*Journal of Medicinal and Industrial Plant Sciences (2025) 3 (2): 1- 14*
ISSN: 2959 – 121X
DOI: https://doi.org/10.32894/MEDIP.25.3.2.1

# Response of two promising cultivars of bread wheat (*Triticum aestivum* L.) to conservation agriculture under rainfed irrigation in a moderate rainfall area in Nineveh Governorate

**Nawaf Jasem Mohammed**
*Center for Arid and Farming and Conservation Agriculture Research's -University of Mosul- Iraq.*

* *Corresponding author: E-mail:* nawafjasem@uomosul.edu.iq

**ABSTRACT**

The field experiment was carried out in the Al-Muhalabiya region, which is roughly 45 kilometers west of Mosul, Iraq, during the 2023–2024 growing season. It used a factorial arrangement with two factors: (1) two tillage systems, Zero Tillage (ZT) and Conventional Tillage (CT); and (2) two bread wheat (*Triticum aestivum* L.) cultivars, Ozkan and Dinka, which were sown at a consistent seeding rate of 100 kg·ha$^{-1}$. The goal was to assess how important morphological and yield-related traits were affected by cultivar type and tillage system in rainfed environments. Results of agronomic characteristics, such as biological yield (BY), plant height (PL), number of grains per spike (NGS), 1000-grain weight (1000GW), and grain yield (GY), the results showed that the Ozkan cultivar performed noticeably better than Dinka. Ozkan demonstrated superior genetic potential and adaptation to conservation tillage by recording the highest biological yield (701.67 g·m$^{-2}$) and grain yield (355.00 g·m$^{-2}$) under ZT. In addition, ZT significantly reduced the weed plant density (WPD) to 0.5 plants·m$^{-2}$ as opposed to 3.17 plants·m$^{-2}$ under CT. Notable agronomic benefits included increased tiller number (NT), spike number (NS), and grain number per spike (NGS). The interaction between cultivar and tillage system was especially significant: while Ozkan maintained more consistent yield traits across both tillage systems, indicating higher genetic resilience, Dinka achieved total weed suppression under ZT. Furthermore, a highly significant and positive correlation (r = 0.990) was found between plant height and grain yield, suggesting a close relationship between vegetative vigor and yield performance. These results underline how crucial it is to match cultivar selection with suitable tillage techniques and encourage the use of Zero Tillage as a resource-efficient, sustainable approach, especially when combined with productive cultivars like Ozkan.

**KEYWORDS:** Wheat Cultivar; Zero-tillage (ZT); Conventional tillage (CT).

**Received**: 28/04/2025; **Accepted**: 28/06/2025; **Available online:** 30/06/2025



---

# استجابة صنفين واعدين من حنطة الخبز (*Triticum aestivum* L.) للزراعة الحافظة تحت الري الديمي في منطقة متوسطة الامطار في محافظة نينوى

نواف جاسم محمد
مركز بحوث الزراعة الجافة والحافظة – جامعة الموصل.

**الملخص**

نُفذت تجربة حقلية خلال الموسم الزراعي 2023–2024 في منطقة المحلبية، التي تقع على بُعد نحو 45 كم غرب مدينة الموصل في العراق. اشتملت التجربة على ترتيب عاملي يتكون من عاملين: (1) صنفين من حنطة الخبز (***Triticum aestivum* L.**) هما **Ozkan** و**Dinka**، زُرعا بمعدل بذار موحد بلغ 100 كغم·هـ$^{-1}$، و(2) نظامي حراثة هما الزراعة بدون حراثة (**ZT**) والحراثة التقليدية (**CT**). هدفت الدراسة إلى تقييم تأثير نوع الصنف ونظام الحراثة في عدد من الصفات المورفولوجية وصفات الحاصل في ظروف الزراعة الديمية. أظهرت النتائج أن الصنف **Ozkan** تفوق معنوياً على الصنف **Dinka** في عدد من الصفات الزراعية، بما في ذلك الحاصل الحيوي، وطول النبات، وعدد الحبوب في السنبلة، ووزن الألف حبة، والحاصل الكلي من الحبوب. تحت نظام **ZT**، سجل الصنف **Ozkan** أعلى حاصل حيوي بلغ 701.67 غم·م$^{-2}$، وأعلى حاصل حبوب بلغ 355.00 غم·م$^{-2}$، مما يعكس كفاءته الوراثية العالية وقدرته على التكيف مع أنظمة الزراعة المحافظة. كما أظهر نظام **ZT** مزايا زراعية واضحة، تمثلت بزيادة عدد الأشطاء والسنابل والحبوب في السنبلة، مع خفض كبير في كثافة الأدغال إلى 0.5 نبات·م$^{-2}$ مقارنة بـ 3.17 نبات·م$^{-2}$ تحت **CT**. كان للتفاعل بين الصنف ونظام الحراثة دور بارز؛ إذ حقق الصنف **Dinka** تثبيطًا كاملاً للأدغال تحت نظام **ZT**، في حين حافظ الصنف **Ozkan** على استقرار إنتاجي ملحوظ في كلا النظامين، مما يشير إلى تمتعه بمرونة وراثية عالية. كما أظهر تحليل الارتباط علاقة موجبة قوية ومعنوية بين طول النبات والحاصل (**r = 0.990**)، مما يدل على أن النشاط الخضري يرتبط ارتباطاً وثيقاً بالإنتاجية. تؤكد هذه النتائج أهمية مواءمة التركيب الوراثي للصنف مع نظام الحراثة المناسب لتحسين نمو القمح وغلته، وتدعم اعتماد الزراعة بدون حراثة كنظام مستدام وفعّال، خاصة عند استخدام أصناف عالية الكفاءة مثل **Ozkan**.

