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ORIGINAL ARTICLE

EFFECT OF ZERO-TILLAGE AND PHOSPHATE FERTILIZATION IN YIELD AND QUALITY OF SUNFLOWER

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Abstract: Field experiment was carried out to determine the effect of zero tillage planting compared to conventional agriculture (tillage before planting) and phosphate fertilizer P_2O_5 (100, 200 and 300 kg.ha^{-1}) in some growth traits and yield of sun flower cultivar Aqmar, in the fields of Agriculture Faculty. The results of the statistical analysis showed no significant difference between tillage and no-tillage regarding to the yield traits and its components (the number of seeds in the disk and the weight of 100 seeds) and the percentage of oil in the seed during both seasons except the weight of 100 seeds. Phosphate fertilization levels of 200 and 300 kg.ha^{-1} were superior in all other traits compared to 100 kg.ha^{-1}, which indicates the possibility of using the level of 300 kg ha^{-1} to improve the traits of the yield and its components. It can be concluded from this study that the cultivation of sun flower species Aqmar without tillage and applying phosphate at level of 300 kg.ha^{-1} will reduce the cost and shorten the time to get to the final production.

***Key words*:** *Helianthus annuus* L., Tillage, Phosphate fertilization, Sunflower.

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1. Introduction

Helianthus annuus L. is one of the most important oil crops in Iraq for its various uses, including the extraction of oil from the seeds, as well as using it to feed cattle [Cheyed (2014)]. It was reported the fourth best oil crop in the world, with oil content of 40-50% as well as protein content of 23% [Khan *et al.* (2012)]. Sun flower crop is highly adaptable within a wide range of environmental conditions, so it is cultivated on vast areas of land around the world [Agele *et al.*(2007)]. The Iraqi environment is suitable for the production of sun flower but its productivity is still low due to the absence modern agricultural techniques and keeping pace with the global development in the use of modern farming systems that ensure the conservation of soil and increase the unit area of cultivated crops. Zero tillage, improved the properties of the chemical, physical and biochemical soils and led to greater productivity stability [Rajabu and Mahmoud (2011)] and increases rainwater harvesting in arid and semi-arid areas compared with conventional farming methods [Anderson *et al*. (2005)], especially in areas where groundwater abated [Humphreys *et al*. (2004)]. The nutrients in the soil have the specific effect on agricultural production. The Iraqi soils have a high calcium carbonate content, which makes the pH of the soil so alkaline that it is deficient in the readiness of nutrients necessary for plant growth, including phosphorus. The phosphorus component is the second most important nutrient after the nitrogen element, which affects all stages of crop growth and the yield and quality of the crop [Salih (2013)]. In light of the above, this study was conducted to determine the extent of the sun flower's response to the oil category and to the sowing without tillage and different levels of phosphate fertilizer and its impact on some of the traits and growth of the crop.

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2. Materials and Methods

A field experiment was carried out in the fields of the Faculty of Agriculture, University of Anbar (Abu Ghraib) in the spring and autumn seasons of 2015. The aim of this study was to determine the effect tillage and phosphate fertilization (100, 200 and 300 kg ha^{-1}) as P_2O_5 20% in some of growth traits of yield sun flower. The field was divided into six strips, three of which were treated normally as recommended regarding to the tillage, while other three parts were without plowing. The Tape is divided to experimental units with a distance of 3 × 4 m to make the area of the single slab 12 m^2 the same dimensions of the sheets left (without plowing) to ensure uniformity in the area of experimental units. The implanted distances are completed on the marginal distance between one line and another of 75 cm. The distance between the plants was 25 cm. For a plant density of 53.333 plant.ha^{-1}, 75 cm were left between the units. 3-5 seeds were planted in one jar. The experiment was carried out by two workers using the split-plot design. The main factor included agriculture without tillage, agriculture by traditional method and secondary factor, phosphate fertilization and three replicates. Nitrogen fertilizers were added at a rate of 280 kg.ha^{-1} in the first two weeks after field emergence in two weeks and the second at the beginning of the formation of floral buds.

2.1 Studied traits

At the maturity stage, discs were collected from five plants chosen randomly from the middle lines of each experimental unit to study the following traits:

Fertility ratio (%) : A random sample of 50 g seeds was taken from each experimental unit and the empty and filled seeds were calculated and then divided by the number of seeds filled with the total seed.

The number of seeds in the disc : Five plants were collected randomly from each experimental unit and seed counted in each disc and the mean was calculated.

Weight of 100 seeds (g) : 100 seeds were randomly calculated from the final yield of each experimental unit and then weighed for the two seasons.

