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EFFECT OF DIFFERENT LEVELS OF THE HUMIC AND FULVIC ACIDS AND NPK ON THE YIELD AND YIELD COMPONENTS OF THE SUN FLOWER PLANT (*HELIANTHUS ANNUUS* L.)

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ABSTRACT : A field experiment was carried out to study the effect of three levels of the humic and fulvic acid (0, 15, 30) kg h^{-1} and three levels of NPK (33.3, 66.6, 100%) of the fertilizer recommendations in some growth characteristics and total seed yield of the sun flower plant. The experiment was applied in a factorial experiment according to the Randomized Complete Block Design (RCBD) with three replicates. The obtained results showed that the adding 30 kg h^{-1} of the humic was superior by giving the highest rate of flower disc diameter (20.49 cm), seed number (1267.4seed $disc^{-1}$), plant yield (97.70 g), and the total seed yield (5.21 tons h^{-1}).Theaddition of fertilizer at level F3 showed the highest rates for all the studied traits. The interaction between the fertilizer and the mixture of acids (humic and fulvic) had a significant effect on the increase of the total seed yield and the highest recorded value was 5.74 tons h^{-1} at the combination level F2H2.

Key words : Humic and fulvic acid, NPK, *Helianthus annuua.*

INTRODUCTION

Sun flower (*Helianthus annuus* L.) is one of the most important oil crops, ranking third in the world after soybean and rapeseed crops. The sun flower seeds consist of more than 49% oil with high taste qualities (Nasrallah *et al*, 2014). It has many uses in cooking, butter and soap, and it is used as a feed for farm animals while the stem can be used as fuel (Baldawi, 2014). The Iraqi environment is suitable for the growth and production of the sun flower plant and despite the availability of factors of production of soil, water and climate, the production of the cultivated area is still low compared to the global average due to several reasons, the most important not to use the modern means to increase production, including the maximum use of fertilizers added and quantities and dates recommended causing a decline in the yield due to the emergence, growth, development and differentiation of plant organs under unsuitable conditions for the high production. According to the central statistical organization (2016), the cultivated area in central and southern Iraq was very limited and did not exceed 450 hectares and an average yield of 1.765 tons h^{-1}. Thus, the lack of cultivated land and the low yield of unit area compared to the developed countries can be noted. The main nutrients N, P and K of the elements needed by the plant in relatively large quantities to reach the best yield, which increases the cost of crop production in addition to the exposing these elements to problems of loss and fixation. To reduce these problems, using non-harmful organic fertilizers for humans, animals and plants (humic and fulvic), which have spread in recent years in local markets was a good contributor to increasing the readiness of the elements and improving soil physical and chemical properties. Most recent studies confirm that the major elements N, P and K increase most of the growth and yield characteristics of the sun flower plant (Mahmoud, 2016). Addition of 12.5 kg h^{-1} of humic acid was significantly increased growth and yield characteristics (Thakur, 2013). The present study was conducted to increase the productivity of the unit area due to the role of humic and fulvic acids in increasing the readiness of N, P and K, and reducing the environmental pollution by reducing the amount of chemical fertilizers added.

MATERIALS AND METHODS

An experiment was carried out at the second research station (3 km from Muthanna Governorate) of the Faculty of Agriculture –Al -Muthanna University for the spring season 2017 in a silty loam soil (Table 1) to study the

effect of three levels (0, 15, 30) kg h^{-1} of humic and fulvic acid and three levels (33.3, 66.6, and 100%) of NPK of the fertilizer recommendation in some growth traits and total seed yield of the sun flower plant. The experiment was of a factorial experiment according to the Randomized Complete Block Design (RCBD) with three replicates. The soil of the experiment was prepared with a plow of two orthogonal plows using the plowshare plow and the smoothing process was performed using the disc harrows. The field was divided into 81 experimental units, the area of each experimental unit was 7.5 square meters (3 mx 2.5 m), which included four lines with length of 2.5 m per line and the distance between lines 75 cm. The hybrid seeds lilo was cultivated on 7/3/2018 and three seeds were planted in one place and 25 cm between place and another with deep of 3 cm (Sahuki, 1994). After the emergence and formation of the first pair of leaves, the number of plants was reduced to one plant in one place. Irrigation and weeding operations were carried out as needed, using urea fertilizer (N% 46) as a source of nitrogen while Superphosphate fertilizer (P2r5% 49) was used as a source of phosphorus and potassium sulfate (K2r 50%) as a source of potassium and a fertilizer recommendation of 160 kg Nh^{-1}, 100 kg P2r5 h^{-1} and 160 kg K2r h^{-1} (Al-Abedi, 2011), based on this recommendation the amount of the second factor was calculated. After the completion of the fertilization process and before reaching the physiological maturation stage, the plants were covered with nets to avoid bird damage. When the signs of complete maturity were observed, the field was harvested on 5/7/2018 after sampling for each experimental unit. The data were statistically analyzed according to the design used by the statistical program Genstat and the least significant difference (rSD) was used to compare the mean of the treatments with a significant level of 5%.

