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EFFECT OF NANO-NITROGEN AND MANUFACTURE ORGANIC FERTILIZER AS SUPPLEMENTARY FERTILIZER IN THE YIELD AND ITS COMPONENT FOR THREE SYNTHETICS OF MAIZE (*ZEA MAYS* L.)

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Abstract

A field experiment was carried out in the fields of the College of Agricultural Engineering Sciences - University of Baghdad /Al-Jadiriya, during the spring and autumn seasons of 2018 in a silty clay soil texture using the Randomized Complete Block Design RCBD through split plot arrangement with three replicates. The main plot consists of three synthetics (Baghdad3, MAHA, and IPA 5018) symbolized as (V_1, V_2 and V_3), while the sub-plot consist of two levels of Nano fertilizer with a concentration of (1 ml fertilizer L^{-1} water, 2 ml fertilizer L^{-1} water) symbolized as (T_1 and T_2) respectively. Furthermore, two levels of the Humic acid fertilizer with a concentration of (1 ml fertilizer L^{-1} water, 2 ml fertilizer of L^{-1}water) symbolized as (T_3 and T_4) respectively, as well as to a comparison treatment in which of the mineral fertilizer Urea was used (46%) Nitrogen by (300 / kg N / ha^{-1}), symbolized as (T_0). The results showed a significant differences between the different fertilization treatment, the Nano fertilizer treatment T_2 was achieved the highest mean in all the yield indicators at both spring and autumn seasons by an averages as follows:- 16.867, 16.011 row/ear for the number of row in ears row , 39.31 and 41.91 grain/row for the number of grain in row, 651.88 and 693.77 grain/ear for the number of grains in ear, 157.600 and 159.478 g for the weight of 500 grain and a total grain yield of 9.2828 and 9.3523 $t.ha^{-1}$. Baghdad 3 class showed a superiority in all yield indicators in the autumn season, which gave the following averages 15.267 row /ear for the number of rows in ear was, 37.50 grain /row for the number of grains in the row, 638.55 grain /ear for the number of grains in ear, 150.900 g for the weight of 500 grain, and a total grain yield of 8.118 $t.ha^{-1}$. Finally, the interaction between the fertilizer treatments and the synthetic had a significant effect on most of the yield traits for both seasons.

Keywords **:** Nano-Nitrogen, RCBD, Nano fertilizer, Humic acid fertilizer

Introduction

Chemical fertilizers cause a general environmental pollution through their effect on the air by emitted in the form of ammonia gas and nitrogen oxides as well as; its effect on water by their fast melts, then filtered down in irrigation water as nitrate, in addition to their contamination of watercourses, in the long term, the mineral nitrogen was merged within the organic mass in the soil through micro-organisms. Therefore, it is necessary to think well, to use a new type of fertilizers instead of traditional ones to provide the nutrients that are necessary for plant growth, increase plant productivity, soil conservation in good condition, and pure environment, Nanotechnology one of the sciences, which interested in the studying of substance treatment on the atomic scale. 10^{-9} of the meter because of the Nanomaterial shows a different material property when they were in their traditional dimensions more than 100 nanometers. The Nano fertilizers have unique advantages due to their small size and large surface area leading to increase the absorption, the high process of photosynthesis, and increased production of active substances in the plant, Nanotechnology is expected to represent a new frontier in modern planting and also to become a major momentum in the near future through the introduction of new applications. The organic planting combines tradition, innovation and sciences for the benefit of the common environment, fair promotes relationships, achieve sustainability, and provide a quality life for all beings. Humic acid was a good source of carbon that necessary for the microorganism activity, and when it added to the soil or sprayed on the vegetative part lead to increase root growth. This process increases the absorption of nutrients by the plant and become a medium for nutrient transfer from the soil to the plant as well as, it has a hormonal effect on the cell protoplasm and the cell wall resulted in rapid cell division and increased plant growth (Bahrani, 2015).

