Al-Muthanna J. For Agric Sci Print ISSN: 2226-4086 Online ISSN:2572-5149
Vol. 11 , Issue.Supplement 01. 2024
https://muthjas.mu.edu.iq/ http://doi.org/10.52113/mjas04/11.1/5

Response of Sunflower (*Helianthus annuus* L.) to Fractionation of Humic Acids and Spraying with Azolla Extract

Ali Fakher Hadi Al-Jabri[1] and Ali Raheem Alhasany[2]

[1,2]Field Crops Department, College of Agriculture, Al-Muthanna University, Al-Muthanna, Iraq.

[1]E-mail: alifakier866@gmail.com
[2]E-mail: ali-raheem2002@mu.edu.iq
Received on 2/1/2024 Accepted on 20/03/2024 Published on 1/4/2024

Abstract. A field experiment was concluded in the 2022 spring season.in field of Al-Khader district, 30 km south of Al-Muthanna Governorate, to evaluate the impact of the productivity of sunflower to fractionation (30 kg Ha^{-1}) of humic acids at three levels (one batch, two batches, three batches) and spraying with an extract Azolla at four concentrations (0, 20%, 40% and 60%), A randomized complete block design was used for the experiment with three replications and by split-plot method by placing humic acid fractionation levels in a main plots, spraying Azolla concentrations in the secondary plots. The study found that level of fragmentation was superior in two batches in 1000 seeds weight, the individual yield of the plant and the total seed yield with averages of (84.85 gm and 98.31 gm $plant^{-1}$ and 5.24 tons ha^{-1}) for the traits in sequence, while the level of fragmentation was superior by three batches in the diameter of the disc and the number of seeds Filled with two averages of (22.75 cm and 961.25 seeds $disc^{-1}$) for the two traits, respectively, spraying Azolla extract at a concentration of 40% was significantly better and generated the greatest mean of disc diameter, number of filled seeds, 1000 seeds weight, individual plant yield and total seed yield, which amounted to 22.60 cm and 1027.86 seed $disc^{-1}$, 85.81 gm, 102.75 gm $plant^{-1}$ and 5.47 tons ha^{-1}) for the traits respectively. The interaction between the two research variables was significant because the two together (40% Azolla extract with splitting in three batches) achieved the highest two averages The weight of 1,000 seeds and the total number of seeds reached (1089.30 seeds $disc^{-1}$ and 90.27 g) for the two traits, respectively.

Keywords. Azolla, Organic Fragmentation, Humic, Sunflower.

1. Introduction

Due to its adaptability, the sunflower plant, Helianthus annuus L., is a member of the compound family and one of the most significant strategic crops in Iraq as it is used to extract vegetable oils for varieties [1]. As for the oily varieties, their importance is manifested by human consumption, as they have a distinctive and palatable flavor, in addition to their high nutritional value, as they contain proteins, carbohydrates and vitamins in good proportions [2].

Plant life depends in large part on fragmentation through the availability of nutrients at the different stages of plant growth and is not limited to a specific stage by adding them at once. Adding fertilizers at once led to a decrease in the plant's benefit from them [3]. Good management, including the adoption of modern technologies Which contributes to the growth and development of crops and supplying them with their needs of nutrients using plant extracts that have proven successful and effective in improving growth characteristics.one of the most important studied characteristic of extracts of plant is the high content of the nutrients, growth regulators Enzymes, and Plant hormones [4]. Azolla extract is Organic nutrient it has many of nutrients, amino acids [5], this study was conducted with the aim of knowing the response of sunflower to humic acid fractionation and spraying with Azolla extract .

2. Materials and Methods

2.1. Experience Site

In the spring of 2022, a field experiment was conducted in a farmer's field in the Al-Khader area, 30 kilometers south of the Al-Muthanna Governorate,(31°E , 45°N), to fractionation (30 kg Ha^{-1}) of humic acids at three levels (one batch, two batches, three batches) and spraying with an extract Azolla at four concentrations (0, 20%, 40% and 60%), A randomized complete block design was used for the experiment with three replications and by split-plot method by placing humic acid fractionation levels in a main plots, spraying Azolla concentrations in the secondary plots. Random samples were taken from several areas of field before planting and mixed well to homogenize them together to take a sample representing the experimental field chemical and physical analyses from a depth of 0 to 30 cm of the field were conducted, in (Table 1).

Table 1. Field soil's chemical and physical characteristics before planting.

