# Assessment of Various Weed Management Practices on the Growth and Yield of Chickpea in Duhok Governorate

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## Abstract

A field experiment was conducted during the 2024-2025 winter season at two locations (Sumel and Zakho) in Duhok Governorate to evaluate the effects of three plant densities (26.66, 33.33, and 44.44 plants/m²) and five weed control methods (a weedy check, Kordiclofen, Dimpex, Matador Pro, and Hand hoeing) on the growth and yield of chickpea (desi) type. The study employed a factorial (RCBD) with three replications. The findings indicated that a plant density of 33.33 plants/m² was optimal, as it produced the highest seed yield (358.09 kg/ha in Sumel and 362.29 kg/ha in Zakho) and the highest harvest index (0.35 in Sumel and 0.34 in Zakho). This density also supported a superior seed index, whereas the lowest density promoted taller plants. Concerning weed control, hand hoeing was the most effective treatment, resulting in the tallest plants, highest pods, greatest seed yield, harvest index, and heaviest seeds, highlighting the significant impact of eliminating weed competition. Kordiclofen was the most effective herbicide, performing comparably to hand hoeing in several key parameters. In contrast, the weedy check resulted in the poorest performance for all measured traits. A significant interaction between plant density and weed control was observed. The combination of the 33.33 plants/m² density with hand hoeing produced the maximum seed yield (469.28 and 478.23 kg/ha for Sumel and Zakho, respectively) and harvest index, demonstrating a powerful synergy. In conclusion, adopting a moderate plant density of 33.33 plants/m² integrated with effective weed control, preferably hand hoeing or the herbicide Kordiclofen, represents the most effective approach for optimizing chickpea growth, yield, and yield components in the area.

**Keywords:** Chickpea, Plant Density, Hand Hoeing, Weed Control.

*This paper represents a part of the MSc. thesis that conducted by the first author.*

## Introduction

Chickpea (*Cicer arietinum* L.) is considered to be one of the most important pulses in the world, ranking as the third-most produced pulse crop [16]. Nutritionally, chickpeas are a rich source of energy, protein, fiber, minerals, and vitamins, in addition to containing beneficial phytochemicals [32]. It also contributes to increased soil fertility in agricultural ecosystems due to its ability to fix nitrogen [10]. Chickpeas are cultivated in over 56 countries and are the third most significant food legume worldwide. India leads global manufacturing, accounting for over 65% of the whole supply. [30] reports that in Iraq, diminished rainfall and constrained irrigation have reduced the acreage dedicated to winter pulses, such as chickpeas. [6] indicates that typical yields are approximately 2.0 t $ha^{-1}$, predominantly from small rainfed farms in central and southern Iraq. Chickpea output in the Kurdistan region has seen variability due to the limited adoption of varied cultivar by

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Kurdish farmers, who predominantly concentrate on certain spring types [13]. The area allocated for chickpea cultivation in the region significantly decreased from 30,699 dunams in 2012–2013 to 27,010 dunams in 2019–2020. This expansion was accompanied by a notable increase in production, from 3,481 tons to 8,569 tons, with the yield escalating from 113.4 kg/dunam to 317 kg/dunam. The Sulaymaniyah governorate had the most extensive cultivated area, totaling 11,353 dunams (42.03%), and achieved the best yield of 400 kg per dunam, culminating in a production of 4,541 tons (52.99%) [13].

One of the most important biotic problems faced in chickpea cultivation is the presence of weeds [2]. Chickpea is a poor competitor, making it vulnerable to weed infestation, especially during its early growth phases [5]. Severe weed infestation is a substantial factor limiting high chickpea yields [19]. Studies have indicated that the presence of weeds throughout the crop season can reduce yield by up to 68% [15].

Successful weed management is important for protecting the chickpea crop and maximizing its production potential [12]. Optimum planting density is a critical management approach that must be adapted according to the cultivar's growth habit, particular environmental circumstances, and its geographical location [25].

Increased plant density in chickpea cultivation can reduce early-season soil water evaporation during periods of minimal plant canopy closure [29]. Conversely, poor plant density might promote the proliferation of aggressive weeds, thereby restricting the crop's yield potential. Consequently, ascertaining the ideal plant population density for the crop within a particular environment is essential [25]. This study aimed at determining the optimum plant population density and assessment of weed management strategies on the growth and productivity of chickpea.

