*Journal of Medicinal and Industrial Plant Sciences (2025) 3 (1): 29- 37*
ISSN: 2959 – 121X
DOI: https://doi.org/10.32894/MEDIP.25.3.3

# The impact of sowing depths on some winter chickpea varieties of (*Cicer arietinum* L.) on some growth and yield traits.

**Dilan Rizgar Hadi, Sumaya Ahmed Abdullah, Bahra Sherko Xalil, Darya Oghuz Siso Ahmad Hshyar Sabri**
*Department of Field Crops and Medicinal Plants, Agricultural Engineering Sciences, Salahaddin University- Erbil*

* *Corresponding author: E-mail:* delan.hadi@su.edu.krd, sumaya.abdullah@su.edu.krd

**ABSTRACT**

The experiment was carried out at the Grdarasha Research Station of the Agricultural Engineering Sciences College-Salahaddin University-Erbil during the growing season 2023–2024. With three repetitions, a field experiment was conducted as a factorial using randomized complete block design (RCBD). Three chickpea varieties (Hazarmerd, Sham, and TH85), and three chickpea depths (3, 5, and 7) cm was used. Variety TH85 with D3 and D7 exhibit superior interaction, as evidenced by the maximum protein output. However, the Hazarmerd type has a higher protein content (%). In addition, TH85 variety outperformed Hazarmerd and Sham types in every category except weight of 1000 seeds and protein. The maximum correlation was obtained between no. of pods with seed yield. although, the higher correlation found from biological yield with protein yield then higher in protein and protein yield.

**KEY WORDS:** Chickpea; varieties; depth; yield component.

**Received**: 22/01/2025 ; **Accepted**: 09/02/2025 ; **Available online:** 31/03/2025


# تأثير الأعماق البذار لبعض أصناف الحمص الشتوية (*Cicer arietinum* L.) على الحاصل ومكونات الحاصل.

ديلان رزگار هادى[1]، سمية احمد عبد الله[2]، بهره شيركو خليل[3]، دريا اوغز سيسو[4]، احمد هشيار صبري[5]
[1،2،3،4،5] قسم المحاصيل الحقلية والنباتات الطبية كلية علوم الهندسة الزراعية / جامعة صلاح الدين-اربيل

الملخص

أجريت هذه التجربة في محطة أبحاث كردة رشة التابعة لكلية علوم الهندسة الزراعية - جامعة صلاح الدين - أربيل خلال موسم النمو 2023-2024. أجريت التجربة في الحقل بثلاث مكرارات وبـأستخدام تصميم القطاعات العشوائية الكاملة **(RCBD)** ثلاثة أصناف من نبات الحمص **Hazarmerd** و**Sham** و**TH85**، وثلاثة أعماق زراعة (3 و5 و7)سم . أظهرت النتائج ان الصنف **TH85** ذات الأعماق 3 و7 اظهر تفاعلًا متفوقًا، مع أقصى إنتاج للبروتين. ومع ذلك، فإن نوع **Hazarmerd** يحتوي على نسبة بروتين أعلى (%). بالإضافة إلى ذلك، تفوقت الصنف **TH85** على **Hazarmerd** و**Sham** في كل المعاملات باستثناء وزن 1000 بذرة والبروتين. تم الحصول على أقصى ارتباط بين عدد القرنات مع حاصل البذور. على الرغم من أن أعلى قيمة ارتباط كان للمحصول البيولوجي مع محصول البروتين يتبعها أعلى قيمة في البروتين ومحصول البروتين.

**الكلمات المفتاحية:** الحمص، الأصناف، العمق، مكونات الحاصل

## INTRODUCTION

Chickpeas (*Cicer arietinum* L.) rank as the third most important grain legume in the world after dry bean and peas. This cool-season annual pulse crop is cultivated in temperate, tropical, and subtropical climates worldwide. Compared to other pulses, seeds are higher in calcium and phosphorus, have a high protein digestibility, and are nutritionally devoid of some antinutritional elements. It provides ruminant and non-ruminant animals with calories and protein for animal feed, and it has a greater fat content and improved digestion of fiber (Emenky and Khalaf, 2010).

It is a popular legume crop grown for its edible seeds. It belongs to the Fabaceae family (leguminaceae) and the Papilionaceae subfamily. It provides a protein-rich diet for vegetarian supplementing stable grains with vital amino acids, vitamins, and minerals (Pingoliya et al.,2013). Based on the size, shape, and color of their grains, chickpea varieties are divided into two categories worldwide. Desi chickpeas typically have bright blossoms and are tiny and dark in color. Kabuli chickpeas are large grained, light colored and have white flowers. In contrast to the more recent emergence of kabulis, the Desi form is regarded as ancient. Both these types had been geographically isolated for many years (Purushothaman et al., 2014).