Materials and Method

Two field experiments were carried out during the spring and autumn seasons in 2018 at the College of Agricultural Engineering Sciences field - Baghdad University/Al- Jadriya. Table 1 shows some soil properties for both seasons to determine the spraying effect of Nano nitrogen and manufactured organic fertilizer (Humic acid) and its effect on three synthetic yield of maize (Baghdad-3, MAHA, IPA 5018). The experiment was applied according to the split plot arrangement, using Randomized Complete Block Design RCBD with three replicates including the main-plot, synthetic class (Baghdad 3, MAHA, IPA 5018), while the sub-plot included the fertilizer treatment in three batches and the number of treatments variable was 15 with three replicates. Thus, the number of experimental units reached 45 experimental unit with dimensions of 3 x 3 m^2, each experimental unit included four lines with a length of 3 meters and a distance of 0.75 meters between one line and another, and 25 cm between hill and another. A distance of 1.5 m was left between the experimental unit and the other, while 2 m between replicate and another and between the main treatment. Seeds of maize were planted in the spring and autumn seasons on 20/3 and 20/7/2018 respectively, 2-3 seeds were placed on the hill and then reduced into one plant after two weeks of planting, when the plant reaches a height of 15-20 cm.

Table 1 : Some chemical and physical properties And methods of estimating the soil of experiment of before planting for spring and autumn seasons 2018

Soil analysis table			
Seq.	**Type of analysis**	**Spring season**	**Autumn Season**
1.	EC ds.m^{-1}	1.4	1.3
2.	PH	7.38	7.40
3.	ml/L Na	1.11	1.10
4.	ml/L Ca	8.13	8.12
5.	Mg	6.11	6.13
6.	Cl	13	14
7.	SOU	0.81	0.80
8.	Mg/kg p	6.21	6.16
9.	K	98.9	95.8
10.	N	21	23
11.	O.M %	0.7	0.10
12.	$CaCo_3$	23	25
13.	Sand **%**	53.2	50.2
14.	Silt **%**	10	11
15.	Clay **%**	36.8	35.3
16.	Soil class	Sandy clay loam	

Note: the Chemical and physical soil properties were analyzed before planting in Baghdad University Laboratories - College of Agricultural Engineering Sciences - Soil Department. The texture of the soil was analyzed using a hydrometer method, while the PH was evaluated using the PH- meter device in soil extracts. Moreover the electrical conductivity was measured using the electrical conductivity device, the organic material was estimated according to the Walkley and Black method, while nitrogen, phosphorus, and potassium were estimated by the bicarbonate extraction method. The experiment included two treatments: the first one, where three certified source genotypes according to the Abu Ghraib Research station -Agricultural Research Office, Ministry of Agriculture symbolizes as V_1, V_2, and V_3 respectively. The second one were two levels of Nano fertilizer and two levels of the Humic acid fertilizer, in addition to comparison treatment which were noted as T_1, T_2, T_3, T_4, T_0 respectively. Furthermore, the following measurements were investigated in this research: the number of rows/ ear, the number of grain/row, the number of grains/ear, the weight of 500 grains (g), and the total grain yield t.ha^{-1}. Finally, the statistical data were statistically analyzed using commercial software Genstat 12 and the results were tested by comparing the means according to Least significant difference (L.S.D) test at the probability level of 0.05.

Results and Discussion

Number of rows in rows (row/ ear)

The number of rows in the ear was affected by genotype, environmental factors, and some growth factors that effect on the vegetative growth, which was detected at the beginning of the ear birth after its size (Brien, 2007). The results in Table 1 showed that there were a significant differences between different fertilizer treatment in both spring and autumn seasons. The Nano fertilizer treatment T_2 has the superiority over the rest of the other treatments and gave the highest average number of rows by 16.867 and 16.011 row/ ear for both seasons respectively, while the comparison treatment T_0 gave the lowest average of this trait by 14.678 and 14.567 row/ ear for both seasons on respectively.