## Material and Methods

A field experiment was conducted during the winter season of 2024-2025 at two locations in Duhok Province, Iraq. The first location was the research farm of the College of Agricultural Engineering Sciences in Sumel (36.847 N, 43.01 E, 583 m altitude). The second location was the agricultural research center in Zakho (37.8 N, 42.41 E, 433 m altitude), located approximately 70 kilometers northwest of Duhok province. Table (1) displays the soil information for the studied locations. The experiment was conducted in a factorial arrangement using a Randomized Complete Block Design (RCBD) with three replications. The first factor was plant density with three levels: D1 (26.66 plants/m²), D2 (33.33 plants/m²), and D3 (44.44 plants/m²). The second factor was weed control method, consisting of five treatments: T1 (weedy check), T2 (Kordiclofen [Aclonifen]), T3 (Dimpex [Clethodim 24%]), T4 (Matador Pro [Quizalofop-P-ethyl]), and T5 (Hand Hoeing). The herbicide information for the studied locations is shown in table (2). Chickpea seeds desi type (cultivar Flip 81) that obtained from the Research Center of Duhok were sown on November 15 in Sumel and November 17 in Zakho. Herbicides were applied at the recommended dose and suitable growth stages according to the herbicide label. At the maturation stage the data were collected on plant height (cm), height of the lowest pod (cm), seed index (g), seed yield (kg/ha), and harvest index (%). Analysis of variance (ANOVA) was used to evaluate treatment effects, and mean comparisons were conducted using Duncan's Multiple Range Test at $p \leq 0.05$.

**.Table (1): Some physical and chemical properties of the soil at Sumel and Zakho locations**

| Location | pH | EC (dS. $m^{-1}$) | Nitrogen (mg/Kg) | Phosphorous (mg/Kg) | Potassium (mg/Kg) | $CaCO_3$ (%) | Organic matter (%) | CEC (cmolc/kg) | Texture | Sand (%) | Silt (%) | Clay (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sumel** | **7.75** | **0.31** | **74** | **4.43** | **15.66** | **18.52** | **1.48** | **27.94** | **Silty Clay** | **5.77** | **45.42** | **48.80** |
| **Zakho** | **7.87** | **0.21** | **83** | **5.87** | **17.82** | **14.23** | **1.92** | **26.88** | **Silty Clay Loam** | **18.41** | **48.75** | **32.84** |

**Table (2):** Information regarding the herbicides studied at Sumel and Zakho locations.

| Trade name | Active ingredient% | Formulation | Recommended Dose (L a.i. $ha^{-1}$) | Time of application | Target weeds |
|---|---|---|---|---|---|
| **Dimpex** | 24% Clethodim | EC | 0.072 | 2 to 3 leaf stage after weed emergence | Narrow leaf weeds |
| **Kordiclofen** | 60% Aclonifen | SC | 0.78 | 2 to 4 leaf stage of crop | Broad leaf weeds |
| **Matador Pro** | 5% Quizalofop-ethyl | EC | 0.06 | 3 to 5 leaf stage after weed emergence | Narrow leaf weeds |

## Results and discussion

### Plant Height (cm)

The data in table (3) reveals distinct and location-specific responses to the treatments. In Sumel, plant density did not significantly affect plant height, as all three densities produced statistically comparable results. Consistent with [21] who revealed that plant densities have no significant effect on plant height. Conversely, in Zakho, a significant density effect was observed, where the lowest density (D1: 26.66 plants/m²) resulted in the tallest plants, indicating less intra-specific competition for light and resources. This aligns with [27], who found that lower densities produced plants with a significantly greater plant height. This indicates that, under Zakho's conditions, less intraspecific competition due to wider

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spacing promoted greater individual plant development. This aligns with the principles of resource allocation, where fewer plants per unit area have greater access to light, water, and nutrients, promoting vegetative growth, as noted by [11]. Weed control strategies exerted a significant and uniform influence across both studied sites. Most weed control treatments, particularly Dimpex, Matador Pro, and hand hoeing, produced significantly taller plants compared to the weedy check. This highlights that reducing early-season weed competition is essential for developing a strong crop canopy, which has been noted by [23].

