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مجلة المثنى للعلوم الزراعية
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Effect of nano NPK and mineral fertilizer on yield and components of three barley cultivars

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Abstract

Afield experiment was carried out in Al-Rumaitha district during agricultural season at 2019-2020, In order to find out the response of three varieties of barley(Buraq, Abaa 99, Abaa 265) to foliar application with nanoparticle fertilizer NPK based on recommendation of mineral fertilizer for ground fertilization (T1 =control treatment , T2 =0% mineral recommendation + 1.5g NPK 20:20:20 nan fertilization, T3=0% mineral recommendation + 3g Nano fertilizer , T4=50% mineral recommendation + 0g Nano fertilizer , T5 =50% mineral recommendation + 1.5g Nano fertilizer recommendation, T6=50% mineral recommendation + 3g Nano fertilizer , T7=100% mineral recommendation , T8=100% mineral recommendation + 1.5g Nano fertilizer and T9=100% mineral recommendation + 3g Nano fertilizer) . The experiment was carried out in Randomized Completely Block Design (R.C.B.D.) at split plot. The main plot was barley varieties while fertilizer treatments were subplots with four replicates and means were compared according to L.S.D. test at the level 0.05. The results summarized as follows: The cultivars Abaa99 and Abaa265 were significantly superior in most of the studied traits, except weight 1000 grains . T8 treatment was affected significantly on number of spikes and the total yield, T5 was superior in harvest index. The interaction between Abaa265 and T8 was significantly superior on grain yield .

Research extracted from the doctoral thesis of the second researcher

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Introduction

Barley (*Hordeum vulgaire* L.) is an important grain crop in Iraq and a green fodder crop. It was mainly used in most countries of the world as animal feed, either in the form of green feed or as grains in a mixture of concentrated rations. It is also used on a small scale in human nutrition, especially in developing countries, by mixing its flour with wheat flour in baking (Al-Saadi, 2006). Nitrogen is a key factor in achieving at optimum yield in cereals and in theirgrowing period requires lot amount of absorbed nitrogen. Excess nitrogen increased leaf area, tiller formation, leaf area index and leaf area duration and this increasing is led to much greaterproduction of dry matter and grain yield (Ryan et al,. 2009).. Phosphorous is one of the essential nutrients important in plant nutrition for its role in the synthesis of major molecules such as amino acids, phosphorous fats, adenosine triphosphate, and enzymatic conjugates that play an active role in the process of oxidation, reduction, photosynthesis and respiration (Al-Baz *et al*., 2008). Potassium is one of the main mineral nutrients that play an important role in plant growth and completing its life cycle, and it is one of the nutrients that all plants need, and

that the absorption of this nutrient is active due to its accumulation in the plant tissues against the concentration gradient with the external nutritional environment (Philippe et al., 2004). One of the most important aim of agricultural policy in any country in the world is to improve production and increase the quantity of agricultural products, in order to meet the needs of the constantly growing population, through the use of modern technology in agriculture. Among these technologies, nanotechnology has the ability to revolutionize agricultural systems (Naderi et al , 2013). This study aimed to know the response of three cultivars of barley to fertilization of nitrogen, phosphorous, nano potassium, and the effect of these elements on growth and yield .

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Material and methods :

The experiment was carried out in Al-Rumaitha city (25 km north of the Muthanna Governorate Center) during agricultural season 2019-2020, with aim of responding three cultivar of barley for foliar application with nanoparticle fertilizer NPK, in conjunction with the recommendation of mineral fertilizer for ground fertilization of the aforementioned elements, random samples of field soil were taken and physical and chemical properties are analyzed (Table 1)

Table (1) physical and chemical properties of field soil

Physical analyzes	
Clay%	38.5
Silt%	42.5
Sand%	19.0
Silt clay mixture	Soil texture
Chemical analyzes	
EC ($dS.m^{-1}$)	4.92
pH	7.62
Available of N% ($mg.Kg^{-1}$)	25.6
Available of P% ($mg.Kg^{-1}$)	8.5
Available of K% ($mg.Kg^{-1}$)	138

Result :

Number of spikes :

The results in Table (2) showed that there was a significant effect of fertilization, the varieties, and their interaction on number of spikes . Buraq cultivar recorded the highest significant number of spikes, reaching 377.3 spikes, the reason may be due to the difference in ability of cultivars to absorb different of nutrient minerals elements, which is a genetically controlled trait and the genetic ability of the variety to produce good growth vegetative for food production (Al-Bayati and Siddiq, 2014). The fertilization treatment T8,T7 and T9 were significantly superior on spike umbers reached 327.9,324.7 and 330.1 spikes respectively, the reason may be due to the increase in nitrogen fertilization in the treatment. It increased the available of the element in the soil as well as N,Pand K absorption through foliar application with nano fertilization , Phosphorous enters in energy compounds ATP and potassium contributes to the transportation of processed food, which had contributed to increasing the number of spikes.. This result was agree with Rahman *et al.*, (2016).Interaction between cultivars and fertilizer treatments had no significant on number of spikes .