Table 1 : Effect of Nano-nitrogen, Humic acid, synthetics and their interaction in the average number of rows in ear (row/ ear)

	Spring Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	14.700	16.000	17.100	14.600	15.500	15.580
MAHA	14.633	15.300	16.867	15.300	15.433	15.507
IPA 5018	14.700	15.100	16.633	15.100	15.033	15.313
LSD 0.05	0.523					N.S
Average fertilization	14.678	15.467	16.867	15.000	15.322	
LSD 0.05	0.299					
	Autumn Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	14.733	15.133	15.667	14.333	14.933	14.960
MAHA	14.733	15.267	16.433	14.267	15.633	15.267
IPA 5018	14.233	14.70	15.933	14.233	14.933	14.807
LSD 0.05	N.S					0.248
Average fertilization	14.567	15.033	16.011	14.278	15.167	
LSD 0.05	0.556					

This behavior may be due to the addition of Nano nitrogen and mineral fertilizers has provided most nutrients, especially the major ones, which increase the paper area that contribute to increase the accumulation of dry material and improve the plant growth in general. Furthermore, it reduces the proportion of ovarian abortion and thus increased pollination and fertilization, which lead to increase the number of rows in the ear. This finding present a good agreement with the results of (Sharifi and Taghizaden 2009), who indicated that the number of rows in ear increased with the increase of added fertilizer and availability throughout the various stages of plant growth. The results showed that there was a significant difference between the synthetic in the autumn season, where the Maha synthetic gave the highest number of rows in autumn season compared to other synthetics with an average of 15.267 row/ ear. The other synthetics did not differ between them in the spring season for this trait and the differences were in the appearance only, due to the convergence of these synthetics genetically that gave close indicators, which was agreed with the results of (Solagh *et al*., 2005, Hassan *et al*., 2015). As for the interaction, it was significantly in the spring season. The combination between synthetic Baghdad 3 and treatment T_2 gave the best interaction with a higher number of rows in ear by 17.100 row/ ear compared to the other combinations, due to the synthetics genetic different in their response to spray nitrogen as Nano-particles rapidly through leaf and at the critical periods of plant growth.

Number of grains per row (grain/row):

The results of Table (2) showed that there was a significant difference between the different fertilizer treatment in both spring and autumn seasons. The Nano fertilizer treatment T_2 has the superiority over the rest of the other treatments and gave the highest average number of grains in a row by 39.31 and 41.91 grain/row for both seasons respectively, while the comparison treatment T_0 gave the lowest average of this trait by 29.57 and 33.78 grain/row for both seasons respectively. The results shows that all fertilization treatments that added to it Nano-fertilizer or Humic acid are superior in comparison treatment. This may be due to the role of Nano-nitrogen in increasing the height of the plant and the leaf area, including obtaining a high carbon representation and transfer its products to the downstream (the grain), the granules of Nano fertilizer caused an increasing in the biological enzymatic reactions and regularity of hormones (Grover *et al*., 2012). In addition to their nutritional role, it was activates the movement of metal and organic elements and regulate their flow to the downstream, which also contributed to increase its capacity. The readiness of the nitrogen element effects produces a regulation in the hormones at work and then control the Oxin at the top of the ear. The Cytokinin acts to prevent the transfer of Oxin from old to new grain and then increase the grain set in a row, which is reflected in the increase of the number of grains in the ear. The results of Table 2 indicate that there were significant differences between the synthetics in the autumn season, where the synthetics Baghdad 3 gave the highest number of grains in the row with an average of 37.50 grain/ row compared to the other synthetics, while the synthetics did not differ between them in this trait and the differences were in the appearance only at the spring season. This behavior resulted from the high temperature during the pollination and fertilization time, which was extremely affected on the percentage of flower set, therefore a difference between the synthetics clearly were observed in the autumn season, these result was agreed with the (Sharifi and Taghizadeh 2009), (BK, Shrestha 2014), and (Hassan *et al*., 2015) findings.

Table 2 : Effect of Nano-nitrogen, Humic acid, synthetics and their interaction in the average number of grain in row (grain/ row)

	Spring Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	31.20	36.33	39.50	31.77	33.17	34.39
MAHA	27.63	35.93	39.00	33.33	33.57	33.89
IPA 5018	29.87	38.53	39.43	33.17	32.67	34.73
LSD 0.05	N.S					N.S
Average fertilization	29.57	36.93	39.31	32.76	33.13	
LSD 0.05	1.39					
	Autumn Season 2018					
Genotypes	Fertilization treatments					Average compositions
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	32.90	37.50	42.73	37.97	36.40	14.960
MAHA	37.00	37.03	40.70	33.60	38.60	15.267
IPA 5018	31.43	37.33	42.30	36.67	36.00	14.807
LSD 0.05	1.75					0.27
Average fertilization	33.78	37.29	41.91	36.08	37.00	
LSD 0.05	1.12					