A significant interaction between population density and weed control was observed at the Zakho, the combination of the lowest plant density (D1: 26.66 plants/m²) with hand hoeing resulted in the maximum plant height (53.25 cm). This illustrates a powerful synergy in which reduced intraspecific competition (low density) combined with the total eradication of interspecific competition (hand hoeing) establishes optimal conditions for plant growth. This conclusion is supported by [1], who asserted that efficient weed control is more essential for vegetative growth than solely adjusting plant density. The insignificant interaction at Sumel indicates that other site-specific factors had a greater .influence on plant height

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**Table (3):** Effect of Plant Densities and Weed Control Methods with Their Interactions on ***Plant Height (cm)*** in the 2025 Growing Season at Sumel and Zakho Locations.

| **Weed Control Methods** | **Sumel** | | | | **Zakho** | | | |
|---|---|---|---|---|---|---|---|---|
| | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods |
| **T1 (Check)** | 21.5 ef | 21.16 f | 23.75 def | 22.13 b | 39.33 cdef | 30.5 g | 32.66 fg | 34.16 b |
| **T2 (Kordiclofen)** | 26.08 bcde | 21.62 ef | 25.33 cdef | 24.34 b | 33.75 defg | 33.16 efg | 33.5 defg | 33.47 b |
| **T3 (Dimpex)** | 27.41 bcd | 30.16 bc | 35.16 a | 30.91 a | 42.12 bc | 37.83 cdefg | 49.25 ab | 43.06 a |
| **T4 (Matador Pro)** | 30.91 ab | 29.91 bc | 30.66 ab | 30.5 a | 41.25 bcde | 40.41 cdef | 42.5 bc | 41.38 a |
| **T5 (Hand hoeing)** | 28.25 bcd | 28.5 bcd | 29.16 bc | 28.63 a | 53.25 a | 41.66 bcd | 34.5 cdefg | 43.13 a |
| Total mean of Plant Densities | 26.83 a | 26.27 a | 28.81 a | | 41.94 a | 36.71 b | 38.48 b | |

Values within each set of means followed by the same letter are not significantly different at p=0.05 according to Duncan's M.R.T., 1955.

**Lowest Pod Height (cm)**

The data in Table (4) suggest that the height of the lowest pod exhibited considerable stability in relation to plant density, as this factor did not significantly affect either studied site. This discovery aligns with [14], who observed that pod height is a comparatively stable trait, less affected by agronomic practices than other yield components. In contrast, [18] and [27] found that plant population density significantly affected the height of the first pod. The effect of weed control was location-dependent In Sumel, the weed control methods did not have a significant effect on the lowest pod height. In contrast, at the Zakho location, weed control methods had a significant effect, with hand hoeing resulting in the highest pod height. This indicates that in the absence of weed stress at Zakho, plants could allocate more resources to main stem development and pod positioning. The significant interaction observed specifically with the lower density (D1: 26.66 plants/m²) combined with hand hoeing resulted in the highest value (32.62), emphasizing that optimal morphological development for harvestability is achieved under conditions

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of minimal competition from both weeds and neighboring crop plants. This corroborates the findings of [31], who asserted that a plant's morphological growth is optimized solely in the absence of substantial intra-specific and interspecific competition. In Sumel, while the primary effect of weed control was non-significant, the interaction indicated that at specific densities, mechanical or chemical control affected pod height, a detail potentially linked to modifications in canopy architecture and light interception resulting from the combination of plant spacing and weed pressure, as discussed by [4] in their work on crop-weed competition.