Tab.2: Effect of fertilization, cultivars and their interaction on number of spikes

Fertilization	Cultivars			Rate of fertilizer
	Abaa 265	Abaa 99	Buraq	
T1				
T2	165.3	226.0	243.3	211.6
T3	175.3	261.3	276.7	237.8
T4	208.0	303.0	286.0	265.7
T5	227.7	307.3	311.7	282.2
T6	227.3	318.7	349.3	298.4
T7	250.7	339.3	384.0	324.7
T8	263.0	340.0	380.7	327.9
T9	254.3	345.7	390.3	330.1
Mean	256.0	352.3	377.3	
$L.S.D._{0.05}$	Cultivars=20.07	Fertilizer =20.95		Interaction =N.S

Number of grains in spike :

The results presented in Table 3 showed that, no significant between the two cultivars and interaction between cultivars and fertilizer treatments in related to number of grains in spike . The treatment of T9 significantly on number of grains in spike (48.08grains) over the rest treatments, with exception of T8, which was not significantly different from them, the reason for this may be due to the role of fertilization with NPK to increase shoot provide nutrients and then increase metabolic processes, especially photosynthesis, which led to the provision of nutrients to the initiators of flowering, which contributed to reducing the failed of flowers setting and thus contributed to the increase in the number of grains., this result agree with Thummanatsakun and Yampracha (2018).

Tab.3: Effect of fertilization, cultivars and their interaction on number of grains in spike

Fertilization	Cultivars			Rate of fertilizer
	Abaa 265	Abaa 99	Buraq	
T1	35.07	36.93	36.77	36.26
T2	36.20	36.93	39.10	37.41
T3	37.80	37.33	42.43	39.19
T4	42.40	44.30	43.63	43.44
T5	43.70	44.70	43.63	44.01
T6	45.83	46.90	44.70	45.81
T7	46.50	46.63	47.70	46.94
T8	47.73	46.43	48.50	47.56
T9	47.90	48.13	48.20	48.08
Mean	42.57	43.14	43.85	
$L.S.D._{0.05}$	Cultivars=N.S	Fertilizer =1.71		Interaction =N.S

Weight of 1000 grains

Table 4 showed that Abaa 265 cultivar was significantly superior in **weight of 1000 grains** 53.00g. comparing to 46.99, 46.81g. in Abaa 99 and Buraq cultivars , The reason for this may be due to the small number of spikes in this cultivar, which helped to transfer of nutrients to the grain.

Moreover, T7 was highest in plant height (50.99g) compare with T1, T2,T3,T4 46.29,47.81 ,48.62 , 49.34g respectively . The reason for this may be attributed to the role of the three elements during the grain's filling time, by delaying aging and increasing the size of the food tissue in the grain (endosperm) and increasing its efficiency in assembling the products of the photosynthesis process, as well as the role of these elements in transporting manufactured materials to places, and this result agreed with Hama *et al,*. (2018).

Tab 4: Effect of fertilization, cultivars and their interaction on weight of 1000 grains gm

Fertilization	Cultivars			Rate of fertilizer
	Abaa 265	Abaa 99	Buraq	
T1	50.30	45.60	42.97	46.29
T2	52.60	45.60	45.23	47.81
T3	54.0	46.20	45.67	48.62
T4	52.13	47.30	47.53	48.99
T5	53.10	48.07	46.87	49.34
T6	54.80	48.63	49.53	50.99
T7	53.37	46.83	47.87	49.36
T8	53.23	48.52	48.50	50.09
T9	53.43	46.17	47.13	48.91
Mean	53.00	46.99	46.81	
$L.S.D._{0.05}$	Cultivars=0.49	Fertilizer =1.11		Interaction = N.S

Grain yield (Meq h^{-1}):

The results presented in Table 5 showed that Buraq and Abaa99 4.86 and 4.75 $tan.h^{-1}$ repectively significantly exceeded Abaa 3.14 Meq h^{-1} t he reason is due to the superiority of two varieties in the number of spikes (Table 2). This result agreed with Al-Ziyadi (2020).. Furthermore, The fertilization treatment T8 was significantly superior on grain yield reached 5.10 $tan.h^{-1}$, the reason may be due to the superiority in number of spikes (Table 2) and the number of grains in the spike (Table 3). This result agreed with the findings of Benzon *et al*., (2015). Interaction Buraq with T8 had highest grain yield reached 6.06 $tan.h^{-1}$.