In contrast to epigeal germinating plants, hypogeal plants may be seeded both shallowly and deeply. Sowing too shallow might result in poor germination due to insufficient soil moisture in the top layer. Deep seed implantation in the soil promotes stronger roots of the plant, which reduces lodging susceptibility (Ali and Idris, 2015). Based on the results of the research done by these authors Singh et al. (2013), the number of pods per plant and 1000 seed weight were greater at shorter depth of sowing (5 cm) compared to deeper depth of sowing (10 cm), and these values dropped as the depth of sowing increased.

Although, the depth can enhance the Rhizobium inoculation's ability to survive on the seed, which leads to improved nodulation, because the soil's moisture content and temperature at deep are more ideal than those on the surface. Gan et al. (2003) stated that increasing the planting depth reduced the chance of birds uprooting the seedlings, heaving, or digging up the seeds. Furthermore, because fewer seeds are needed per unit area, small seeds lower Kabuli chickpea production costs by 15% to 25%. Per Lucy (2005) deeper sowing depths are employed when the top soil layer is dry or when more "depth" protection against herbicide residues on the soil surface is required. Though it helps to decrease crop lodging, deeper seeding might cause more soil disturbance and delayed crop emergence (Haigh and McMullen, 2012).

Regarding the sowing depth, research has been done in several countries to determine the ideal depth for chickpeas. Baye et al. (2020) found that the depth of seeding had a substantial influence on legume crops growth, yield, and germination. In their study, shallower depths of seeding resulted in more growth and production, reducing competition amongst plants for available light, water, and nutrients compared to deeper depth of sowing .

The aim of this study is to investigate how different seeding depths affect the growth and yield component parameters of selected chickpea varieties in the Erbil Governorate, Iraqi Kurdistan Region, under rainfall circumstances.

## MATERIALS AND METHODS

This study was carried out at the Grdarasha Research Station of College of Agricultural Engineering Sciences at Salahaddin University in Erbil during the growing season of 2023–2024. Located at a height of

420 MASL, the semi-guaranteed Iraqi rain zone is between Latitude 36° 06' 44".8 N and Longitude 44° 00' 44.4" E. A representative sample of air-dried soil was collected from the field at a depth of 0 to 30 cm. Then sieved through a 2 mm mesh screen and examined for certain physical and chemical characteristics, as indicated. The average annual rainfall falls between (250 and 600) mm. Displays the field's minimum and highest temperatures, relative moisture content, and rainfall during the planting season.

**The chemical analysis of the study media**

| soil properties | Unit |
|---|---|
| Sand (g $kg^{-1}$) | 384.75 |
| Slit (g $kg^{-1}$) | 515.00 |
| Clay (g $kg^{-1}$) | 100.25 |
| Texture Class | Silty clay loam |
| P.H | 7.53 |
| Electrical Conductivity (EC) ds $m^{-1}$ | 0.38 |
| Organic Matter (%) | 0.91 |
| Bulk density (Mg $m^{-3}$) | 1.45 |
| Total Nitrogen (N) ppm | 89.17 |
| Total Phosphor (P) ppm | 5.36 |
| Total Potassium (K) ppm | 64.10 |
| Sand (g $kg^{-1}$) | 384.75 |
| Slit (g $kg^{-1}$) | 515.00 |
| Clay (g $kg^{-1}$) | 100.25 |
| Texture Class | Silty clay loam |
| P.H | 7.53 |

*Laboratory Soil and Water Sciences Department, College of the Agricultural Engineering Sciences, University of Duhok.

**Climatic conditions during the growing season (2023-2024)**

| Months | Air Temp. C° | | Relative moisture % | Rainfall (mm) |
|---|---|---|---|---|
| | Minimum | Maximum | | |
| September | 26.1 | 38.4 | 16.0 | 0.7 |
| October | 20.0 | 30.0 | 30.7 | 10.1 |
| November | 13.4 | 21.5 | 60.5 | 46.5 |
| December | 9.5 | 18 | 67.0 | 66 |
| January | 7.9 | 14.8 | 72.1 | 142 |
| February | 7.8 | 15.9 | 62.5 | 71 |
| March | 11 | 19.5 | 52.5 | 67 |
| April | 18.3 | 29.2 | 34.3 | 46 |
| May | 20.6 | 30.7 | 32.7 | |
| June | 29.8 | 41 | 12.9 | |