Adjective		Value	Unit of measure
Ph		7.65	———
E.C		3	Desi Siemens M-1
Organic matter		4.45	gm kg^{-1} soil
ready-made nitrogen		20.50	mg^{-1} kg soil
ready-made phosphorous		15.33	mg^{-1} kg soil
ready-made potassium		140	mg^{-1} kg soil
separators the soil	The soil	520	g kg^{-1} soil
	mud	115	g kg^{-1} soil
	silt	365	g kg^{-1} soil
Tissue		alluvial sand mixture	g kg^{-1} soil

2.2. Field Operations

The experimental field was plowed by two plows in an orthogonal manner using a flip-flop plow. Then the smoothing and leveling process was carried out by means of disc harrows, and the field was divided for the purpose of providing a suitable cradle for the seeds. It was then divided into three sectors, each sector containing 12 experimental units with an area of 9 m2 (3 x 3 m), leaving a distance of 1 m between the experimental units. [6], Seeds of Shamus cultivar dated 4/3/2022 were sown manually in the upper third of the meadow by planting three seeds in the hole [7], then We keep only one plant in the each hole. The field has been fertilized using triple superphosphate (21%P), while potassium sulfate (50%K), according to the fertilizer recommendation (160 kg urea, 100 kg P_2O_5 and 160 kg K_2O) in each hectare [8].

The humic acids fertilizer (30 kg H^{-1}) was divided as follows:

- The recommendation is added to the ground at once and is symbolized by the symbol H1.
- Splitting the recommendation, and it is added to the ground in two batches and is symbolized by the symbol H2.
- Splitting the recommendation, and it is added to the ground in three batches and is symbolized by the symbol H3

The fractionated organic fertilizer was added by 3 batches, first batch one month after the emergence, the second batch after 15 days the

first batch, the third batch after 15 days from the second batch .

Spraying with four concentrations of Azolla extract, symbolized by the symbol A, which are :

- The first concentration is the comparison treatment, spraying with distilled water only and denoted by the symbol A0
- The second concentration is spraying with Azolla extract (20%) and symbolized by the symbol A1
- The third concentration spraying with Azolla extract (40%) and symbolized by the symbol A2
- The fourth concentration sprayed with Azolla extract (60%) and symbolized by the symbol A3

Plants were sprayed after two months of planting

3.Results and Discussions

2.3. Disc Diameter (cm)

The findings of the analysis of variance showed that the two study factors had a substantial impact. which are single, while the interaction between treatments wasn't significant differences in diameter of the disc.

It can be seen from Table (2) there is a significant increase in the disc diameter when the levels of fragmentation of humic acids are increased. While the level of H1 supplied the lowest average, the level of H3 gave the greatest average of 22.75 cm and wasn't significantly from the level of H2, which recorded an average of 22.46 cm. The lowest mean of the characteristic was 21.62 cm, and this finding was consistent with [9], who demonstrated that fertilizer addition to the sunflower crop caused disc diameter to rise due to crop fragmentation.

The results in (Table 2) show that there are significant differences in the diameter of the disc when spraying with Azolla extract, with the concentration A2 recording the highest average of 22.60 cm and the measurement treatment A0 giving the lowest average of 21.56 cm, respectively. This could be because of the function of plant hormones and acids. The extract's amino acid content and this outcome supported the findings of [10], who claimed that spraying plant extracts on a sunflower crop increased the disc's diameter.

Table 2. Effect levels of humic acid and Azolla and the interaction between treatments on disc diameter (cm).

Azolla (A)/ Humic Acids (H)	**A_0**	**A_1**	**A_2**	**A_3**	**Humic acid averages**
H_1	20.86	21.86	21.73	22.06	21.62
H_2	22.03	22.80	22.73	22.30	22.46
H_3	21.80	22.60	22.33	23.33	22.75
Azolla averages	21.56	22.42	22.60	22.56	
(L.S.D 0.05)	H	A			A×H
	0.58	0.55			N.S

2.4. Seeds Number Per Disc (seed disc^{-1})

The statistical analysis's findings revealed that spraying with Azolla extract, fractionating humic acid, and their interactions had no discernible impact on the number of seeds in the disc.

Table 3. Effect levels of humic acid and Azolla and the interaction between treatments on seeds number per disc (seed disc^{-1}).