**Table (4):** Effect of Plant Densities and Weed Control Methods with Their Interactions on ***the Lowest Pod Height (cm)*** in the 2025 Growing Season at Sumel and Zakho Locations.

| Weed Control Methods | Sumel | | | | Zakho | | | |
|---|---|---|---|---|---|---|---|---|
| | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods |
| **T1 (Check)** | 16 ab | 14.58 b | 17.12 ab | 15.90 a | 24.08 bc | 19.75 c | 20.75 c | 21.52 b |
| **T2 (Kordiclofen)** | 15.5 ab | 15.61 ab | 16.08 ab | 15.73 a | 24.08 bc | 23.08 bc | 23.12 bc | 23.43 ab |
| **T3 (Dimpex)** | 15.5 ab | 16.66 ab | 17.83 ab | 16.66 a | 19.75 c | 21.66 c | 27.83 b | 23.08 ab |
| **T4 (Matador Pro)** | 17.33 ab | 16.5 ab | 16.5 ab | 16.77 a | 22 c | 22.41 c | 19.66 c | 21.36 b |
| **T5 (Hand hoeing)** | 17.58 ab | 17.83 ab | 18.25 a | 17.88 a | 32.62 a | 23.91 bc | 20.33 c | 25.62 a |
| Total mean of Plant Densities | 16.38 a | 16.24 a | 17.15 a | | 24.50 a | 22.16 a | 22.34 a | |

Values within each set of means followed by the same letter are not significantly different at p=0.05 according to Duncan's M.R.T., 1955.

## Seed Index (g)

Table (5) indicates that plant density significantly influenced the seed index. In Sumel, plant density significantly influenced seed weight, with the lowest density (D1: 26.66 plants/m²) and (D2: 33.33 plants/m²) densities achieving substantially heavier seeds (25.31 g and 24.93 g, respectively) than the highest density (D3: 44.44 plants/m²) (18.26 g). This illustrates a distinct negative correlation between plant

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density and seed size, as highlighted by [22], whereas reduced competition per plant at reduced densities facilitates greater resource distribution to individual seeds. Similarly, [26] reported that chickpea plants grown under lower densities result in larger and heavier seeds. In Zakho, the density (D2: 33.33 plants/$m^2$) recorded the highest mean seed index (20.62 g), indicating that it provided the optimal balance for seed filling under those conditions. This is consistent with the findings of [3], who observed that moderate plant populations can optimize canopy structure and allow sufficient photo assimilate partitioning, enhancing seed weight under certain environments. Regarding weed control, hand hoeing consistently produced the heaviest seeds at both sites, with kordiclofen also showing favorable results. This emphasizes that efficient weed control preserves essential resources such as water and nutrients during the crucial grain-filling phase. [28] identified this as a major predictor of ultimate seed size In Sumel, the interaction between population density and control methods was particularly pronounced. The optimal combination for maximizing seed weight was the lowest density (D1: 26.66 plants/$m^2$) treated with the herbicide Dimpex, recording (34.35 g), whereas the highest density (D3: 44.44 plants/$m^2$) consistently decreased seed index across nearly all of the treatments. In Zakho, the density (D2: 33.33 plants/$m^2$) combined with hand hoeing produced the greatest seed index (26.14 g). The effectiveness of specific combinations was not applicable across different locations. The (D1: 26.66 plants/$m^2$) treated with Dimpex, which performed well in Sumel (34.35 g), resulted in the lowest seed index (13.49 g) in Zakho. The interaction detected in both locations supports the broader principle described by [17], who argued that physiological responses to agronomic treatments are strongly modulated by environmental context. This concept is further supported by [7], who documented substantial site-dependence in chickpea seed weight and yield responses under differing densities and weed pressures.

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**Table (5):** Effect of Plant Densities and Weed Control Methods with Their Interactions on *the **Seed Index (g)*** in the 2025 Growing Season at Sumel and Zakho Locations.

| Weed Control Methods | Sumel | | | | Zakho | | | |
|---|---|---|---|---|---|---|---|---|
| | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods |
| **T1 (Check)** | 17.37 f | 24.33 cd | 18.86 ef | 20.19 b | 14.62 fg | 17.09 defg | 15.38 efg | 15.70 c |
| **T2 (Kordiclofen)** | 23.28 de | 31.47 ab | 16.92 f | 23.89 a | 18.83 cde | 21.76 bc | 20.88 bcd | 20.49 b |
| **T3 (Dimpex)** | 34.35 a | 20.87 def | 17.80 f | 24.34 a | 13.49 g | 18.15 cdef | 17.07 defg | 16.24 c |
| **T4 (Matador Pro)** | 29.90 ab | 19.56 def | 18.39 ef | 22.62 ab | 20.68 bcd | 19.96 bcd | 19.39 bcd | 20.01 b |
| **T5 (Hand hoeing)** | 21.67 def | 28.41 bc | 19.34 ef | 23.14 ab | 22.87 ab | 26.14 a | 21.36 bc | 23.46 a |
| Total mean of Plant Densities | 25.31 a | 24.93 a | 18.26 b | | 18.10 b | 20.62 a | 18.82 ab | |

Values within each set of means followed by the same letter are not significantly different at p=0.05 according to Duncan's M.R.T., 1955.

