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Response Growth and Yield of Bread Wheat (*Triticum aestivum* L.) and Weeds Associated with Tillage Systems (2).

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ABSTRACT

A field experiment effect of tillage system on growth and yield of wheat (*Triticum aestivum* L.) for associated weeds in the dry land was carried out during the agricultural season 2023-2024 in two locations, the first in the Kwaitla village (35 km west of the city center of Mosul), and the second in the Seta village (30 km southwest of the city center of Mosul), (About 400 mm of rainfall for each), with different soil texture. The experiment was conducted in cooperation with the World Food program WFP. The experiment included two factors, the first was tillage systems: Conventional Tillage system (CT) and Zero Tillage system (ZT), the second factor was two locations. The experiment was designed according to the factorial experiment system using a completely randomized block design and with three replications. The wheat grains (Ozgan Var.) were sown at a sowing rate of 100 kg hectare^{-1}. Fertilizer was added (DAP) and Urea by 100 kg hectare^{-1} per each. The data were analyzed statistically with the SAS program and the mean parameters were compared using the Duncan multi-range test. The results obtained that Kwaitla location outperformed the seta location in the traits of weeds number.m^{-2} and number of grains.spike^{-1}. while the seta location outperformed the Kwaitla location in the spike tall, weight of 1000 grain and plant height, the two locations did not differ in the other traits, the (CT) system outperformed in weeds number.m^{-2}, spike tall compared with (ZT) system, non- significant between the two system in number of grains of spike only, the (ZT) system outperformed at the other traits compared with the (CT) system. In the interaction between locations and tillage systems, the interaction of the ZT system in Seta location achieved a significant superiority in grains yield trait with a value of (523.33 gm.m^{-2}), while the lowest value was (191.67 gm.m^{-2}) was to the interaction of the CT system at the Seta location.

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KEYWORDS: Zero Tillage, Conventional Tillage, water, Kwaitla location, Seta location.

INTRODUCTION

Wheat occupies the first place among the cereal crops grown in the country and the world, given its importance in achieving food security for the entire world population, in addition to its role in economic and social development (Alrijabo (2022) and Aljuburi and Antar (2021). The cultivation of this crop is widespread in a large area of arable land around the world, and this plant occupies the first place in global agricultural production. The area cultivated with this crop in the Arab world is estimated at about 30.46% of the total cultivation of other cereal crops, with a production rate reaching 48.02% of the production of these crops (Jalli et al. (2021)). This percentage amounts to about 3.07% of the global production of this crop, which was estimated at about 749.46 million tons. Iraq contributes 12.92% of the production of Arab countries. There are many problems facing the agricultural sector, especially wheat cultivation. The main problem is the lack of moisture, which contributes to the low yield due to global climate change and regional conflicts over water resources. This has led to a significant decrease in cultivated area in Iraq, especially in areas that rely on rain-fed irrigation. This has also led to a decline in crop quality due to the spread of weeds, which grow best in poor environmental conditions. Researchers are exploring new scientific methods to increase crop productivity and improve their quality, such as the use of conservation agriculture, a modern scientific method in agriculture that was introduced to Iraq through cooperation with the International Center for Agricultural Research (ICARDA) in 2005. This system has achieved positive results in Nineveh Governorate compared to traditional agriculture (Woznik and Rachon (2020)). Furthermore, preserving the remains of the previous crop in the soil and not disturbing the soil in this type of tillage has led to better results compared to other systems. The study aims to disseminate the no-tillage technology and abandon traditional tillage to obtain the best production at the lowest costs and to fully utilize rainwater, as well as to rationalize the amount of fuel used in agricultural operations, in addition to abandoning the use of chemical pesticides by eliminating weeds and preventing their growth in subsequent seasons. The research was conducted in cooperation with the World Food Program (W.F.P)under an agreement to develop agriculture in Iraq and disseminate the conservation agriculture technology.