Azolla (A)/ Humic Acids (H)	**A_0**	**A_1**	**A_2**	**A_3**	**Humic acid averages**
H_1	1061.33	1216.66	1092.66	1059.33	1107.49
H_2	891	1079.66	1072.66	1162	1051.33

H_3	1105.33	1092	1146.66	1082.66	1106.66
Azolla averages	1019.22	1129.44	1103.99	1101.33	
(L.S.D 0.05)	H	A			A×H
	N.S	N.S			N.S

2.5. Number of Seeds Full (tablet^{-1} seed)

The results indicated the significant effect of humic acid fractionation and spraying with Azolla extract and the interaction between them for the characteristic of the number of full seeds .

It was noticed from Table (4) that there was an increase in the number of filled seeds with an increase in the fragmentation of humic acids, as the hash level H3 provided a mean of 961.25 disk seeds, the highest value, for this characteristic while the H1 level recorded lowest mean at 868.32 seeds disk^{-1}. Perhaps the reason due to the role of fragmentation of the added humic acids, which provided the plant's need of nitrogen and other elements in the different stages of growthwhich increased the effectiveness of their absorption and transmission inside the plant tissue and had an impact on the diameter of the disc (Table 2), increasing the number of seeds in the disc that were whole seeds.

Results from Table 4 clearly demonstrated Azolla A2 concentration's superiority, which had a mean value of 1027.86 disc^{-1} seeds for this characteristic, while comparison treatment A0 had a mean value of 729.23 disc^{-1} seeds for this trait. and the reason may be due to the extract's content of nutrients and plant hormones. Stimulating growth, which led to an increase in carbon representation and its positive reflection on the diameter of the disc (Table 2), This helped to move dry materials, which then accumulated in the seeds downstream, increasing the number of filled seeds in the disc.

The interaction between fractionating humic acids and spraying with Azolla extract was also found to have substantial differences in this feature, with the combination (H3A2) producing the greatest average of 1089.30 disc^{-1} seeds and the combination (H1A0) producing the lowest average of 700.70 seeds. According to what was stated in relation to the influence of specific elements and how this was reflected in the interaction between the components, disc^{-1} Table (4), this is explained.

Table 4. Effect levels of humic acid and Azolla and the interaction between treatments on the number of filled seeds (disc^{-1} seed).

Azolla (A)/ Humic Acids (H)	**A_0**	**A_1**	**A_2**	**A_3**	**Humic acid averages**
H_1	700.70	973.30	933.30	866.00	868.32
H_2	724.30	966.30	1061.00	1052.30	950.97
H_3	762.70	1003.00	1089.30	990.00	961.25
Azolla averages	729.23	980.86	1027.86	969.43	
(L.S.D 0.05)	H	A			A×H
	75.50	51.42			95.86

2.6. 1000 Seeds Weight of (gm)

The analysis of variance shows the significant effect of humic acid fractionation and spraying with azolla extract and the interaction between acid fractionation and azolla on 1000-seed weight trait.

the results in (Table 5) showed that the second level of fragmentation H2 exceeded the weight of 1000 seeds and gave highest average at 84.85 g, while the level of fragmentation H1 recorded the lowest average of 80.63 g. The weight of the seed increased as a result, in addition to adopting the principle of compensation in the yield and its components, which led to a positive increase. This result is consistent with [11], who indicated that the fractionation of adding fertilizers led to an increase in the weight of 1000 seeds.

The findings in (Table 5) demonstrated the moral superiority of spraying Azolla concentration A2, which recorded the greatest mean for the trait amounting to 85.81 g in comparison to measurement treatment A0,

which recorded the lowest average for this characteristic amounting to 79.34 g. This is consistent with (5) who observed a notable increase in the weight of 1000 seeds as a result of the plants' response to spraying with plant extracts. This is accomplished by activating the vital processes in the plant that contribute to the transfer of the products of carbon metabolism to the disc and subsequently increase the weight of the seeds.

The results demonstrated the superiority of the combination (H3A2), which recorded the highest average for the trait at 90.27 gm, while the combination (H3A0) gave the lowest average for this trait at 78.42 gm. This trait was significantly affected by the interaction between fractionating humic acids and spraying with Azolla extract (Table 5).

Table 5 Effect levels of humic acid and Azolla and the interaction between treatments on the weight of 1000 seeds (gm).

Azolla (A)/ Humic Acids (H)	**A_0**	**A_1**	**A_2**	**A_3**	**Humic acid averages**
H_1	78.81	86.27	80.37	77.07	80.63
H_2	80.80	83.05	86.81	88.77	84.85
H_3	78.42	82.13	90.27	85.17	83.99
Azolla averages	79.34	83.81	85.81	83.67	
(L.S.D 0.05)	H	A			A×H

2.7. Individual Plant Yield (g plant^{-1})

The statistical analysis' findings demonstrated the major impact of humic acid fractionation. and spraying with Azolla extract for this trait, while the interaction did not show any significant difference between the two study factors .