**الكلمات المفتاحية:** صنف القمح؛ الزراعة بدون حراثة؛ الزراعة بحراثة (التقليدية).

# INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops cultivated by humans for thousands of years and continues to be a cornerstone of global food security, especially bread wheat, which belongs to the Poaceae family (Wolde & Schnurbusch, 2019). It serves as a primary source of energy for a large segment of the world population and is often referred to as the "queen of grains" due to its nutritional value and versatility, particularly in bread production. Wheat provides approximately 25% of the daily caloric and protein intake for the global population and contains essential amino acids in considerable amounts. Currently, over 35% of the world's population relies on wheat as a staple in their daily diet.

According to projections, the global population is expected to increase from 7 to 9 billion by 2050, necessitating a substantial rise in wheat production to meet future food demands (FAO, 2020). In 2021, the total area cultivated with wheat worldwide reached approximately 220 million hectares, with an overall production of 799 million tons (World Food and Agriculture – Statistical Yearbook, 2023). In Iraq, wheat cultivation is projected to cover around 2.7 million hectares in 2024, with a corresponding production of about 6 million tons, positioning the country close to achieving wheat self-sufficiency. In Nineveh Governorate alone, approximately 367,000 hectares were cultivated with wheat, yielding nearly 2 million tons.

Cultivars are central to crop improvement and productivity, as they possess genetic variability responsible for key agronomic traits. Their selection directly influences vegetative growth, grain yield, quality, and adaptability to environmental conditions. For example, studies in Basra, Iraq, demonstrated the superiority of the 'Ibaa 99' soft wheat cultivar over 'Abu Ghraib 3' and 'Al-Latifiya' in traits such as plant height and tiller number (Al-Sebahi et al., 2015).

Similarly, multi-location field trials conducted in Montana, USA, evaluated more than 20 winter wheat cultivars under diverse agro-environmental conditions. The cultivar 'Yellowstone' exhibited statistically significant superiority in biological yield, grain yield, and spike-related traits (Maes, 2016). Other studies conducted in Erbil (Omar & Al-Layla, 2024), Kirkuk, and Mosul regions have shown considerable genetic diversity among local and imported wheat genotypes, with certain cultivars like 'Hewlir 4' and 'Gomeza 9' outperforming others in yield-related parameters under varying agroecological conditions.

In addition to genotype, the tillage system is a critical agronomic factor influencing wheat performance. Conservation tillage particularly Zero Tillage (ZT) has received increasing attention due to its environmental and economic benefits, including reduced soil erosion, improved water retention, enhanced soil organic matter, and decreased fuel consumption. Several studies in Iraq and elsewhere have demonstrated that ZT can significantly improve traits such as plant height, tiller number, spike length, and grain yield compared to conventional tillage (CT) (Verma et al., 2010; Al-Obaidi & Alrijabo, 2022).

Furthermore, ZT has been associated with reduced weed infestation due to minimal soil disturbance, which prevents weed seed germination. Studies in Nineveh and other regions (Al-Jubouri, 2021; Al-Mashhadani, 2020) have consistently shown that conservation agriculture systems outperform traditional tillage in both biological and economic yield components. For instance, Al-Jubouri (2021) reported a 20–34% increase in key yield traits under ZT across two locations in Mosul.

Given these considerations, the present study aims to evaluate the performance of two bread wheat cultivars, 'Ozkan' and 'Dinka', under two tillage systems (ZT and CT) in a rainfed environment within Nineveh Governorate. The objective is to identify genotype × tillage system interactions that optimize yield and resource efficiency in semi-arid agricultural conditions.

