

EFFECTS OF IRRIGATION METHODS AND SOIL MOISTURE
REGIMES ON THE GROWTH DYNAMICS OF CHICKPEA
(*CICER ARIETINUM L.*) CULTIVARS

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ABSTRACT: *This study evaluated the growth dynamics of two chickpea (*Cicer arietinum L.*) cultivars, Obod and Polvon, under furrow and drip irrigation and two irrigation regimes designated 60–65–60 and 70–75–65. The source dataset reports plant height at seven observation dates (1, 10 and 20 April; 1, 10 and 20 May; and 1 June) for eight cultivar × irrigation-method × regime combinations over 2022–2024. The analysis reconstructed absolute height increments, interval-specific growth rates and contrasts between treatments from the reported values. By 1 June, plant height ranged from 52.6 to 56.5 cm. The greatest final height was recorded for Polvon under drip irrigation and the 70–75–65 regime (56.5 cm), followed by Obod under drip irrigation and 60–65–60 (56.2 cm). Compared with the corresponding furrow treatment, drip irrigation increased final height by 3.6 cm for Obod and 2.3 cm for Polvon under 60–65–60; the respective differences under 70–75–65 were +0.1 and +2.8 cm. Most absolute growth occurred after 20 April, with strong increments through May. Treatment responses were cultivar- and regime-dependent, precluding a single universal ranking of irrigation regimes. The findings characterize vegetative responses within the supplied dataset but do not establish statistical significance, water-use efficiency or yield effects because replication, water volumes and yield data were not provided.*

Keywords: chickpea; *Cicer arietinum L.*; drip irrigation; furrow irrigation; plant height; growth dynamics; irrigation regime; Obod; Polvon.

1. INTRODUCTION

Chickpea is an important pulse crop in semi-arid agriculture, where seasonal water availability often constrains canopy development, reproductive performance and stable production. Irrigation scheduling must balance the prevention of excessive water stress against the costs of water delivery and the risk of poorly timed or excessive irrigation. The choice of irrigation method can alter the spatial distribution of water within the root zone, while the irrigation regime determines the moisture conditions experienced during successive crop growth phases. Consequently, cultivar-specific responses are plausible even when the same irrigation treatment is applied.

Plant height provides an accessible, repeated indicator of vegetative growth. It integrates stem elongation over time, but it is not equivalent to biomass, grain yield or irrigation productivity. Evaluating a series of observations, rather than only final height, helps identify periods of accelerated elongation and changes in treatment ranking. Such descriptive evidence is especially useful when a source contains repeated phenological measurements but lacks individual-plot records.

The objective of this article was to assess the reported 2022–2024 plant-height dynamics of Obod and Polvon chickpea cultivars under furrow and drip irrigation, compare the two reported irrigation regimes within each cultivar, and quantify the size and timing of observed treatment differences. A further objective was to distinguish directly observed results from mechanisms suggested by the wider literature.

2. LITERATURE REVIEW

Water limitation affects plant growth through both physiological regulation and restrictions on carbon assimilation. Davies and Zhang [1] describe root-to-shoot signaling under drying soil, a process that can modify shoot development before severe visible wilting occurs. This provides a mechanistic rationale for monitoring incremental stem growth under

contrasting moisture regimes. However, their review does not predict the direction or magnitude of height differences for the particular chickpea cultivars assessed here.

Allen et al. [2] developed the FAO-56 framework for estimating reference evapotranspiration and crop water requirements. Their approach emphasizes that irrigation planning should be linked to atmospheric demand and crop development. In the present dataset, no evapotranspiration or irrigation-depth measurements were supplied, so the numerical irrigation-regime codes must not be converted into applied-water volumes. Fereres and Soriano [3] reviewed deficit-irrigation strategies and emphasized that water stress impacts depend on crop stage, intensity and timing. This supports analysis of multiple observation dates instead of relying on a single end-of-season measurement.

Passioura [4] discussed ways to improve crop productivity under water scarcity, highlighting the importance of separating water capture, biomass production and harvest allocation. The implication for the present study is that greater plant height should not automatically be interpreted as superior grain yield. Blum [5] similarly argued for a distinction between drought resistance and effective water use in crop improvement. These concepts caution against treating a tall plant as direct evidence of irrigation efficiency or drought adaptation.