MATERIALS AND METHODS

A field experiment was carried out during the agricultural season 2023-2024 in two locations (about 400 mm. rain water for each), the first was in the Kwaitla village 35 km west of the city center of Mosul, and the second in the Seta village 30 km western south of the city center of Mosul, with different soil texture. The experiment included two factors. The first was the two locations and the second factor was the tillage systems: Conventional tillage system (CT) and Zero tillage system (ZT), Wheat grains (Ozgan var.) were sown at a sowing rate of 100 kg hectare^{-1}. Fertilizer was added (DAP) and Urea by 100 kg hectare^{-1} per each. The experiment was designed according to the factorial experiment system using a completely randomized block design and with three replications. Weeds samples were collected at the beginning of April from 1 .m^{-2} area from each treatment, harvesting date was at the end of May. The studied traits were: Weeds No. m^{-2} .Biological Yield gm.m^{-2}. Plant height cm. Spike length cm.Tillers.m^{-2}. Spikes.m^{-2}.Grains.spike^{-1}.Weight of 1000 grains gm. and Grains weight gm.m^{-2}.

The data were analyzed according to the factorial experiment system and the design of the randomized complete blocks design. The means were compared using the Duncan range test, as the different coefficients were taken to be significant with different letters of the alphabet at a probability level of 5%.

RESULTS AND DISCUSSION

Table (1) the effect of locations on weeds and the phenotypic and quantitative traits of bread wheat.

Location	Weeds No. m^{-2}	Biological Yield gm.m^{-2}	Plant height cm.	Spike length cm.	Tillers.m^{-2}
Kwaitla	34.83 a	775.00 a	61.70 b	8.31 b	469.26 a
Seta	3.83 b	783.50 a	69.37 a	9.58 a	518.33 a

Table (1) indicates that locations have a significant effect on the number of weeds, phenotypic and quantitative traits of bread wheat crop, as the Kwaitla location was more weedy compared to the Seta location, as the number of weeds m^{-2} for the two locations reached (34.83, 3.83 weeds.m^{-2}) respectively. Seta location also outperformed in the traits of plant height cm and spike length with values of (69.37 cm, 9.58 cm) respectively. While there were no significant differences between the two locations in the traits of biological weight gm.m^{-2} and number of tillers.m^{-2}.the reason for this s the difference in the amount of rainfall between the two location , These results are consistent with results of Alkol et al (2021) and Minhas et al (2023) .

Table (2) the effect of locations on the yield and its components traits of bread wheat.

Location	Spikes.m^{-2}	Grains .spike^{-1}	Weight of 1000 grains gm.	Grains weight gm.m^{-2}
Kwaitla	465.2 a	33.58 a	21.50 b	333.33 a
Seta	491.07 a	25.33 b	27.48 a	357.50 a

Table (2) indicates that locations also have a significant effect on the traits of the yield and its components. Although there was no significant difference in the traits of number of spikes.m^{-2} and grain yield gm.m^{-2}.The Kwaitla location outperformed the Seta location significantly in the trait of number of grains per spike with a value of (33.58 grains. spike^{-1}), while the Seta location outperformed significantly in the trait of weight of 1000 grains with a value of (27.48 gm.).

The reason for this results because the 2 location were under the zone of Moderate Rainfall Area MRA Aula et al et al (2025) . The table also indicates that there are significant differences between the two locations in the trait of number of weeds which was decreased significantly in the Seta location compared to the Kwaitla location by (31. m-2) , this may be due to the fact that the field contains many weed seeds , which led to their spread in that season .the Seta location also outperformed the Kwaitla location significantly in the spike tall by 1.27 cm this may be due to the fact that the condition of the plant in this location is better either due in the lack of weeds or because the soil is better than in the Kwaitla location, Antar and Ahmad (2020) and El-Sadek et al (2020).

Table (3) the effect of Till-systems on weeds and the phenotypic and quantitative traits of bread wheat.