## MATERIALS AND METHODS

The field experiment was carried out in northern Iraq (Al-Mahlabiya), which is located within medium rainfall areas, where the seasonal rainfall is 350-500 mm, to study evaluate of two wheat cultivars to conservation and conventional agricultural practices under semi-irrigation in the Nineveh Governorate. The experiment consisted of two factors: the first was the cultivars, which included two varieties, Ozkan and Dinka, which is seeding rate of 100 kg $ha^{-1}$. Second factor contained tillage systems (conservation tillage and conventional tillage systems), with three replications. Two types of seeders were used: a specialized disc seeder for no-till farming, imported from Turkey, and a conventional disc seeder. The field was fertilized with urea (N46%) with rate 80 kg $ha^{-1}$, Half of this amount is added during cultivation and the other half at the tillering stage. Phosphorus fertilizer was added at sowing at rate 80 kg $ha^{-1}$(DAP, 18%N, 46% P2O5), also according to the recommended rate. The data were analyzed according design (RCBD) Antar, and Adnan Hussein Al-Wakkah (2017).

**Measured Indicators:**

1. **Biological Yield (BY) ($g.m^{-2}$):** The biological yield was calculated by weighing all wheat plants above the soil surface (straw and grain) in the experimental unit after harvest.
2. **Weed Plant Density (WPD) ($plants.m^{-2}$)**: Weed plant density was determined by randomly placing a wooden frame measuring 1 × 1 meter (1 $m^2$) within each experimental unit. All weed plants located within the frame were counted to estimate the number of plants per square meter. It is preferable to conduct the counting at the flowering stage of the weeds to ensure an accurate representation of maximum weed density before plant senescence or interference with the crop occurs

3. **Plant Height (PL) (cm):** Ten plants were randomly selected from each experimental unit at maturity, and their height was measured from the base at soil level to the tip of the spike (excluding awns), with the average height calculated.
4. **No. Tillers $m^{-2}$(NT)**: The total number of tillers per square meter was counted for each experimental unit before the booting stage.
5. **No. Spikes (NS) ($m^{-2}$):** The number of spikes from all plants in the harvested experimental units was recorded at the maturity stage
6. **Spike Length (SL) (cm):** Forty spikes were randomly selected from each experimental unit, and their lengths were measured from the base to the tip (excluding awns) at maturity. The average spike length was calculated.
7. **NO. Grains $Spike^{-1}$ (NGS)**: Forty spikes from each experimental unit were randomly selected, threshed, and the number of grains per spike was counted to determine the average number of grains per spike.
8. **1000 Grain Weight (1000GW) (gm)**: The thousand-grain weight was measured by counting and weighing all the grains from forty randomly selected spikes from the experimental unit and calculating the average weight of 1000 grains.
9. **Grain Yield (GY) ($g.m^{-2}$)**: Grain yield was calculated using the following equation: Grain Yield ($gm/m^2$) = number of spikes per square meter × number of grains per spike × (1000 grain weight / 1000).

**RESULTS AND DISCUSSION**

The results presented in Table (1) indicate that the cultivar Ozkan significantly outperformed Dinka under both tillage systems, with an average biological yield of (645.0 $g·m^{-2}$)compared to (459.17 $g·m^{-2}$) for 'Dinka. This difference suggests a clear genetic variation between the two cultivars in their ability to efficiently utilize available environmental resources, which is reflected in superior physiological and structural plant efficiency,These results agree with Melesse( 2017) and Maes (2016).

It is also evident from the table that the zero tillage (ZT) system led to a significant increase in biological yield compared to the conventional tillage (CT) system. The overall mean under ZT was (609.17 $g·m^{-2}$) , while it was (495.00 $g·m^{-2}$) under CT. This implies that ZT may contribute positively to plant growth and biomass accumulation, likely due to improved soil structure, moisture retention, and reduced disturbance, Are in agreement with the findings of AL-Obaidi and Alrijabo (2022) and Al-Hamdani (2020).

Furthermore, the interaction between cultivars and tillage systems reveals that the highest biological yield was achieved by cultivar Ozkan under the ZT system, recording (701.67 $g·m^{-2}$) , which is the highest value in the table. In contrast, the lowest yield was observed for Dinka under the CT system, at (401.67 g·m⁻²) . This interaction highlights the important role of the interplay between genetic potential and agronomic practices such as tillage method in enhancing crop productivity. These results agree with

**Table 1.** Effect of cultivars and tillage systems on biological yield ($g \cdot m^{-2}$).

| Cultivar | Tillage systems | | Average |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | d 401.67 | c 516.67 | 459.17a |
| **Ozkan** | b 588.33 | a 701.67 | 645.0b |
| **Average** | b 495.00 | 609.17a | |

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

The data in Table (2) indicate that there were no significant differences between the two cultivars in terms of weed density (WPD). However, regarding the tillage factor, the conventional tillage (CT) system recorded the highest average number of weeds, reaching( 3.1667 plants·m⁻²). In contrast, the zero tillage (ZT) system showed a substantial reduction in weed density, with an average of (0.5000 plants·m⁻²) . This finding suggests that the ZT system significantly contributed to suppressing weed emergence. Such an effect may be attributed to the minimal soil disturbance in ZT, which prevents buried weed seeds from being exposed to the soil surface, thus limiting their germination. Additionally, the retention of crop residues on the soil surface under ZT may act as a physical barrier, inhibiting weed seedling emergence by reducing light penetration and moderating soil temperature.