Farooq et al. [6] synthesized physiological and agronomic effects of drought stress in plants, including growth inhibition and altered developmental processes. Their review offers a broad context for differences in elongation rates between irrigation treatments, although the study at hand lacks soil moisture profiles and plant-water-status measurements needed to verify those pathways. Turner [7] examined agronomic opportunities to improve rainfall-use efficiency in dryland systems and stressed the combined roles of genotype, soil and management. Taken together, these seven sources indicate that

irrigation response should be interpreted as a genotype-by-management interaction rather than a universal effect of drip irrigation or a particular regime.

A specific evidence gap remains: published general principles cannot establish the relative height response of Obod and Polvon under the exact irrigation combinations in the supplied field table. The present article addresses that narrow descriptive gap using the available repeated height observations, without claiming causal mechanisms or inferential statistical support not contained in the source.

3. MATERIALS AND METHODS

The analysis used a one-page table titled “No‘xat navlari o‘shish dinamikasiga sug‘orish usullari va sug‘orish tartiblarining ta’siri (2022–2024 yy)”, supplied by the study authors. It contains eight treatment combinations: two cultivars (Obod, Polvon), two irrigation methods (furrow irrigation, identified as control, and drip irrigation) and two coded irrigation regimes (60–65–60 and 70–75–65). Plant height (cm) was reported at 1, 10 and 20 April, 1, 10 and 20 May, and 1 June. The source does not specify field location, soil type, number of replicates, year-wise observations, uncertainty estimates or the operational definition of the three regime-code values.

For each treatment, net seasonal elongation was calculated as $H(1 \text{ June}) - H(1 \text{ April})$. Growth over a given interval was the difference between consecutive recorded heights. For the six intervals, elapsed calendar days were 9, 10, 11, 9, 10 and 12, respectively; mean interval elongation rates were calculated as the height increment divided by elapsed days. Matched-method contrasts were calculated as the drip-irrigated height minus the furrow-irrigated height for the same cultivar and regime. The table is described as covering 2022–2024, but it does not contain separate annual values; therefore, no interannual analysis was attempted. All comparisons are descriptive and no hypothesis tests were performed.

4. RESULTS AND DISCUSSION

Table 1 reproduces the eight treatment trajectories in chronological order. Heights increased at every observation for all treatments. At the first observation, values ranged from 13.0 to 14.7 cm, whereas the final values ranged from 52.6 to 56.5 cm. The comparatively narrow range at the final date does not imply that irrigation was irrelevant: matched treatment contrasts and interval-specific differences show that the ranking of combinations changed with cultivar and moisture regime.

Table 1.

**Plant height (cm) by cultivar, irrigation method and regime,
reported for 2022–2024.**

Method	Regime	Cultivar	1 Apr	10 Apr	20 Apr	1 May	10 May	20 May	1 Jun
Furrow	60–65–60	Obod	13.3	15.9	21.1	29.8	40.7	47.7	52.6
Furrow	60–65–60	Polvon	13.0	16.0	20.1	28.1	38.2	45.2	52.9
Furrow	70–75–65	Obod	14.6	16.8	21.5	30.5	41.6	48.6	54.4
Furrow	70–75–65	Polvon	13.1	16.7	20.6	29.1	39.6	46.6	53.7
Drip	60–65–60	Obod	14.2	17.6	22.2	31.9	43.4	50.4	56.2
Drip	60–65–60	Polvon	13.9	17.2	22.3	31.9	43.5	50.5	55.2
Drip	70–75–65	Obod	14.0	16.8	21.4	30.4	41.4	48.4	54.5
Drip	70–75–65	Polvon	14.7	17.6	22.9	32.9	44.9	51.9	56.5

Final plant height and net elongation. Under furrow irrigation and 60–

65–60, Obod reached 52.6 cm and Polvon 52.9 cm. Under furrow irrigation and 70–75–65, final heights were 54.4 and 53.7 cm, respectively. Drip irrigation with 60–65–60 resulted in 56.2 cm for Obod and 55.2 cm for Polvon; drip irrigation with 70–75–65 resulted in 54.5 and 56.5 cm. Thus, the tallest Obod treatment differed from the tallest Polvon treatment. Across the observation period, net elongation ranged from 39.3 cm (furrow, 60–65–60, Obod) to 42.0 cm (drip, 60–65–60, Obod), while Polvon gained between 39.9 and 41.8 cm depending on treatment.

Table 2. Descriptive seasonal growth and drip-versus-furrow differences.