The interaction between the synthetics and the different fertilization treatments had a significant effect in the autumn season, the combination of synthetic Baghdad 3 and treatment T_2 was giving the best interaction and the highest average number of grains in the row reached to 39.50 grain/row compared to other combinations. This may be due to the difference in the synthetics genetically in this trait and the quick using of Nano fertilizer in the nutrients, providing when spraying on plant leaf during the critical periods of growth and moderate temperature at this season in pollination and fertilization time.

Number of grains in ear (grain/ear):

The number of grains in ear considered as one of the main components of maize extract, which is a result from the number of rows and the number of grains in the row leading

to a function that reflects the accumulation of dry material. Table 3 showed there were significant differences between different fertilizer treatments in both spring and autumn seasons. The fertilizer treatment T2 achieved the highest number of grains in the class with 651.88 and 693.77 grain/ear for both seasons respectively, while T_1 recorded the second highest average of grains in a row with 560.80 and 636.11 grain/ear, followed by fertilizer treatment of Humic acid T_4 with an average of 551.29 and 593.24 grain/ear for both seasons. While the average of this trait decreased to its lowest value in the comparison treatment T_0 and reached 423.77 and 486.21 grain/ear in both seasons respectively. The increase in the number of grains in the ear in T_2 treatment may be due to the role by the particle of Nano fertilizer in providing fast absorption nutrients, increasing the biological and enzymatic interactions and regulating the function of hormones, which has created a new opportunity for the plant to accumulate the necessary dry material for the pollination and fertilization process.

Table 3 : Effect of Nano-nitrogen, Humic acid, synthetics and their interaction in the average number of grain in ear (grain/ ear)

	Spring Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	438.40	567.57	662.20	534.90	542.47	549.11
MAHA	420.87	566.00	638.97	506.53	563.50	539.17
IPA 5018	412.03	548.83	654.47	526.30	547.90	537.91
LSD 0.05	44.359					N.S
Average fertilization	423.77	560.80	651.88	522.58	551.29	
LSD 0.05	27.248					
	Autumn Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	497.47	729.23	779.10	586.90	619.13	638.55
MAHA	489.67	592.20	634.93	539.60	589.97	569.27
IPA 5018	471.50	567.80	667.27	542.37	570.63	567.27
LSD 0.05	80.909					35.049
Average fertilization	486.21	636.11	693.77	549.92	593.24	
LSD 0.05	45.249					

In addition to the raising of the carbon representation efficiency, increasing the amount of ready-made representations, and provide a good chance to reduce the abortion in flowers by reducing the competition between them on the food product (Attia and Jaddoua, 1999). Which increases the potential of flower fertilization and then formation the grains. The results of Table 3 also showed a significant difference between synthetics in the number of grain/ear in the autumn season, class Baghdad 3 was given the highest average by 638.55 grain/ear, which was significantly different from the other synthetic MAHA and IPA 5018 that gives an average of 569.27 and 567.27 grain/ear, respectively. This indicates the large genetic variation between the synthetics in this trait, which illustrate that each genotype has a genetic susceptibility to produce a certain number of grains in one ear. These results are agreed with the (Pactash and Wahib 2003), (Ali *et al*., 2009), and (Nasiri *et al*., 2016) findings. The interaction between the synthetics and fertilization treatments was a significantly affected by the number of grains in the ear. The combination between the synthetic Baghdad 3 and the fertilizer treatment T_2 gave the highest average of this trait by 662.20 and 779.10 grain/ear for both seasons, while synthetic IPA 5018 and T_0 gave the lowest average interaction 412.03 and 471.50 grain/ear in both seasons, respectively

Weight of 500 Grain (g):