As for the interaction between cultivars and tillage systems, the interaction of the Dinka cultivar with ZT resulted in complete weed suppression, recording (0.000 plants·m⁻²) , indicating a strong synergistic effect between cultivar and tillage method in reducing weed infestation. In contrast, the Ozkan cultivar did not exhibit a strong interaction with the tillage system, as weed presence persisted even under ZT conditions. This points to a significant interaction between cultivar and tillage system, wherein Dinka appears more responsive to the ZT environment in terms of weed suppression. Such a response may be linked to its morphological traits or enhanced soil coverage capacity which can further inhibit weed growth through competitive exclusion or physical shading. Are compatible with AL- Mashhadani (2020).

**Table 2.** Effect of cultivars and tillage Systems on weed plant density (WPD) ($plants.m^{-2}$)

| Cultivar | Tillage systems | | Average |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | a 3.667 | b 0.000 | 1.8333 a |
| **Ozkan** | a b 2.667 | a b 1.000 | a 1.8333 |
| **Average** | a 3.1667 | b 0.5000 | |

Table (3) shows that the Ozkan cultivar significantly outperformed Dinka in terms of plant height with an average of (62.567 cm) , while Dinka exhibited a lower average height of (55.900 cm) . This variation reflects underlying genetic differences between the two cultivars in terms of vegetative growth possibly due to Ozkan's superior growth potential or a more favorable physiological response to environmental conditions. These results agree with AL-Sebahi et al (2015).

Although the tillage system factor did not lead to statistically significant differences, the zero tillage (ZT) system resulted in taller plants compared to the conventional tillage (CT). The mean plant height under ZT was (61.933 cm) , while under CT it was (56.533 cm) . This trend may be attributed to the ability of ZT to enhance vegetative development through improved soil moisture retention reduced nutrient loss from the soil surface, and minimized mechanical stress on the root zone, which collectively promote better root and shoot growth, these results agree with AL-Mashhadani (2020) and of AL-Obaidi and Alrijabo (2022).

Regarding the interaction between cultivar and tillage system the highest plant height was recorded for Ozkan grown under the ZT system reaching (65.000 cm) . Conversely, the lowest plant height was observed for Dinka under CT with a value of (52.933 cm) . This interaction indicates a positive and significant synergistic effect between the Ozkan cultivar and the zero-tillage system, where both factors contributed to enhanced vertical growth. On the other hand, the limited response of Dinka to the change in tillage system suggests a restricted genetic capacity for adaptation to reduced tillage conditions.

**Table 3.** Effect of cultivars and tillage systems on plant height (PL) (cm)

| **Cultivar** | **Tillage systems** | | **Average** |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | b 52.933 | a b 58.867 | b 55.900 |
| **Ozkan** | a b 60.133 | a 65.000 | a 62.567 |
| **Average** | a 56.533 | a 61.933 | |

In Table (4) the statistical analyses demonstrated that both cultivars Dinka and Ozkan exhibited a comparable performance in terms of the average number of tillers $\mathbf{m^{-2}}$ as no significant differences were observed between their respective means for this trait.

Regarding the effect of tillage systems, the results revealed that the zero tillage (ZT) system led to a significant increase in tiller number, with the highest recorded mean of (294.833 tillers·$m^{-2}$) compared to the conventional tillage (CT) system, which recorded (185.833 tillers·$m^{-2}$). This improvement under ZT can be attributed to enhanced soil conditions, such as better surface moisture conservation more stable temperature in the upper soil layers, and reduced disturbance of the soil's physical structure factors that collectively support greater root proliferation and the development of additional tillers. These results agree with Shafaqat et al (2016) and Al-Hamdani(2020)

The interaction between cultivar and tillage system revealed that the highest number of tillers was recorded for Dinka grown under ZT reaching (339.000 tillers·m$^{-2}$), whereas the lowest value for this trait was also observed in Dinka but under the CT system with (151.000 tillers·m$^{-2}$). This substantial variation indicates a significant interaction effect between cultivar and tillage system, suggesting that Dinka is highly responsive to improved soil and environmental conditions provided by ZT. This responsiveness may reflect the cultivar's morphological and physiological adaptability to reduced tillage environments.