Till-system	Weeds No. m^{-2}	Biological Yield $gm.m^{-2}$	Plant height cm.	Spike length cm.	Tillers.m^{-2}
CT	29.17 a	480.00 b	57.67 b	9.26 a	380.33 b
ZT	9.50 b	1078.50 a	73.40 a	8.63 b	607.46 a

Table (3) indicates that the till system has a significant effect on the number of weeds and the phenotypic and quantitative traits of the bread wheat crop, as the Conventional Tillage (CT) field was weedy compared to the Conservation Agriculture field implemented with Zero Tillage technology (ZT) this may be because not disturbing the soil reduced the number of seeds that appeared on the soil surface and stored in the seed bank .As the number of weeds.m^{-2} for the two till systems reached (29.17, 9.50 weeds.m^{-2}) respectively , These results are consistent with results of Antar and Ahmad (2020) In biological yield the ZT system outperformed the CT system with a value of (1078.50 gm.m^{-2}, 480.00 gm.m^{-2}) respectively. In terms of plant height, the ZT system (73.40 cm) outperformed the CT system (57.67 cm) with a significant difference. The ZT system outperformed the CT system in the number of tillers, which reached (607.46 tillers.m^{-2}) in ZT compared with (380.33 tillers.m^{-2}) in CT system. While the only significant superiority of the CT system was in the spike length, which reached (9.26 cm) in CT system, compared to (8.63 cm) in ZT system.

Table (4) the effect of Till-systems on the yield and its components traits of bread wheat

Till-system	Spikes.m^{-2}	Grains .$spike^{-1}$	Weight of 1000 grains gm.	Grains weight gm.m^{-2}
CT	363.67 b	30.52 a	22.59 b	258.34 b
ZT	592.60 a	28.40 a	26.39 a	432.50 a

Table (4) indicates the significant superiority of the ZT system over CT in the traits of number of spikes.m^{-2}, weight of 1000 grains, and grain yield gm^{-2}, with values of (363.67 spikes.m^{-2}, 26.39 gm., 432.50 gm.m^{-2}) respectively, while there was no significant difference between the two cultivation methods for the trait of number of grains per spike.

The reason for the superiority of ZT system in grain yield is due to its superiority in the two most important traits of the yield components, which are the number of spikes.m^{-2} and the number of grains per spike, which achieved a significant difference in the grain yield trait in ZT system compared to the grain yield of CT system. These results are consistent with results of

Also these results may be due to the fact that ZT works to preserve moisture in the soil to benefit from it and does not allow it to evaporate because of the hard layer between the lines, compared to CT in which the soil loses large amounts of the moisture Gandia et al (2021) and Abdulrahman et al (2023) . The number of weeds.m-² has decreased in ZT compared with CA by 19.67 this may be due to the hard layer which do not permit to the weed seed to growth. Non-significant between the CT and ZT in number of grains per spike. This result is consistent with the result of Hussain et al (2023) and Aljaddir and Antar (2024) .

Table (5) the effect of interaction between locations and Till-systems on weeds and the phenotypic and quantitative traits of bread wheat.

Location	Till-system	Weeds No. m^{-2}	Biological Yield $gm.m^{-2}$	Plant height cm.	Spike length cm.	Tillers.m^{-2}
Kwaitla	CT	53.00 a	566.67 c	55.27 c	9.08 a	458 c
	ZT	16.67 b	983.33 b	68.13 b	7.53 b	480.528 b
Seta	CT	5.33 c	393.33 d	60.07 c	9.43 a	302.66 d
	ZT	2.33 c	1173.67 a	78.67 a	9.73 a	734.4 a

Table (5) indicates that significant differences were achieved in the interaction between the two factors of locations and till systems. In the trait of the number of weed plants, the highest number of weed plants (53.00 weed.m^{-2}) was achieved in the interaction of the Kwaitla location with CT compared to ZT (16.67 weed.m^{-2}) in the same location. While the lowest significant number of weeds was in the Seta location for ZT (2.33 weeds.m^{-2}) without significant differences with CT system (5.33 weeds.m^{-2}) in Seta location too.

While the highest biological yield (1173.67 gm.m^{-2}) was achieved in the interaction of the Seta location with ZT, with a significant difference from the rest of the treatments, while the lowest biological yield was in the interaction of the Kwaitla location with CT (566.67 gm.m^{-2}).