**Seed Yield (kg/ha)**

The data in Table (6) suggests that seed yield was significantly affected by plant density, weed control methods, and their interaction at both studied sites. At Sumel, the plant density (D2: 33.33 plants/m²) recorded the highest mean seed yield (358.09kg/ha), which was strongly higher than the lowest density (D1: 26.66 plants/m²) and comparable to the highest density (D3: 44.44 plants/m²). Similarly, in Zakho, the (D2: 33.33 plants/m²) recorded the highest seed yield (362.29 kg/ha), significantly surpassing lowest and matching the highest densities. This corresponds with [33], who noted that increasing crop density from a poor to a recommended level significantly enhanced chickpea seed yield. Results are additionally supported by [5] and [9], which indicated optimal densities within this range. Regarding weed control methods, hand hoeing proved to be the most effective method at both locations, resulting in the highest yield of (385.83 kg/ha) in Sumel and (411.42 kg/ha) in Zakho. While hand hoeing was the most effective treatment overall, Kordiclofen proved to be the superior chemical alternative, achieving yields of 350.27 kg/ha in Zakho and 324.24 kg/ha in

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Sumel, providing an acceptable alternative for conditions where manual weeding is unfeasible. This underscores its value as a chemical alternative, consistent with the integrated weed management principles outlined by [24]. The severe production reduction in the weedy check plots at both locations confirms that chickpea is a poor competitor, with uncontrolled weeds resulting in substantial yield losses, as reported by [1]. The interaction between density and weed control was significant for seed yield. The most effective combination at both sites was the plant density (D2: 33.33 plants/m²) combined with hand hoeing, resulting in the highest yields of (469.28 kg/ha) at Sumel and (478.23 kg/ha) at Zakho. This powerful synergy shows that optimal plant spacing and efficient weed control are effective strategies for improving chickpea yield. The results from [24] strongly support these findings, illustrating that the correlation between plant density and the weed management approach significantly affects seed yield, with integrated treatments providing optimal productivity and weed suppression efficacy.

**Table (6):** Effect of Plant Densities and Weed Control Methods with Their Interactions on *the **Seed Yield (kg/ha)*** in the 2025 Growing Season at Sumel and Zakho Locations.

| Weed Control Methods | Sumel | | | | Zakho | | | |
|---|---|---|---|---|---|---|---|---|
| | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods |
| **T1 (Check)** | 121.04 g | 238.47 ef | 250.4 ef | 203.30 c | 141.44 g | 255.17 e | 260.10 e | 218.90 d |
| **T2 (Kordiclofen)** | 197.05 f | 402.01 abc | 373.66 bcd | 324.24 b | 249.97 e | 377.73 cd | 423.10 b | 350.27 b |
| **T3 (Dimpex)** | 413.96 ab | 341.21 bcd | 338.45 cd | 364.54 ab | 184.28 f | 363.38 d | 341.70 d | 296.45 c |
| **T4 (Matador Pro)** | 373.53 bcd | 339.42 cd | 302.56 de | 338.50 ab | 273.65 e | 336.92 d | 333.70 d | 314.76 c |
| **T5 (Hand hoeing)** | 341.47 bcd | 469.28 a | 346.74 bcd | 385.83 a | 336.25 d | 478.23 a | 419.78 bc | 411.42 a |
| Total mean of Plant Densities | 289.41 b | 358.08 a | 322.36 ab | | 237.12 b | 362.29 a | 355.68 a | |

Values within each set of means followed by the same letter are not significantly different at ,.p=0.05 according to Duncan’s M.R.T