**Table 4.** Effect of cultivars and tillage systems on tillers m$^{-2}$(NT).

| **Cultivar** | **Tillage systems** | | **Average** |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | d 151.000 | a 339.000 | a 245.000 |
| **Ozkan** | c 220.667 | b 250.667 | a 235.667 |
| **Average** | b 185.833 | a 294.833 | |

The results in Table (5) revealed that the differences between the studied cultivars were not statistically significant in terms of number of spikes(m$^{-2}$), Although the difference was not significant, the Dinka cultivar recorded a numerically higher value (238.5 spikes·m$^{-2}$) compared to Ozkan, which recorded (226.0 spikes·m$^{-2}$).

The statistical analysis indicated a significant effect of tillage system on the number of spikes·m$^{-2}$. The zero tillage (ZT) system outperformed the conventional tillage (CT) system, with a general average of (289.5 spikes·m$^{-2}$) under ZT compared to (175.0 spikes·m$^{-2}$) under CT. This difference may be attributed to the role of ZT in preserving favorable soil structural properties such as soil moisture retention enhanced root anchorage and reduced surface desiccation in addition to improved microbial activity all of which contribute positively to the plant's vegetative and reproductive development, Are compatible AL-jubouri (2021); AL-Mashhadani (2020) and Al-Mafarji & Al-Jouburi (2023a).

Regarding the interaction between cultivars and tillage systems Dinka cultivar exhibited a strong response to the ZT system, achieving the highest spike number of (334 spikes·m$^{-2}$) . Conversely the lowest value (143 spikes·m$^{-2}$) was also recorded for Dinka under CT. This indicates a high sensitivity of this cultivar to the tillage system employed. The interaction suggests that certain cultivars may be more adapted to specific agricultural environments, highlighting the importance of conducting broader agroecological evaluations to identify optimal cultivar–tillage combinations for enhanced productivity.

**Table 5.** Effect of cultivars and tillage systems on no. spikes (NS) ($m^{-2}$)

| Cultivar | Tillage systems | | Average |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | d 143.000 | a 334.000 | a 238.500 |
| **Ozkan** | c 207.000 | b 245.000 | a 226.000 |
| **Average** | b 175.000 | a 289.500 | |

The results presented in table (6) indicated no significant differences between the studied cultivars in terms of spike length. Although the difference was not statistically significant, the cultivar Dinka recorded a numerically higher spike length of (8.25 cm) compared to (7.75 cm) for Ozkan. This variation can be attributed to genetic differences and the differential response of cultivars to environmental conditions.

The data also showed that the tillage system did not exert a statistically significant effect on spike length. However, the (ZT) system recorded a higher mean value (8.27 cm) compared to the (CT) system (7.73 cm), suggesting a possible positive influence of ZT on spike development, although not statistically confirmed. These results agree with Shafaqat et al (2016) and AL-Jubouri (2021).

Statistical indicators, however, revealed a significant interaction between cultivars and tillage systems. The Dinka cultivar recorded its highest spike length under the CT system (8.60 cm), whereas Ozkan exhibited its maximum value under ZT, reaching (8.63 cm) thereby outperforming Dinka under the same system (7.90 cm). This pattern of interaction indicates that each cultivar responds differently depending on the tillage system used. Such findings are consistent with the principles of integrated crop management which emphasize the importance of aligning genotype with agronomic practice to optimize crop performance. These interactions further underscore the need for site-specific evaluation of cultivars under different management systems prior to adoption, to ensure maximum efficiency in terms of growth and yield outcomes.

**Table 6.** Effect of cultivars and tillage systems on spike length (SL) (cm)

| Cultivar | Tillage systems | | Average |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | a 8.6000 | a b 7.9000 | a 8.2500 |
| **Ozkan** | b 6.8667 | a 8.6333 | a 7.7500 |
| **Average** | a 7.7333 | a 8.2667 | |

Table (7) so far as grain per spike is concerned, there were no differences within the cultivars involved to be found out, based on

Shown that tillage system had a major effect on this characteristic. With a mean of (36.00 grains spike$^{-1}$) over (29.92 grains spike$^{-1}$) from the (CT) system, the (ZT) system had a notable yield benefit. This is due to the enhanced soil conditions provided by the ZT system that individually favor better vegetative and reproductive growth. These conditions included improved soil water retention, temperature stability, and minimized disturbance to the root zone. These findings concur with Hassan et al. (2018) and AL-Mashhadani (2022) and Hussain et al. (2018). The interaction of cultivar by tillage system showed a distinct pattern of response.