*Data source: Meteorological Directory- Erbil province

The land was separated into three blocks 2m apart each one consisted of 9 plots; separated from each other by 1m the size of each plot was (1m length × 1 m width with four lines of 0.25 m apart). The first factor included three chickpea variety (Hazarmerd, Sham and TH85), the second factor was three chickpea depths (D3, D5 and D7) cm. A factorial experiment conducted with randomized complete block design (RCBD) with three replicates. Duncan's Multiple Range Test was used to compare the means at the 5% significant level. SPSS (Statistical Package for Social Sciences) Program, version (22.0) in 2019, was used to do the statistical analysis (Weinberg and Abramowitz, 2008).. The seeds were hand sowed on 27th of November 2023; they were managed by a specialized instrument to get the precise depth. Seeds were dropped along within the hole prepared by hand opener at adjusted specified depth of seeds, thereafter covered by with soil by hand rake. Five plants were selected from the middle lines of each experimental unit to study some vegetative parameters, like (Chlorophyll content, Plant height (cm), No. of branches plant -1), and some yield parameters like (No. of pod plant-1, 1000 seed weight (g), Seed yield (kg/ha), Biological yield (kg/ha), Harvest Index (%), Protein (%), Protein yield (kg ha-1). Chemical content in seeds were estimated from digested samples for the percentage of protein by Kjeldahl Apparatus (Garcia-Servin et al., 2022).

## RESULTS AND DISCUSSION

### Growth parameters

A close examination of Table 3 revealed that different varieties did not significantly affect chlorophyll content or the number of branches. However, plant height was substantially influenced by the varieties used in the study. The highest plant heights (64.77 and 62.88) cm were recorded for Hazarmerd, followed by TH85, whereas the lowest mean (57.52) cm was observed for Sham. This variation may be attributed to the genetic characteristics of the varieties (Emenky and Khalaf, 2010) .

On the other hand, it was noticed that different depths had a significant effect for producing SPAD values. It ranged from 44.90 to 47.60 units, being the minimum at D7 and the maximum at D3. In contrast, plant height and number of branches plant -1 did not affected by sowing depth. This implies that depth of sowing did not give significant difference for these parameters. This result is in harmony with findings of Emenky and Khalaf (2010), They found that Sowing depth showed no significant effect on plant height, which may be attributed to enough rainfall and a protracted growth. stage; also, because the sowing occurred in the winter, the effect of water deficiency was reduced.

According to the findings, Hazarmerd at a 3 cm depth was the most suitable interaction for both chlorophyll content and plant height, recording the highest mean values (49.73 and 68.22 cm) respectively. Meanwhile, for the number of branches, TH85 at the same depth recorded the highest value (6.77).

Table 1. Response of growth parameters in different varieties of chickpea to different levels of depths

| Varieties | Chlorophyll (SPAD) | Plant Height (cm) | No. of branches |
|---|---|---|---|
| Hazarmerd | 47.53 a | 64.77 a | 4.77 a |
| Sham | 46.97 a | 57.52 b | 5.18 a |
| TH85 | 45.18 a | 62.88 a | 5.55 a |
| **Depths (cm)** | **Chlorophyll (SPAD)** | **Plant Height (cm)** | **No. of branches** |
| D3 | 47.60 a | 63.55 a | 5.44 a |
| D5 | 47.20 a | 60.18 a | 4.55 a |
| D7 | 44.90 b | 63.55 a | 5.51 a |
| **Varieties × Depths** | **Chlorophyll (SPAD)** | **Plant Height (cm)** | **No. of branches** |
| Hazarmerd × D3 | 49.73 a | 68.22 a | 4.89 ab |
| Hazarmerd × D5 | 47.30 ab | 64.55 ab | 4.55 ab |
| Hazarmerd × D7 | 45.56 ab | 61.55 abc | 4.88 ab |
| Sham × D3 | 48.20 ab | 58.22 bc | 4.66 ab |
| Sham × D5 | 47.66 ab | 54.89 c | 4.33 b |
| Sham × D7 | 45.06 b | 59.44 bc | 6.55 ab |
| TH85 × D3 | 44.86 b | 64.22 ab | 6.77 a |
| TH85 × D5 | 46.63 ab | 61.11 abc | 4.77 ab |
| TH85 × D7 | 44.06 b | 63.33 ab | 5.11 ab |

At 5% of DMRT, means with the same litters for each factor and interaction do not differ significantly

**Yield and yield components**

Seed yield is a crucial criterion for evaluating treatment effectiveness. Consequently, it is essential to see seed production as the final consequence of an interaction of many processes, reactions, and morphological alterations that occur in plants during their growth and developmental phases (Hashim and Kakarash, 2024) .