Method	Regime	Cultivar	Final height (cm)	Net gain (cm)
Furrow	60–65–60	Obod	52.6	39.3
Furrow	60–65–60	Polvon	52.9	39.9
Furrow	70–75–65	Obod	54.4	39.8
Furrow	70–75–65	Polvon	53.7	40.6
Drip	60–65–60	Obod	56.2	42.0
Drip	60–65–60	Polvon	55.2	41.3
Drip	70–75–65	Obod	54.5	40.5
Drip	70–75–65	Polvon	56.5	41.8

Matched comparisons of irrigation methods. Under 60–65–60, drip irrigation exceeded furrow irrigation in final height by 3.6 cm (6.8% of the furrow value) for Obod and by 2.3 cm (4.3%) for Polvon. Under 70–75–65, the differences were only 0.1 cm (0.2%) for Obod but 2.8 cm (5.2%) for Polvon. The method effect was therefore not uniform across the two cultivars and two regimes. In particular, a near-identical Obod endpoint under the higher-coded regime should not be overlooked in a general claim that drip irrigation always produces taller plants.

Contrasts between irrigation regimes. Under furrow irrigation, 70–75–

65 exceeded 60–65–60 at 1 June by 1.8 cm for Obod and 0.8 cm for Polvon. Under drip irrigation, however, Obod was 1.7 cm taller with 60–65–60 than with 70–75–65, while Polvon was 1.3 cm taller with 70–75–65 than with 60–65–60. The opposite cultivar rankings within drip irrigation suggest a potentially important cultivar $\times$ regime interaction. Because neither replicated plot values nor uncertainty estimates were supplied, this pattern should be viewed as a descriptive interaction, not as a statistically demonstrated one.

Temporal growth pattern. All eight treatments showed relatively small increases in early April and stronger increases from late April through May. For example, Obod under drip irrigation with 60–65–60 grew from 22.2 cm on 20 April to 31.9 cm on 1 May (+9.7 cm over 11 days), and then to 43.4 cm on 10 May (+11.5 cm over 9 days; approximately 1.28 cm day⁻¹). Polvon under drip irrigation with 70–75–65 grew from 22.9 to 32.9 cm between 20 April and 1 May (+10.0 cm), and then to 44.9 cm by 10 May (+12.0 cm; approximately 1.33 cm day⁻¹). These are the strongest nine-day increments for those respective treatments. Subsequent elongation continued, but the interval-specific rates generally moderated toward 1 June.

Interpretation and limits. The apparent advantage of drip irrigation in several combinations is consistent with the possibility of improved temporal or spatial availability of root-zone moisture, as discussed in general irrigation and drought literature [1–3, 6]. Nevertheless, the dataset does not include soil moisture, root development, irrigation amounts, evapotranspiration, biomass, seed yield or water productivity. Consequently, differences cannot be attributed definitively to water distribution, nor can an agronomic recommendation be made on water savings or yield alone. In addition, the source aggregates the 2022–2024 period without explaining whether the numbers are annual means, pooled observations or another summary. The precision of decimal values must not be confused with statistical confidence.

For practical follow-up, the observed cultivar-specific ranking provides

testable hypotheses. Future experiments should report the meaning of each irrigation regime, applied water volumes, soil characteristics, meteorological data, plot replication, annual values and variability. Analysis of variance or an appropriate repeated-measures/mixed-effects model could then test method $\times$ regime $\times$ cultivar interactions across time. Measurements of leaf area, biomass, phenology, yield and irrigation water productivity would determine whether the observed height responses translate into meaningful agronomic benefits.

5. CONCLUSIONS

The reported 2022–2024 observations show progressive height increases for Obod and Polvon under all eight irrigation combinations. Final plant height ranged from 52.6 to 56.5 cm, with the maximum in Polvon under drip irrigation and 70–75–65 (56.5 cm), and the next-highest value in Obod under drip irrigation and 60–65–60 (56.2 cm). Drip irrigation increased final height relative to matched furrow treatments by 0.1–3.6 cm, depending on cultivar and regime. Under drip irrigation, the regime producing the tallest plants differed between cultivars, highlighting the need for genotype-specific interpretation. Rapid stem elongation was especially evident between late April and mid-May. These results establish descriptive differences in plant height, but not statistical significance, yield superiority or water-saving performance. Replicated trials with measured water inputs and productivity outcomes are required before recommending an optimal irrigation treatment.

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