With a grain count of 37.73 grains spike$^{-1}$ on the ZT system, the Ozkan cultivar excelled over Dinka cultivar, which under the same conditions posted 34.27 grains spike$^{-1}$. The two cultivars, however, fared better under the CT system, where the Ozkan posted a marginally lower figure of (28.50 grains spike$^{-1}$) and Dinka posted (31.33 grains spike$^{-1}$). As a result of its physiological reaction and higher adaptability flexibility to changes in moisture, aeration, and nutrient availability, this variation indicates that Ozkan is more sensitive to tillage system changes. Thus, the choice of proper cultivar to an agronomic system is needed to enhance crop productivity, highlighting the significance of genotype × management interactions in crop production strategy.

**Table 7.** Effect of cultivars and tillage systems on no. grains spike$^{-1}$ (NGS)

| Cultivar | Tillage systems | | Average |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | b c 31.333 | b 34.267 | a 32.8000 |
| **Ozkan** | c 28.500 | a 37.733 | a 33.1165 |
| **Average** | b 29.9165 | a 36.000 | |

Table (8) revealed the presence of significant differences among the cultivars in terms of 1000-grain weight. The Ozkan cultivar outperformed Dinka with a mean weight of (29.78 gm) compared to (23.50 gm) for Dinka. This significant difference is likely attributed to genetic variation in grain characteristics, particularly size and density. Cultivars with larger grain size often exhibit greater efficiency in photosynthesis and more effective translocation and accumulation of dry matter during the grain-filling period. Are compatible with Omar and AL-Layala (2024) and Wael and Ahmed (2016).

The data also indicate that the effect of tillage systems was not statistically significant, as no meaningful differences were observed between the (CT) and (ZT) systems. The average weights recorded were (27.12 gm) under CT and (26.17 gm) under ZT.

However, a significant interaction between cultivar and tillage system was observed. The Ozkan cultivar maintained its superiority under both tillage regimes, registering (30.23 gm) under CT and (29.33 gm) under ZT. In contrast the Dinka cultivar recorded lower values for the same trait, with

(24.00 gm) under CT and (23.00 gm) under ZT. This outcome indicates that Ozkan exhibits high genetic stability in expressing this trait regardless of tillage conditions, while Dinka appears more sensitive to environmental fluctuations.

Such interaction highlights the importance of genotype-by-management compatibility and supports the recommendation to prioritize Ozkan in environments with variable agronomic practices, given its consistent performance in producing high grain weight, a trait directly contributing to overall yield potential.

**Table 8.** Effect of cultivars and tillage systems on 1000 grain weight (1000GW) (gm)

| Cultivar | Tillage systems | | Average |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | b 24.0000 | b 23.0000 | b 23.5000 |
| **Ozkan** | a 30.2333 | a 29.3333 | a 29.7833 |
| **Average** | a 27.1167 | a 26.1667 | |

The results in table (9) indicate a clear and significant difference between the cultivars with the Ozkan cultivar significantly outperforming Dinka in the studied trait. Ozkan recorded a grain yield of (347.5 $g \cdot m^{-2}$) compared to (228.33 $g \cdot m^{-2}$) for Dinka. This disparity reflects Ozkan's superior genetic potential for traits associated with grain yield, which may include enhanced productive capacity or more favorable physiological characteristics. Are similar to those found by AL -Jumaili and Rojbayany (2024) and Melesse (2017).

The data also show that the (ZT) system resulted in higher grain yield compared to the (CT) system, with mean yields of (300.83 $g \cdot m^{-2}$) and (275.00 $g \cdot m^{-2}$), respectively. Although the differences were not statistically significant, they highlight the potential positive impact of conservation tillage on improving the environmental and nutritional conditions for plant growth, thereby supporting better development and yield. Are in agreement with the findings of Hassan et al (2018), AL-Obaidi; Alrijabo (2022); AL-Jubouri (2021) Al-Mafarji et al (2024)

Furthermore, the interaction between cultivar and tillage system revealed that Ozkan maintained its superiority under both systems registering the highest yields under CT (340.00 $g \cdot m^{-2}$) and ZT (355.00 $g \cdot m^{-2}$). In contrast Dinka showed lower values under both CT and ZT. This suggests a significant cultivar by tillage interaction where Ozkan demonstrates improved performance particularly under ZT while Dinka appears more sensitive to management conditions. These findings underscore the importance of selecting cultivars that are well-adapted to specific agronomic systems to achieve optimal yield performance.