Tab.5: Effect of fertilization, cultivars and their interaction on grain yield (Meq h^{-1})

Fertilization	Cultivars			Rate of fertilizer
	Abaa 265	Abaa 99	Buraq	
T1	1.92	3.30	3.42	2.88
T2	2.71	3.50	3.39	3.20
T3	2.86	3.43	3.72	3.34
T4	3.11	4.36	4.72	4.06
T5	3.52	5.60	5.31	4.81
T6	3.59	5.65	5.61	4.95
T7	3.58	5.74	5.72	5.01
T8	3.56	5.68	6.06	5.10
T9	3.41	5.50	5.82	4.91
Mean	3.14	4.75	4.86	
$L.S.D._{0.05}$	Cultivars=0.36	Fertilizer =0.46		Interaction =0.68

Biological yield (Meq h^{-1}):

In Table (6) showed that there was a significant effect of fertilization , varieties and their interaction on Biological yield, The caltivars Buraq giving the highest Biological yield compared with Abaa99 and Abaa265 cultivar reached 13.65, 12.35 and 12.98 Meq h^{-1} respectively, The reason may be attributed to their superiority in spike numbers (Table 2), and this result agreed with what Al-Jiashi (2020). Concerning to the treatments, T9 had the highest Biological yield, 15.99 tan.h^{-1} , which was significantly higher than T1,T2,T3.T4.T5 and T6, The reason may be due to the role of NPK nanofertilizer, which increased the amounts of reactions and enzymatic activities, which provided an opportunity for cell division, growth and development, and thus increased the amount of dry matter in the plant (Abdel-Aziz, 2016). Interaction treatment Buraq in T9 was significantly superior on this studied characteristic above 17.80 Meq h^{-1}.

Tab.6: Effect of fertilization, cultivars and their interaction on Biological yield (Meq h^{-1}).

Fertilization	**Cultivars**			**Rate of fertilizer**
	Abaa 265	Abaa 99	Buraq	
T1	8.85	9.12	9.60	9.19
T2	10.7	8.57	10.24	9.87
T3	11.63	10.67	10.73	11.01
T4	11.89	13.25	11.67	12.27
T5	13.21	13.72	13.82	13.58
T6	13.07	14.84	15.83	14.58
T7	13.74	15.10	16.29	15.04
T8	13.80	15.56	16.85	15.40
T9	14.20	15.97	17.80	15.99
Mean	12.35	12.98	13.65	
L.S.D.$_{0.05}$	Cultivars=0.57	Fertilizer =0.96		Interaction =1.20

Harvest Index:

In table 7 noted that Abaa99 and Buraq cultivars were superior in harvest index, reaching 36.64 and 35.74, respectively, significantly superior compare with Abaa265 cultivar 25.35, the reason is due to the superiority in grain yield (Table 5) and the biological yield (Table 6). The treatment of T5 significantly on harvest index 35.35 over T1,T3and T5, with exception of T2,T4T6,T7and T8, which were not significantly different from them, the reason for this may be due to by increasing the concentrations of nutrients in the leaves, which leads to an increase in the weight and size of the spike compared to other plant parts, as the efficiency of the plant increases in the production of nutritional compounds and their accumulation in the carrier vessels, which form the initiators of spikes and later become grains without depletion of organic compounds from the lower parts of the plant.

Tab.7: Effect of fertilization, cultivars and their interaction on harvest index.

Fertilization	**Cultivars**			**Rate of fertilizer**
	Abaa 265	Abaa 99	Buraq	
T1	21.67	36.29	35.83	31.26
T2	25.34	40.72	33.18	33.08
T3	24.73	32.10	34.61	30.48
T4	26.32	32.80	40.32	33.14

T5	26.73	40.77	38.54	35.35
T6	27.46	38.11	35.42	33.66
T7	26.06	37.93	35.12	33.04
T8	25.83	36.68	35.86	32.79
T9	24.00	34.36	32.73	30.36
Mean	25.35	36.64	35.73	
L.S.D.$_{0.05}$	Cultivars=2.71	Fertilizer =2.86	Interaction =N.S	

Conclusion:

Adoption of the treatment (50% mineral recommendation + 3g Nano fertilizer) for grain production and the adoption of treatment (100% mineral recommendation + 3g Nano fertilizer) for the production of fodder for its superiority in the biological yield, and the adoption of the two varieties Abaa 265 and Abaa 99 for growth and yield .

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