The total seed yield (mega gr ha^{-1}) : Mean yield of ten plants collected randomly to present the yield per plant, then multiplied by the plant density after correcting the weight based on humidity of 8% for all traits related to weight.

Percentage of oil in seeds (%) : Oil was extracted from the seeds using Soxhlet and the ratio estimated according to the method mentioned in the American Society of Chemical Analysts on the basis of the dry weight of seeds [A.O.A.C. (1980)].

3. Results and Discussion

3.1 Fertility percentage (%)

Results presented in Table 1 shows a significant effect of zero tillage and tillage method in the spring season and the absence thereof in the autumn season. There is also a significant effect of phosphate fertilization in fertility ratio in both seasons, whereas the interaction between the two factors did not have any significant effect. The results of the table show that the plants produced from tillage treatment were significantly superior compared to plants from no-tillage treatment. Increasing in phosphate fertilizer levels led to an increase in fertility rates as it was 61.94% and 65.41% for both seasons, respectively at the level of 100 kg.ha^{-1} and increased to reach the highest percentage (74.47% and 74.86%). For both seasons respectively at level of 300 kg.ha^{-1}, with no significant difference in compression to 200 kg.ha^{-1}. This was due to the indirect effect of the phosphorus component on the improvement of vegetative growth, which was reflected in the reproductive growth represented by the size of ovaries, fertility and availability of the resulting increases in the size and efficiency of the source, which increases the amount of nutrients reaching the downstream seeds, thus reducing the number of unfilled seeds.

3.2 Number of seeds per disc

Results presented in Table 2 indicate that there is a significant effect of phosphate fertilization, whereas there was no significant difference observed between zero tillage and tillage in both seasons. It is clear that the increase of phosphate fertilization from 100 kg.ha^{-1} to 300 kg.ha^{-1} resulted in an increase in the number of seeds per disc from 625.5 and 694.4 for the spring season to 709.9 and 787.5 for the autumn season, respectively. This is due to the role of phosphate fertilizers in improving the characteristics of the root, which is reflected in the growth traits and the number of fertilized flowers. This result is supported by the high fertilization rate (Table 1).

Table 1: Effect of agriculture without tillage and phosphate fertilization in fertility rate (%) for the spring and autumn seasons of 2015.

Phosphate fertilizer Kg ha^{-1}	Spring season			Autumn season		
	Agriculture		Average	Agriculture		Average
	Zero tillage	Tillage		Zero tillage	Tillage	
100	58.98	64.89	61.94	66.13	64.69	65.41
200	71.21	72.54	71.87	71.98	74.01	72.99
300	74.66	74.47	74.47	74.02	75.69	74.86
L.S.D. 0.05	N.S		3.61	N.S		1.91
Average	68.28	70.63		70.71	71.46	
L.S.D. 0.05	1.43			N.S		

Table 2: Effect of planting without tillage and phosphate fertilization in the number of seeds per tablet for the spring and autumn seasons of 2015.

Phosphate fertilizer Kg ha^{-1}	Spring season			Autumn season		
	Agriculture		Average	Agriculture		Average
	Zero tillage	Tillage		Zero tillage	Tillage	
100	619.2	631.8	625.5	708.6	411.2	709.9
200	667.1	671.3	669.2	757.3	784.0	770.7
300	692.7	696.2	694.4	785.5	789.5	787.5
L.S.D. 0.05	N.S		26.4	N.S		23.8
Average	659.7	666.4		750.0	761.6	
L.S.D. 0.05	N.S			N.S		

3.3 Weight of 100 seeds (g)

Results of the analysis of the mean weight of 100 seeds showed significant effect of phosphate fertilization levels, while there was no significant effect on the spring planting method and the interaction between the two seasons (Table 3). Plants from no-tillage treatment were superior compared to tillage with a very small difference (0.06 g). This was considered to be due to the fact that soil with zero tillage has increased ability to retention water for long possible time compared to tilled soil, which positively affects the growth and yield characteristics of plants [Anderson *et al*. (2005)], especially in the early stages of plant growth in the autumn season where temperatures is high during the months of August and September.

The results of Table 3 show the positive effect of increasing levels of phosphate fertilization on 100 seed weight. After the weight of 100 seeds reached 7.12 and 7.45 g at the level of 100 kg. 300 kg.ha^{-1} for both seasons of cultivation, which did not differ significantly from the level of 200 kg.ha^{-1} in the spring season. The reason for increasing seed weight by increasing levels of phosphate fertilizer is due to its known effects at all stages of crop growth and seed yield and quality [Salih (2013)].