**Table 9.** Effect of cultivars and tillage systems on grain yield (GY) ($g.m^{-2}$)

| Cultivar | Tillage systems | | Average |
|---|---|---|---|
| | **ZT** | **CT** | |
| **Dinka** | c210.000 | b 246.660 | b 228.333 |
| **Ozkan** | a 340.000 | a 355.000 | a 347.500 |
| **Average** | b 275.000 | a 300.833 | |

Table (10) presents the correlation analysis between the dependent variable (Y) and several independent variables. The results highlight the strength, direction, and statistical significance of these relationships, which can be summarized as follows:

A very strong and statistically significant positive correlation at the 0.05 level was found between Y and plant height (PL), with a correlation coefficient of (r = 0.990). This indicates that an increase in plant height has a direct and positive effect on Y.

A strong positive correlation was also observed between Y and grain yield (GY) (r = 0.940), though it was not statistically significant. Nonetheless, the relationship holds potential biological importance.

Similarly, a strong positive correlation was recorded between Y and grain weight (GW) (r = 0.764), but this as well did not reach statistical significance.

The number of grains per spike (NGS) showed a moderate positive correlation with Y (r = 0.502), which was also not statistically significant.

In contrast, straw weight (WP) exhibited a moderate negative correlation with Y (r = -0.492), suggesting a potential trade-off between straw production and the response variable Y.

Other variables, such as the number of tillers (NT) and number of spikes (NS), were weakly and positively correlated with Y (r = 0.366 and 0.359, respectively), and neither correlation was statistically significant.

Spike length (SL) had the weakest correlation with Y, showing a very weak negative relationship (r = -0.107).

These findings are in agreement with those reported by AbdulHamid et al., (2017); Al-Mafarji and Al-Jubouri (2023b).

**Table 11.** Correlation between the studied traits.

| | Y | WP | PL | NT | NS | SL | NGS | GW | GY |
|---|---|---|---|---|---|---|---|---|---|
| Y | 1 | | | | | | | | |
| WP | -.492 | 1 | | | | | | | |
| PL | .990* | -.611 | 1 | | | | | | |
| NT | .366 | -.962* | .491 | 1 | | | | | |
| NS | .359 | -.970* | .485 | .999** | 1 | | | | |
| SL | -.107 | -.045 | -.092 | -.180 | -.137 | 1 | | | |
| NGS | .502 | -.670 | .565 | .445 | .477 | .708 | 1 | | |
| GW | .764 | .143 | .672 | -.194 | -.218 | -.394 | -.084 | 1 | |
| GY | .940 | -.229 | .893 | .155 | .136 | -.338 | .191 | .930 | 1 |

* and ** Correlation is significant at the 0.05 and 0.01 level, respectively

## CONCLUSIONS

In light of the obtained results, the study presents the following recommendations:

1. Incorporate the Ozkan cultivar into agricultural production programs, particularly in regions that implement conservation agriculture practices, due to its superior performance across key agronomic traits and its demonstrated genetic stability under different tillage systems.
2. Adopt the zero tillage (ZT) system as a viable agronomic practice, given its positive impact on enhancing both biological and grain yields, increasing the number of tillers and spikes, and significantly reducing weed density. These effects collectively contribute to minimizing reliance on chemical inputs and improving resource use efficiency.
3. Emphasize the interaction between cultivar and tillage system in applied research and crop improvement programs. The findings suggest that yield responses are highly influenced by the compatibility between a cultivar's genetic characteristics and the adopted management practices.
4. Encourage long-term and multi-seasonal studies to evaluate cultivar performance under various tillage systems and across diverse agroecological environments. Such investigations are essential to generalize findings and to identify optimal cultivar–management combinations tailored to specific regional conditions.

## REFERENCES

AbdulHamid, M. I. E., Qabil, N., & El-Saadony, F. M. A. (2017). Genetic variability, correlation and path analyses for yield and yield components of some bread wheat genotypes. Journal of Plant Production, 8(8), 845-852.

Agricultural Statistics Directorate, 2020

Al-Hamdani, Nawaf Jassim Mohamed (2020). Effect of planting distances with and without pressure wheel and seeding rates on the growth and yield components of bread wheat (*Triticum aestivum* L.). Master's Thesis, College of Agriculture and Forestry, University of Mosul, Iraq.

Al-Jubouri, Jassim Mohamed Aziz and Abdul Karim, Bishtwan Hama Ali (2021). Genotype-environment interaction of approved cultivars of soft wheat (*Triticum aestivum* L.) across diverse Iraqi environments. Syrian Journal of Agricultural Research, 8(1): 58-73.

Al-Jumaili, A. A. M., & Rojbayany, S. N. H. (2025). Evaluation of yield, baking and farinographic tests of several genotype of bread wheat (*Triticum aestivum* L.) under the influence of spraying with different concentrations of glutamic acid and arginine. Journal of Medicinal and Industrial Plants, 3(1), 38-54.