The weight of the grain was one of the main components in yield of yellow maize, which gives an indication of the accumulation of dry material in the grain and reflects the efficiency of the downstream and the source. The weight of the grain expresses the speed of its growth, which related genetically to the synthetic and all the factors that affecting on the growth, where the development and fullness of seeds is an important indicator of plant yield. (Al-Jabouri and Anwar, 2008). The results of Table 4 showed a significant difference between the different fertilization treatments at both spring and autumn seasons. The fertilizer treatment T2 achieved the highest average weight of 500 grain reached 157.600 and 159.478 g for both seasons respectively, followed by T_1 and T_4 with an average of 149.767 152.356, 143.678 and 146.133 g respectively, for both seasons. While the comparison treatment recorded the lowest average for this trait by 135.111 and 137.311 g for both seasons respectively. Also the results showed that the Nano fertilization and Humic acid treatments were superior to the comparison treatment. The increase in grain weight at the Nano- nitrogen treatment T_2 may be due to the role of this nutrient in nanoparticles with the ground addition to the increasing of the size and efficiency of the source, which caused an increasing in the representation of nutrients that helped to form a good downstream and then a heavier grain weight (Kanani *et al*., 2013). This was agreed with (Sharifi and Namvar 2016). In addition to providing the major nutrients in a balanced manner, which resulted in an increase in leaf area and continued vitality in carbon representation, the carbohydrates manufacture and proteins and thus increased the grain weight. The increase in grain weight at the Nano-nitrogen treatment T_2 may be due to the role of this nutrient in nanoparticles with the ground addition in the increasing of the size and efficiency of the source, which caused an increasing in the representation of nutrients that

helped to form a good downstream and then a heavier grain weight (Kanani *et al*., 2013). This was agreed with (Sharifi and Namvar 2016). In addition to providing the major nutrients in a balanced manner, which resulted in an increase in leaf area and continued vitality in carbon representation, the carbohydrates manufacture and proteins and thus increased the grain weight. The reason for the increasing the grain weight in the Humic acid treatments was due to the increase in the indices of all vegetative growth, due to its containment of nutrients, which in turn caused the improvement of growth and increase the size of plant root as it helps to increase the permeability of nutrients through cellular membranes of cells. Therefore, the increasing in the vegetative part of the plant, especially the leaf area, which is the center of carbon representation and then it was reflected in the weight increase of 500 grain and grain yield. This result was agreed with (Afifi *et al*., 2014), (Arjumend *et al*., 2015), (Mahdi 2016, Ghorbani 2016, Al Ani 2018) and (Khan *et al*., 2018).

Table 4 : Effect of Nano-nitrogen, Humic acid, synthetics and their interaction in the average of 500 g grain

	Spring Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	137.300	152.733	162.300	144.700	146.367	148.680
MAHA	130.600	142.633	154.100	137.300	141.167	141.160
IPA 5018	137.433	153.933	156.400	141.500	143.500	146.553
LSD 0.05	12.267					5.392
Average fertilization	137.311	152.356	159.478	144.411	146.133	
LSD 0.05	6.962					
	Autumn Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	138.633	155.567	164.400	147.867	148.033	150.900
MAHA	133.400	145.633	155.600	142.800	142.267	143.940
IPA 5018	139.900	155.867	158.433	142.567	148.100	148.973
LSD 0.05	11.248					4.880
Average fertilization	137.311	152.356	159.478	144.411	146.133	
LSD 0.05	6.300					

The results of Table 4 showed significant differences between the yellow maize synthetics for this trait during both seasons, where the Baghdad 3 synthetic gave the highest average by 148.680 and 150.900 g in compared to other synthetics, which indicates the extreme genetic difference between the synthetics for this trait. These results agreed with what number of researchers findings, including (Ali *et al*., 2009). As for the interaction between the synthetics and the fertilization treatments for this trait the combination between the Baghdad 3 and the fertilizer treatment T_2 the highest average weight of 500 grain reached to 162.300 and 164.400 g for both seasons. While MAHA and T_0 were given the lowest average of 130.600 and 133.400 g for both seasons respectively

Total Grain Yield (t ha^{-1})