As for the plant height trait, the interaction of ZT with the Seta location achieved the highest significant plant height compared to the rest of the treatments, with a value of (78.67 cm), while the lowest plant height was in the interaction of both locations with the CT system, with no significant difference between them.

As for the spike length trait (cm), the lowest value for this trait was in the interaction of the ZT system with the Kwaitla location (7.53 cm), while the remaining treatments outperformed this trait without any significant difference between them.

In the trait of the number of tillers.m^{-2}, the interaction of the ZT system at the Seta location achieved the highest number of tillers.m^{-2} (734.4 tillers.m^{-2}) with a significant difference from the rest of the treatments, followed by the interaction of the ZT system with the Kwaitla location (480.528 tillers.m^{-2}), while the interaction of the CT system with the Seta location had the lowest value for this trait (302.66 tillers.m^{-2}).

Table (6) the effect of interaction between locations and Till-systems on the yield and its components traits of bread wheat.

Location	Till-system	Spikes.m^{-2}	Grains.$spike^{-1}$	Weight of 1000 grains gm.	Grains weight gm.m^{-2}
Kwaitla	CT	452 c	33.70 a	21.39 b	325.00 b
	ZT	478.4 b	33.47 a	21.62 b	341.67 b
Seta	CT	275.34 d	27.33 b	23.80 b	191.67 c
	ZT	706.806 a	23.33 c	31.17 a	523.33 a

Table (6) indicates the achievement of significant differences in the interaction between the two factors of locations and till systems in the traits of the yield and its components. In the trait of the number of spikes.m^{-2}, the highest number of spikes (706,806 spikes.m^{-2}) was achieved in the interaction of the Seta location with the ZT system, with a significant difference from the rest of the treatments. This was followed by the interaction of ZT with the Kwaitla location (478.4 spikes.m^{-2}) with a significant difference from the interaction of CT with the two locations, while the lowest value (275.34 spikes.m^{-2}) was for the interaction between the CT system and the Seta location.

While the interaction between the Kwaitla location and the CT and ZT systems achieved the highest value for the number of grains per spike (33.70 grains.spike^{-1}, 33.47 grains per.spike^{-1}) respectively, with a significant difference from the rest of the treatments.
As for the 1000-grain weight trait, the interaction of the Seta location with the ZT system achieved the highest significant value for the 1000-grain weight (31.17 gm.), while there was no significant difference between the remaining treatments.

In trait of grain yield, the interaction of the ZT system in Seta location achieved a significant superiority with a value of (523.33 gm.m^{-2}), while the lowest value was (191.67 gm.m^{-2}) was to the interaction of the CT system at the Seta location. There was also no significant difference between the interactions of the two till systems at the Kwaitla location Al-Hanoush et al (2023) , Abdulateef (2023) and Hussain and Antar (2024) .
It is noted from the table that most of the traits of the interaction between the ZT system in the Seta location achieved the best values and thus achieved the highest grain yield gm.m^{-2}, which reached (523.33 gm.m^{-2}). This is due to the benefits of using the ZT system as well as the environment of the location and the small amount of weeds in its field. this may be also due to the fact that the weeds numbers in the Seta location is less compare than Kwaitla location .while the decrease of weed at ZT because the hard layer among the lines of sowing which prevent the weed seed from germination, Al-jubori and Alabar (2021) Jabbar et al (2023).

CONCLUTIONS

The results of this study are important for decision-makers in the Nineveh Governorate administration and the Ministry of Agriculture to make the appropriate decision to advise the spread of the application of Conservation Agriculture to all grain crops farmers in Nineveh Governorate, especially since it is the food basket of Iraq and because 95% of the governorate's fields depend on rainfed agriculture.

RECOMMENDATIONS

The Conservation Agriculture technique should also be to recommend the spread to all Iraqi farmers who depend on supplementary or full irrigation and who suffer from a scarcity of irrigation water, due to the success of this technique in reducing the use of irrigation water to approximately half while increasing the grain yield, and thus it achieves all the requirements of economic, environmental and human agricultural development.

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