at the 50% pod-setting stage was utilized more efficiently than continuous water supply throughout the entire growing season.

Gan et al. (2010) aimed to improve water use efficiency by applying different nitrogen fertilizer rates in chickpea cultivation, combined with seed inoculation using *Rhizobium* bacteria. As a result, yield levels increased.

In light of these findings, our research focused on irrigated and non-irrigated chickpea production, where different biostimulants were applied. Our objective was to assess the effect of irrigation on sandy soils, complemented by evaluating the impact of various biostimulants on yield and biomass production.

MATERIAL AND METHOD

The experiment was established at the Research Institute of Nyíregyháza, where humus sandy soil is typical. The cv. 'Bori' chickpea variety was used and sown in April at a row spacing of 24 cm, when the soil temperature consistently reached 8 °C. The size of the microplots was 1 m^2.

During cultivation, irrigated and non-irrigated treatments were separated. In the non-irrigated plots, only natural precipitation was available, which totaled 171 mm during the growing season. In the irrigated plots, natural rainfall was supplemented with irrigation by applying 30 mm each time when no precipitation occurred. This was done four times during the growing season, resulting in a total of 120 mm irrigation.

In the microplot experiment, biostimulants were applied as foliar fertilizers twice, at the recommended doses provided by the manufacturers: once before flowering and once after flowering, before pod filling. Four treatment groups were established: (1) control, (2) algae-based, (3) silicon-based, and (4) algae + silicon-based products. The control group received only water at the time of foliar application.

At the end of the growing season, five representative plants were selected per plot and evaluated individually. Root length, root weight, shoot length, and shoot weight were measured, along with yield and above-ground biomass excluding seeds.

For the data analysis, we used R version 4.2.2.

RESULTS AND DISCUSSIONS

Root length increased significantly more under irrigated conditions during the growing season compared to non-irrigated treatments (*Table 1*).

Similarly, shoot length was significantly greater under irrigation (average 41.63 cm) than in non-irrigated plants (average 35.80 cm). Although no statistically significant differences were observed among the foliar fertilizer treatments, the control treatment showed the highest average shoot length values.

In terms of biomass production, plants grown under irrigated conditions achieved significantly higher values per microplot (332.63 g) compared to those under non-irrigated conditions (259.29 g). While differences among treatments were not statistically significant, the control and the algae + silicon treatments resulted in notably higher biomass compared to plants treated only with algae or only with silicon.

Regarding yield, plants in irrigated plots produced significantly higher yields (305.89 g) than those in non-irrigated plots (168.90 g), representing nearly a twofold increase. Although no statistically significant differences were found among treatments, higher yields were observed in the control and algae + silicon treatments.

It was evident that root length was not a reliable predictor of biomass production or yield. In contrast, shoot length showed a stronger relationship with both biomass accumulation and yield.

Under the climatic conditions of 2025, the applied biostimulants did not show measurable effects. This may be due to the fact that, in this particular growing season, the products were not able to express their potential. For future

Table 1

Growth and Yield Parameters of Chickpea in 2025

	root lenght	stem lenght	crop yield	biomass quantity
Effect of irrigation				
Rainfed	13.65^{b}	35.80^{b}	168.90^{b}	259.29^{b}
Irrigated	15.10^{a*}	41.63^{a**}	305.89^{a***}	332.63^{a*}
Effect of treatments				
1. Controll	14.475^{a}	40.38^{a}	257.61^{a}	328.33^{a}
2. Alga	14.325^{a}	37.85^{a}	219.66^{a}	276.13^{a}
3. Silicon	14.225^{a}	38.08^{a}	225.54^{a}	267.25^{a}
4. Alga+Silicon	14.475^{a}	38.55^{a}	246.77^{a}	312.12^{a}

p<0.05 ''* *p<0.01 '**'* *p<0.001 '***'* studies, it is recommended to expand the range of biostimulant types and to increase the number of applications.

CONCLUSIONS

Based on the results of 2025, it can be concluded that the presence of precipitation has a greater influence on yield and biomass production than the applied foliar fertilizers; therefore, significantly higher yields can be achieved through irrigation.

The effects of the biostimulants could not be statistically distinguished; however, the results of the control and the algae + silicon-treated plots were similar.

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