It is evident from Table 4 that significant differences were observed in 1000-seed weight (g) and protein content (%) due to variations in chickpea varieties. The highest values (453.33 g and 22.04%) were recorded for Hazarmerd, whereas the lowest means (307.78 g and 19.80%) were observed for TH85. In contrast, TH85 recorded the highest values for seed yield, biological yield, and protein yield. This variation may be attributed to each variety's unique genetic potential and its interaction with the surrounding environment. Similar variety-specific differences were reported by Singh et al.(2003) .

On the other hand, the number of pods and harvest index (%) were not influenced statistically by varieties of chickpea. The variation in yield characteristics of varieties may be related to the genetic differences and their response to environmental conditions (Sandeep and Godi, 2023). The same results were observed from Abdullah et al. (2024) who stated that there were no significant differences for these parameters between all varieties.

As can be perceived in the same table no improvement of all yield and yield components upon depth of sowing noticed except protein percentage. As per findings, planting at D3 recorded the maximum values of all parameters which are statistically at par with D5 and D7. Gan et al. (2003) found the similar results seeding at shallower depths increased seedling emergence and shoot productivity better. In contrast to other parameters protein percentage significantly influenced by sowing depths. The highest percentage of protein (21.23 %) was noted from D5 that was superior to sowing at D3 (20.62) and D7.(19.80)

Additionally, the interaction between the studied factors (varieties × depths) had a positive influence on all yield and yield components except for number of pods and harvest index (%) which were not improved by the interaction between the factors. The largest mean value (490.00) was observed from (Hazarmerd × D7) for 1000 seeds weight. Siddique et al. (1999) found similar results, by observing that deep seeding promotes superior plant development. The same variety at D5 produced the highest protein percentage .(22.66)

Biological and protein yields were significantly affected by the interaction between variety and sowing depth. The highest biological and protein yields (9053.33 and 835.57 kg $ha^{-1}$) respectively were recorded for the TH85 × D3 interaction. However, the highest seed yield (4256.67 kg $ha^{-1}$) was observed for TH85 at a D7 sowing depth. These results are consistent with the findings of Gan et al. (2003), who reported that deeper sowing may enhance crop establishment by providing access to greater soil moisture, thereby reducing the risk of lodging.

Table 2. Response of yield and yield components in different varieties of chickpea to different levels of depths

| **Varieties** | **No. of pods** | **1000 seeds weight (g)** | **Seed yield (kg $ha^{-1}$)** | **Biological yield (kg $ha^{-1}$)** | **Harvest index (%)** | **Protein (%)** | **Protein Yield (kg $ha^{-1}$)** |
|---|---|---|---|---|---|---|---|
| Hazarmerd | 43.03 $^{a}$ | 453.33 $^{a}$ | 2676.67 $^{b}$ | 5854.44 $^{b}$ | 45.43 $^{a}$ | 22.04 $^{a}$ | 589.95 $^{ab}$ |
| Sham | 35.51 $^{a}$ | 447.78 $^{a}$ | 1854.44 $^{b}$ | 3875.56 $^{b}$ | 49.59 $^{a}$ | 19.80 $^{b}$ | 366.02 $^{b}$ |
| TH85 | 40.11 $^{a}$ | 307.78 $^{b}$ | 4008.89 $^{a}$ | 8212.22 $^{a}$ | 49.90 $^{a}$ | 19.80 $^{b}$ | 792.25 $^{a}$ |