## Harvest Index (%)

Table (7) demonstrates that the harvest index was strongly influenced by plant density, weed control methods, and their interaction, providing noticeable results at both locations. In Sumel, the plant density (D2: 33.33 plants/m²) provided the highest mean value (0.35), significantly surpassing other densities. This corresponds with [31] findings, which indicate that moderate plant densities enhance light interception and root distribution, resulting in an increased harvest index through the optimization of the source-sink balance. Conversely, both low and high densities reduced the harvest index due to resource underutilization or severe intra-specific competition. In Zakho, both the (D1: 26.66 plants/m²) and (D2: 33.33 plants/m²) densities resulted in a considerably superior harvest index compared to the (D3: 44.44 plants/m²) density, with (D2: 33.33 plants/m²) achieving the highest mean (0.34). This confirms that a moderate plant population maximizes the desired balance between vegetative and reproductive growth, a notion corroborated by [8], who emphasized the crucial role of optimal density in improving the distribution of resources in legumes. In terms of weed control, hand hoeing achieved the highest harvest index at both sites (0.39 in Sumel and 0.37 in Zakho), illustrating its superior effectiveness in redistributing resources to grain production by eliminating weed competition. The herbicide Kordiclofen demonstrated efficacy, highlighting its significance as a chemical option, as noted in the integrated weed control principles by [23]. The weedy check consistently resulted in the lowest harvest indices, demonstrating the substantial effect of uncontrolled weed competition on reproductive efficiency, a yield loss mechanism outlined by [20]. A significant interaction was observed in Sumel where the combination of (D2: 33.33 plants/m²) and Hand hoeing recorded the highest harvest index (0.48). Although the interaction in Zakho was not significant, the numerical trends showed that the highest values (0.42) were also achieved with the D2 combined with hand hoeing. The powerful synergy observed, through which the combination of D2 and hand hoeing resulted in the highest harvest index, is corroborated by [14], which demonstrated that an optimal plant density, combined with efficient weed control, establishes conditions favorable to an enhanced source-sink relationship, resulting in an improved harvest index.

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**Table (7):** Effect of Plant Densities and Weed Control Methods with Their Interactions on ***the Harvest Index (%)*** in the 2025 Growing Season at Sumel and Zakho Locations.

| **Weed Control Methods** | **Sumel** | | | | **Zakho** | | | |
|---|---|---|---|---|---|---|---|---|
| | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods | **D1** 26.66 plants.m$^{-2}$ | **D2** 33.33 plants.m$^{-2}$ | **D3** 44.44 plants.m$^{-2}$ | Means of Weed Control Methods |
| **T1 (Check)** | 0.23 h | 0.27 efgh | 0.24 gh | 0.25 d | 0.27 ef | 0.29 def | 0.26 ef | 0.27 c |
| **T2 (Kordiclofen)** | 0.28 defg | 0.34 bc | 0.26 fgh | 0.29 c | 0.33 bcd | 0.32 cde | 0.29 cde | 0.31 b |
| **T3 (Dimpex)** | 0.36 bc | 0.31 cdef | 0.34 bc | 0.33 b | 0.30 cde | 0.38 ab | 0.28 def | 0.32 b |
| **T4 (Matador Pro)** | 0.31 cde | 0.35 bc | 0.38 b | 0.35 b | 0.32 bcde | 0.32 cde | 0.23 f | 0.29 bc |
| **T5 (Hand hoeing)** | 0.37 b | 0.48 a | 0.33 bcd | 0.39 a | 0.35 bc | 0.42 a | 0.33 bcd | 0.37 a |
| Total mean of Plant Densities | 0.31 b | 0.35 a | 0.31 b | | 0.31 a | 0.34 a | 0.28 b | |

Values within each set of means followed by the same letter are not significantly different at p=0.05 according to Duncan's M.R.T., 1955.

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## Conclusion

This research demonstrated that a plant density of 33.33 plants/m² is ideal for chickpea cultivation, resulting in enhanced seed production and harvest index concerning weed control methods. Hand hoeing demonstrated the highest efficiency. achieving the highest yields, harvest index, and seed weight. A plant density of 33.33 plants/m² combined with hand hoeing produced the best seed manufacturing, thus recommending it for farmers. The herbicide Kordiclofen demonstrated efficacy as a chemical substitute for manual hoeing, providing a viable weed management solution for chickpea cultivators.

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