Grain yield was influenced by the genotype, environmental factors, and other treatment processes, including fertilization, which depends on the carbon representation rate and the efficiency of transfer its outputs to grain (Al aboode, 2010, Hamoud, 2010). The results of Table 5 showed significant differences between the different fertilizer treatments for both seasons. The treatment of T_2 gave the highest average of grain yield by 9.282 and 9.352 t ha^{-1} for both seasons respectively, followed by T_1 fertilization treatment with an average of 7.954 and 8.068 , then the Humic acid treatment T_4 with an average of 7.535 and 7.654 for both seasons respectively. The comparison treatment gave the lowest average of the grain yield with 6.894 and 6.594 t ha^{-1} for the both seasons respectively, and also it was noted the superiority of Nano-fertilizer treatments and Humic acid on the comparison treatment. The reason behind the increasing the average of this trait when spraying with Nano-fertilizer was coming from the positive reflection of its significant effect on the increase in the yield components such as the number of grains in ear according to Table 3 and weight of 500 grain according to Table 4, which resulted from the increasing of the vegetative growth of the crop and leaves area. Furthermore the Carbone representation increment which in turn caused the yield increase, This result was supported by number of researchers such as (Nadi *et al*., 2013), (Valadkhan *et al*., 2015), (Drostkar *et al*., 2016), and (Gommaa *et al*., 2017) in yield increasing the number of crops. The increase in Humic acid treatment came as a result of its effect on the increasing in all vegetative growth indicator because it contains nutrients elements, that caused a growth improvement and increase the root size of the plant, which it helps to increase the permeability of nutrients through cellular membranes of the cells. Therefore, an increased was occurred in the vegetative part of the plant especially the leaf area, which is consider as the center of carbon representation and then reflected on increasing the weight of 500 grain and grain yield (Afifi *et al*., 2014), (Arjumend *et al*., 2015), (Mehdi 2016), (Ghorbani 2016), (Al-Ani 2018) and (Khan and others 2018). This result was reinforced by the high significant positive correlation of the yield components, which gave values for 500 grains weight and the number of grains in ear reached to (0.61** and 0.72**) (0.71** and 0.86**) for both seasons respectively. This result was agreed with the results of (Aziz, Muhammad 2012), (Al kazaali 2015), and (Oluwatosin and Ajani 2016), while the differences between the synthetics did not reach to the significant effect in spring season, which indicated that the synthetics respond to the growth and yield indicators

were very closely and no big differences was observed. This result was agreed with the results of (BK and Shrestha 2014. The results of the Table (5) showed that the investigated synthetics differed significantly between them, Baghdad 3 class was gave the highest yield of the plant with an average of 8.118 t ha^{-1} in the autumn season compared with other two synthetics. This synthetic has gone a long way in the growth period and the increasing in previous traits as mentioned in Tables 2, 3 and 4, which was reflected in the increase in grain yield in the plant. The above results was reinforces by the high significant positive correlation between the yield and the planting duration till 75 anthesis and silking, which gave values of (0.69 ** and 0.70 **), respectively.

Table 5 : Effect of Nano-nitrogen, Humic acid, synthetics and their interaction in the average grain yield t ha^{-1}

	Spring Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	6.732	8.479	9.907	7.333	7.444	7.979
MAHA	6.897	7.511	8.865	7.274	7.493	7.768k
IPA 5018	7.054	7.872	9.076	7.170	7.669	7.608
LSD 0.05	1.206					N.S
Average fertilization	6.894	7.954	9.282	7.259	7.535	
LSD 0.05	0.716					
	Autumn Season 2018					
Synthetics	Fertilization treatments					Average synthetics
	T_0	T_1	T_2	T_3	T_4	
Baghdad 3	6.715	8.593	10.002	7.403	7.879	8.118
MAHA	6.851	7.661	8.930	7.358	7.451	7.650
IPA 5018	6.218	7.950	9.125	7.229	7.633	7.631
LSD 0.05	0.642					0.282
Average fertilization	6.594	8.068	9.352	7.330	7.654	
LSD 0.05	0.364					

The interaction between the synthetics and the fertilization treatments was observed significantly, where the combination between synthetic Baghdad 3 and T_2 gave the highest average to the plant yield by 9.907 and 10.002 t ha^{-1} for both seasons respectively. While the interaction between IPA 5018 and T_0 gave the lower average for this trait by 6.218 t ha^{-1}.

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