| Depths (cm) | No. of pods | 1000 seeds weight (g) | Seed yield (kg ha$^{-1}$) | Biological yield (kg ha$^{-1}$) | Harvest index (%) | Protein (%) | Protein Yield (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| 3 | 41.63 a | 414.44 a | 3210.00 a | 7140.00 a | 44.82 a | 20.62 b | 664.65 a |
| 5 | 40.07 a | 400,00 a | 2762.22 a | 5304.44 a | 51.75 a | 21.23 a | 586.30 a |
| 7 | 36.96 a | 394.44 a | 2567.78 a | 5497.78 a | 48.35 a | 19.80 c | 497.26 a |
| **Varieties × Depths** | **No. of pods** | **1000 seeds weight (g)** | **Seed yield (kg ha$^{-1}$)** | **Biological yield (kg ha$^{-1}$)** | **Harvest index (%)** | **Protein (%)** | **Protein Yield (kg ha$^{-1}$)** |
| Hazarmerd × D3 | 42.33 a | 460.00 ab | 3143.33 a-d | 6640.00 ab | 47.43 a | 21.43 c | 673.61 ab |
| Hazarmerd × D5 | 42.55 a | 410.00 bc | 3073.33 a-d | 6266.67 ab | 50.01 a | 22.66 a | 696.41 ab |
| Hazarmerd × D7 | 44.22 a | 490.00 a | 1813.33 bcd | 4656.67 ab | 38.86 a | 22.05 b | 399.84 ab |
| Sham × D3 | 37.00 a | 480.00 a | 2473.33 a-d | 5726.67 ab | 42.43 a | 19.61 f | 484.77 ab |
| Sham × D5 | 38.11 a | 486.67 a | 1456.67 d | 3090.00 b | 47.17 a | 20.82 d | 303.28 b |
| Sham × D7 | 31.44 a | 376.67 cd | 1633.33 cd | 2810.00 b | 59.16 a | 18.98 g | 310.00 b |
| TH85 × D3 | 45.55 a | 303.33 e | 4013.33 ab | 9053.33 a | 44.59 a | 20.83 d | 835.57 a |
| TH85 × D5 | 39.55 a | 303.33 e | 3756.67 abc | 6556.67 ab | 58.08 a | 20.21 e | 759.22 ab |
| TH85 × D7 | 35.22 a | 316.67 de | 4256.67 a | 9026.67 a | 47.03 a | 18.37 h | 781.95 a |

At 5% of DMRT, means with the same litters for each factor and interaction do not differ significantly

## Correlation

Table 5 indicates a positive and highly significant correlation between the number of branches and plant height (r = 0.821**). As well as, the interaction between variety and sowing depth had no significant effect on the number of pods and harvest index. The data of the same table shows that there was a positive and highly significant correlation between seed yield and both chlorophyll content (r = 0.968**) and the number of pods (r = 0.914**). Similarly, biological yield showed a significant correlation with chlorophyll content, the number of branches, and seed yield (r = 0.892**, 0.960**, and 0.909**) respectively. Furthermore, protein yield exhibited a strong correlation with the number of pods, seed yield, biological yield, and protein content (r = 0.829**, 0.988**, 0.900**, and 0.924**) respectively.

Table 3. Correlation coefficient analysis among the traits of Chickpea

| Traits | Chlorophyll (SPAD) | Plant Height (cm) | No. of Branch | No. of Pods | 1000 Seed Weight (g) | Seed Yield (kg $ha^{-1}$) | Biological Yield (kg $ha^{-1}$) | Harvest Index (%) | Protein (%) | Protein Yield (kg $ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Chlorophyll (SPAD)** | 1.000 | | | | | | | | | |
| **Plant Height (cm)** | 0.319* | 1.000 | | | | | | | | |
| **No. of Branch** | 0.310* | 0.821** | 1.000 | | | | | | | |
| **No. of Pods** | 0.115 | 0.650** | 0.666* | 1.000 | | | | | | |
| **1000 Seed Weight (g)** | 0.420* | 0.581** | 0.454* | 0.713** | 1.000 | | | | | |
| **Seed Yield (kg $ha^{-1}$)** | 0.968** | 0.255 | 0.573** | 0.914** | 0.499** | 1.000 | | | | |
| **Biological Yield (kg $ha^{-1}$)** | 0.892** | 0.301 | 0.960** | 0.443* | 0.424* | 0.909** | 1.000 | | | |
| **Harvest Index (%)** | 0.685* | 0.171 | 0.095 | 0.020 | 0.342* | 0.269 | 0.520** | 1.000 | | |
| **Protein (%)** | 0.291 | 0.208 | 0.292 | 0.458* | 0.392* | 0.542** | 0.726** | 0.376* | 1.000 | |
| **Protein Yield (kg $ha^{-1}$)** | 0.042 | 0.283 | 0.521** | 0.829** | 0.452** | 0.988** | 0.900** | 0.259 | 0.924** | 1.000 |

.*And** Correlation is significant at the 0.05, 0.01 level respectively.

## CONCLUSIONS

The superiority of the interaction between TH85 and sowing depths of 3 cm and 7 cm was evident in producing the highest protein yield. Meanwhile, the Hazarmerd variety was superior in protein content (%). Additionally, TH85 outperformed both Hazarmerd and Sham in all characteristics except for 1000-seed weight and protein content. The highest correlation was observed between the number of pods and seed yield. Furthermore, a strong correlation was found between biological yield and protein yield, which was also positively associated with higher protein content and protein yield.

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