Al-Mafarji, T. R. T., & Al-Jubouri, J. M. A. (2023a). Combining Ability and Gene Action of Half Diallel Crosses in Bread Wheat (*Triticum aestivum* L.). IOP Conference Series: Earth and Environmental Science, 1262(5).

AL-Mafarji, T. R. T., & AL-Jubouri, J. (2023b). Heterosis, correlations and path analysis of grain yield components in bread wheat (*Triticum aestivum* L.). Kirkuk Univ. J. Agric. Sci, 14(3), 34-46 .

Al-Mafarji, T. R. T., Al-Jubouri, J. M. A., & Kanbar, A. (2024). Estimate Combining Ability and Gene Action of Yield, and Some Qualitative Traits of Bread Wheat Genotypes. (*Triticum aestivum* L.) of Half-Diallel Crosses. Tikrit Journal for Agricultural Sciences, 24(3), 182–196.

Al-Mashhadani, Ahmed Majid Abdullah (2020). Effect of tillage systems, seeding rates, and herbicides on the growth and yield of bread wheat (*Triticum aestivum* L.) under rainfed conditions. Master's Thesis, College of Agriculture and Forestry, University of Mosul, Iraq.

Al-obaidi, A. H. S., & Alrijabo, A. A. (2022). Effect of seed soaking in Bread Wheat (*Triticum aestivum* L.) on growth and yield components in rain fed area in Iraq. Indian journal of ecology 49 special issue (18): 592-596.

Al-Sebahi, Walid Abdul-Ridha, Abdul-Mahdi Saleh Al-Ansari, and Sundus Abdul-Kareem Al-Abdullah (2015). Effect of nitrogen fertilizer levels on the growth and yield of three wheat cultivars (*Triticum aestivum* L.). Basrah Journal of Agricultural Sciences, 28(1): 237-252.

Antar, Salem Hamadi and Adnan Hussein Al-Wakkah (2017). Statistical analysis of agricultural experiments using SAS software. National Library and Documentation House, Baghdad, Deposit Number 2464.

FAO. (2020) Food and Agriculture Organization of the United Nations,2020. FAOSTAT Statistical Database. Rome: FAO, 2020.

Hussain T.Tahir , Husam A.Mati and Yassen H.ALTahan (2018).Technical and economic study to compare the performance of different wheat cultivation systems in Kirkuk. . Journal of kirkuk University for Agricultural Sciences ...Vol (9) No(3) .

Hussain, I., Khan, E. A., Hassan, G., Gul, J., Ozturk, M., Alharby, H.& Alamri, S. (2017-A). Integration of high seeding densities and criss cross row planting pattern suppresses weeds and increases grain yield of spring wheat. Journal of Environmental Biology, 38(5 (Special Issue)), 1139-1145.

Knezevic, D., Zecevic, V., Stamenkovic, S., Atanasijevic, S., & Milosevic, B. (2012). Variability of number of kernels per spike in wheat cultivars (*Triticum aestivum* L.). Journal of Central European Agriculture .608-614 ,(3)13

Maes. Montana Agricultural Experiment Station (2016). Winter Wheat Varieties, Performance Evaluation and Recommendations. Montana State Uni., USA Montana Agric. Experimental Station Bulletin, 2B-1093 rev. Affiliation: Montana State University.

Nineveh Agriculture Directorate – Planning Department – 2020

Omar, A. A., & Al-Layla, M. J. (2024). Estimation genetic parameter, genotypic and phonotypic correlation, path and cluster analysis of quantitative traits for Bread Wheat genotypes in Erbil under rain-fed condition. Journal of Medical and Industrial Plant Sciences, 2.(3)

Shafaqat, A., Iqbal, M. S., Ahmad, R., & Ahmad, M. (2016). Growth and yield response of wheat (*Triticum aestivum* L.) to tillage and row spacing in maize–wheat cropping system in a semi-arid region. Eurasian Journal of Soil Science, 5(1), 53–61.

Verma, A.; C. P. Sngh; V.K. Singh; S. Kannaujiya and K. Singh (2010). A study of impact of zero tillage on productivity of wheat (*Triticum aestivum* L.) under different size groups. Plant Archives, 10 (2): 849-850.

Wael M. Jasem and Ahmed H.AL Jibouri (2016). Evaluation of performance and genetic parameters and correlation for yield and yield components in bread wheat (*Triticum aestivum* L) by using tillage systems. Journal of kirkuk University for Agricultural Sciences ...Vol (7) No (1) .

Wolde, G. M., Mascher, M., & Schnurbusch, T. (2019). Genetic modification of spikelet arrangement in wheat increases grain number without significantly affecting grain weight. Molecular Genetics and Genomics, 294(2), 457-468.

World Food and Agriculture – Statistical Yearbook 2023