3.4 Total seed yield (mega gr ha^{-1})

Results of Table 4 indicate significant effect of phosphate, while no significant difference was observed no-tillage and tillage in both seasons. It is clear that the increase of phosphate fertilization from 100 kg.ha^{-1} to 300 kg.ha^{-1} resulted in an increase in plant yield by 21.69% and 15.55% for both seasons, respectively. This is due to the role of phosphate in increasing the number of seeds in the disc (Table 2) and the weight of 100 seeds (Table 3), which was reflected in the increase of plant yield. Although, the differences between the two treatments were not significant in these traits, the differences were not significant. Therefore, it is possible to propose to study such studies and find their economic feasibility. The results also indicate the positive role of the addition of phosphate fertilizer, which surpassed both the levels of 200 and 300 kg.ha^{-1}at the level of 100 kg. ha^{-1}, indicating the possibility of using the level of 200 kg.ha^{-1}in improving the growth traits that may be reflected in the plant.

Table 3: Effect of planting without tillage and phosphate fertilizer in the weight of 100 seeds for the spring and autumn seasons of 2015.

Phosphate fertilizer Kg ha^{-1}	Spring season			Autumn season		
	Agriculture		Average	Agriculture		Average
	Zero tillage	Tillage		Zero tillage	Tillage	
100	7.07	7.17	7.12	7.46	7.44	7.45
200	7.66	7.62	7.64	7.58	7.48	7.53
300	7.75	7.86	7.80	7.66	7.62	7.64
L.S.D. 0.05	N.S		0.20	N.S		0.11
Average	7.49	7.55		7.57	7.51	
L.S.D. 0.05	N.S			0.03		

Table 4: Effect of agriculture without tillage and phosphate fertilization in the total seed yield (mega gr ha^{-1}) for the spring and autumn seasons of 2015.

Phosphate fertilizer Kg ha^{-1}	Spring season			Autumn season		
	Agriculture		Average	Agriculture		Average
	Zero tillage	Tillage		Zero tillage	Tillage	
100	2.92	3.02	2.97	3.53	3.53	3.53
200	3.51	3.82	3.67	3.83	3.91	3.87
300	3.58	3.96	3.77	4.01	4.01	4.01
L.S.D. 0.05	N.S		0.15	N.S		0.12
Average	3.34	3.60		3.79	3.82	
L.S.D. 0.05	N.S			N.S		

Table 5: Effect of agriculture without tillage and phosphate fertilization in the number of seeds per tablet oil ratio (%) for the spring and autumn seasons of 2015.

Phosphate fertilizer Kg ha^{-1}	Spring season			Autumn season		
	Agriculture		Average	Agriculture		Average
	Zero tillage	Tillage		Zero tillage	Tillage	
100	43.77	45.31	44.54	41.04	40.86	40.95
200	51.09	51.13	51.11	43.50	44.12	43.81
300	53.69	54.71	54.20	44.13	45.67	44.90
L.S.D. 0.05	N.S		2.63	N.S		1.37
Average	49.52	50.38		42.89	43.55	
L.S.D. 0.05	N.S			N.S		

3.5 Oil Ratio (%)

Both studied factors affected the percentage of oil in the seeds as it was in seed yield (Table 5). The increased levels of phosphate fertilization increased the seed content of oil to give an increase rate of 17.82% and 8.80% at the level of 300 kg.ha^{-1} for both spring and autumn seasons respectively compared to the level of 100 kg.ha^{-1}, which gave the lowest average proportion of oil reached 44.54% and 40.95% for both seasons. This was due to the role of the phosphorus element in improving the growth and yield traits (Table 4), as well as increasing the plant content of the fatty acids which are main component of this compound. This result is in line with Alusi (2002) finding of an increase in sunflower seed oil content when increasing levels of phosphate fertilizer added from 0 to 180 kg. ha^{-1}.

4. Conclusion

It can be concluded from the above obtained results that there was no difference to be mentioned between tillage and no-tillage regarding to yield traits and components and the percentage of oil in both seasons

except for the weight of 100 seeds in the autumn season, which exceeded that for plants in tilled soil with a very small difference (0.06 g). We also conclude that the levels of phosphate fertilizer were significantly affected all studied traits in both spring and autumn seasons. Both the 200 and 300 kg.ha^{-1} levels superior to 100 kg. ha^{-1} indicating that the 200 kg.ha^{-1} level can be used to improve the properties of the yield components reflected in the plant yield.

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