Table 1 : Physical and chemical properties of soil before planting.

Studied traits	Unit	Proportion
Electrical conductivity (ECe)	(DS/M $^{-1}$)	3.5
Degree of soil reaction		7.7
Nitrogen	mg. Kg $^{-1}$	21.3
Phosphorus	mg. Kg $^{-1}$	12.1
Potassium	mg. Kg $^{-1}$	140.2
Organic matter	g. Kg $^{-1}$	10.6
Soil separators		
Sand %	g. Kg $^{-1}$ soil	209
Clay %	g. Kg $^{-1}$ soil	399
Silt %	g. Kg $^{-1}$ soil	392
Soil category	Silty loam soil	

* Samples of the soil were analyzed in the Central Laboratory / Soil and Water Department Laboratory of the Faculty of Agriculture - University of Baghdad

Table 2 : Effect of different levels of humic, fulvic, NPK and their interaction on the flower disc diameter (cm)

F / H	F1	F2	F3	Average H
H0	14.07	15.50	16.64	18.03
H1	18.79	20.33	21.90	19.40
H2	21.23	22.37	22.92	20.49
LSD0.05	N.S			0.688
Average F	15.40	20.34	22.17	
LSD(0.05) F	0.688			

Table 3 : Effect of different levels of humic, fulvic and NPK and their interaction on the seed number(seed $disc^{-1}$)

F / H	F1	F2	F3	Average H
H0	1012.3	1120.5	1169.2	1150.9
H1	1180.2	1198.4	1302.4	1210.6
H2	1260.1	1313.0	1330.8	1267.4
LSD0.05	N.S			21.93
Average F	1100.6	1227.0	1301.3	
LSD(0.05) F	21.93			

RESULTS AND DISCUSSION

Disc diameter (cm)

Table 2 showed that disc diameter was significantly increased with the increase in levels of the humic and fulvic mixture addition. Treatment H2 recorded the highest mean (20.49 cm) of the trait compared to H0 which had the lowest mean (18.03 cm) with an increase proportion of 12% while H1 had achieved an increase ratio of 7.06 % compared with H0. The obtained result can be attributed to the positive effect of humic and fulvic mixture addition in the increase of the availability of nutrient elements and their presence in higher parts of the plant which reflects positively in increase of the disc diameter. The obtained results were in agreement with Baldatto, (2015); Okur and Yagmur (2017);Attia and Kazim (2017). Additionally, the results showed that the fertilizer supplementation F3was higher mean of 22.17 cm compared with F1 which had mean of 15.40 cm with an increase of 30.53%. The F2 treatment recorded value of 20.34 cm with an increase of 24.28% compared to treatment F1 and this may be due to the fact that increased fertilization levels have been positively reflected in the increased diameter of the flower disc. This result is consistent with the results of Malamasuri et al (2013), Zubaidi and Zubaidi (2015). The results of the table indicate that there was no significant interaction between the two factors.

Table 4 : Effect of different levels of humic, fulvic and NPK and their interaction on the weight of 1000 seeds (g)

F / H	F1	F2	F3	Average H
H0	82.01	80.59	79.68	79.01
H1	77.86	78.34	77.63	78.18
H2	77.16	75.60	74.62	77.31
LSD0.05	N.S			1.293
Average F	80.76	77.94	75.79	
LSD(0.05) F	1.293			

Number of seeds (seed disc $^{-1}$)

Table 3 showed that the treatment H2 was significantly higher (1267.4 seeddisc^{-1}) with an increase of 9.19% compared to H0, which gave the lowest seed number(1150.9 seed disc^{-1}). The obtained resultcan be attributed to the increase in the diameter of the flower disc (Table 2) and the consequent increase in the number of seeds in the disc. This result is consistent with Thakur (2013), Zubaidi and Aussie (2017). Furthermore, the results of the same table showed that F3 was higher by giving the highest mean(1301.3 seed disc^{-1}) compared to treatment F1, that recorded the lowest mean(1100.6 seed disc^{-1}), while F2 had mean of 1227.0 seed disc^{-1} with an increase of 10.30% compared with F1. This may be due to increased disc diameter and reflection in increasing seed count. This finding is consistent with Khanwani *et al* (2014). The results showed that there was a significant interaction between the study factors. F3H2, F3H1, and F2H2 were not significantly different from each other and showed an increase of 23.93, 22.90 and 22.27% respectively compared to F1H0which gave the lowest seed number 1012.3seed disc^{-1}, but it was significantly higher than the rest of the treatments. This may be due to the positive role of humic and Fulvic mixture in increasing the availability of the added fertilizers and thus achieving maximum use of these fertilizers.

Weight of 1000 seeds (g)

The results of Table (4) showed the difference in response to the levels of the humic and fulvic acid mixture. The H0 treatment recorded the highest mean rate of 79.01 g compared with H2 treatment which gave the lowest mean of 77.31 g while H1 treatment gave 78.18 g. It can be attributedthe fact that seed weight depends on the amount of processed food from the source as well as the size of the sink and its ability to withdraw the largest amount of metabolic material from the source. Table (3) indicated an increase in the number of seeds in the flower disk for H2 and H1 compared to H0 and thus the distribution of metabolic products on a larger number of seeds, resulting in lower seed weight for the two treatments compared to H0 according to the principle of compensation. Moreover, the results of the same table also showed a difference in the response to the fertilizer NPK. TheF1 treatment had the highest weight mean (80.76 g) compared with F3, which gave the lowest weight of 75.79 g while F2 recorded value of 77.94 g. This may be due to the fact that the increase in fertilization levels led to an increase in the number of seeds in the disk as shown in Table (3), which resulted in the distribution of metabolic products on a larger number of seeds, thus decreasing the weight of the seed according to the compensation principle. As for the interaction between the experimental factors, there was insignificant interaction has been noted.

Plant yield (g/plant^{-1})

The results of Table (5) showed that the H2 treatment was significantly higher (97.70 g/plant $^{-1}$) with an increase rate of 7.08% compared with H0 which gave the lowest mean of 90.78 g/plant^{-1} while H1 treatment (94.50 g/plant^{-1}) was significantly differ from H0. This may be due to the increase in the diameter of the disc (Table 2) and the increase in the number of seeds in the table (3). Similar result has been pointed by Thakur (2013). Additionally, F3 treatment was higher(98.83 g/plant^{-1}) with an increase of 10.43% compared to F1 which gave the lowest mean of 88.52g/plant^{-1}while F2 gave an average of 95.63 g/plant^{-1} with an increase of 7.43% compared to treatment F1. It can be explained by the increase of the disc diameter which resulted in increasing the number of seeds (Table 3), thus increase the individual plant yield. As well, the results showed that there was a significant interaction between the two factors. The combination F2H2 gave the highest mean of 101.24 g/plant^{-1}with an increase of 17.91% compared to the combination F1H0 that gave the lowest mean of 83.10 g/plant^{-1}. The combination F2H2 did not differ significantly from the combinations F3H2 and F3H1, which gave 99.63 and 99.48 g/plant^{-1} respectively, and these combinations were not significantly different from F3H0 (97.38 g/plant^{-1}). The results showed a high increase in the individual plant

Table 5 : Effect of different levels of humic, fulvic and NPK and their interaction on plant yield (g/plant^{-1})

F / H	F1	F2	F3	Average H
H0	83.10	90.23	92.22	90.78
H1	91.85	93.80	101.24	94.50
H2	97.38	99.48	99.63	97.70
LSD0.05	2.86			1.651
Average F	88.52	95.63	98.83	
LSD(0.05) F	1.651			

Table 6 : Effect of different levels of humic, fulvic and NPK and their interaction on the total seed yield (tons h^{-1})

F / H	F1	F2	F3	AverageH
H0	4.43	4.81	4.91	4.84
H1	4.90	5.00	5.39	5.04
H2	5.19	5.30	5.31	5.21
LSD0.05	0.1524			0.088
Average F	88.52	5.10	5.27	
LSD(0.05) F	0.088			

yield due to the addition of the humic and fulvic acid mixture with the addition level F3 and F2, indicating the benefit of this combination in increasing the readiness of N, P, K and reflection in the increase of the flower disc diameter and the number of seeds and thus increase the plant yield.

Total seed yield (tons h^{-1})

Table (6) showed a significant increase in the total seed yield when the acid mixture of humic and fulvic was added. The treatment H2 gave the highest mean of 5.21 tons h^{-1} with an increase of 7.10% compared to H0 which gave the lowest average of 4.84 tonsh^{-1} while treatment H1 gave mean of 5.04 tons h^{-1} with a significant difference from H0. The obtained result can be attributed to the increase in the flower disc diameter (Table 2), the number of seeds in the disk (Table 3) and the plant yield (Table 5). The present result consistent with finding of Hatami (2017). Significantly, increasing fertilizer ratio (NPK) have increased the total seed yield. The F3 gave the highest average of 5.27 tons h^{-1} with an increase of 10.43% compared to F1 which gave a mean average of 4.72 tons h^{-1}, meanwhile, F2 gave an average of 5.10 tons h^{-1} with an increase rate of 7.45 % compared to F1The obtained result can be attributed to the increase in the flower disc diameter (Table 2), the number of seeds in the disk (Table 3) and the plant yield (Table 5) which was positively reflected in the overall seed yield (Khanwani *et al*, 2014).Furthermore, there was a significant interaction between the two factors. The combination F2H2had the highest mean rate of 5.39 tons h^{-1} with an increase of 17.81% compared to the combination F1H0, which gave the lowest average rate of 4.43 tons h^{-1}. F2H2 was not significantly differ from F3H2 and F3H1, which gave 5.31 and 5.30 tons h^{-1}respectively and these two combinations were not significantly different from the combination F3H0 which gave 5.19 tons h^{-1}. The present study confirm the high increase in the total seed yield as a result to the addition of Humic and Fulvicmixture with the level of addition F2, indicating the benefit of this combination in increasing the plant yield.

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