Table (6) demonstrates the moral superiority of humic acid fractionation, with level H2 providing the highest average for the characteristic, amounting to 98.31 gm plant^{-1}, and level H1 providing the lowest average, amounting to 89.75 gm plant^{-1}. The role of fractionating humic acids in increasing the diameter of the disc (Table 2), the quantity of filled seeds (Table 4), and the weight of 1000 seeds (Table 5) can be attributed to the superiority. These factors were positively reflected and resulted in an increase in the yield of the individual plant. positively impacted each plant's particular output.

The results in (Table 6) revealed significant differences between the concentrations of Azolla spray in the trait of the individual yield, with concentration A2 providing the highest average for the trait amounting to 102.75 gm plant^{-1} compared to comparison A0, which recorded the lowest average of 77.89 gm plant^{-1}. These findings concur with those of [12], who observed a significant increase in the individual yield of the plant when spraying with plant extracts.

Table 6. Effect levels of humic acid and Azolla and the interaction between treatments on individual plant yield (gm plant^{-1}).

Azolla (A)/ Humic Acids (H)	**A_0**	**A_1**	**A_2**	**A_3**	**Humic acid averages**
H_1	72.67	91.67	98.33	96.33	89.75
H_2	81.33	101.67	104.92	105.33	98.31
H_3	79.67	92.00	105.00	100.00	94.16
Azolla averages	77.89	95.11	102.75	100.55	
(L.S.D 0.05)	H	A			A×H
	6.27	4.75			N.S

2.8. Total Seed Yield (ton ha^{-1})

The results showed the significant effect of humic acid fractionation and spraying with

Azolla extract for this trait, while the interaction between them did not show any significance.

The results of Table (7) show that there are substantial variations in the amount of humic acids split in the total seed yield, with the level of fragmentation H2 recording the highest average of 5.24 tons H^{-1} and the first level of fragmentation H1 recording the lowest average for this trait of 4.78 tons H^{-1}. These results agreed with [9]. On the yield of the sunflower, who noted in their study the significant increase in the total seed yield in response to the fertilizer fractiona. The increase in the total yield may be due to the increase in the diameter of the disc (Table 2), the number of filled seeds in Table (4), the weight of the 1000 seeds in Table (5), and the yield of the individual plant in Table (6), which led to an increase in the total yield per unit area.

The results of (Table 7) also demonstrated the moral superiority of the total seed production when spraying with Azolla extract, as the comparison treatment A0 produced the lowest average of 4.14 tons ha^{-1} and the third spray concentration A2 recorded the greatest average of 5.47 tons ha^{-1}. These results concurred with the findings of (5) that spraying with plant extracts resulted in a considerable increase in the total seed yield. One component of the yield, indicated by the weight of 1000 seeds in Table (5), increased as a result of the increase in the total yield.

Table 7. Effect levels of humic acid and Azolla and the interaction between treatments on the total seed yield (ton ha^{-1}).

Azolla (A)/ Humic Acids (H)	**A_0**	**A_1**	**A_2**	**A_3**	**Humic acid averages**
H_1	3.87	4.88	5.24	5.13	4.78
H_2	4.33	5.41	5.59	5.61	5.24
H_3	4.24	4.90	5.59	5.33	5.01
Azolla averages	4.14	4.73	5.47	5.35	
(L.S.D 0.05)	H	A			A×H
	0.33	0.25			N.S

Conclusions

The results of the experiment conclude the following:

- Increasing the total yield of seeds by 9.62% and the percentage of protein in seeds by 16.55% when comparing the second level of fragmentation H2 with the first level H1 as a result of the increase in the components of the yield represented by the weight of 1000 seeds as well as the number of filled grains and an increase in the diameter of the disc.
- The percentage of increase in the total seed yield was 31.80% and the percentage of protein in the seeds was 9.03% when spraying with a concentration of 40% of Azolla extract compared to the comparison treatment as a result of the increase in the number of filled seeds, which led to an increase in the weight of 1000 seeds.
- Spraying with the combination (H3×A2) led to a significant superiority in some growth and yield traits, as it gave the highest average number of filled seeds amounting to 1089.30 disc-1 seeds, while the combination ((H2×A2) recorded the highest average of the protein content in the seeds amounting to 8.98%

References

[1] Al-Badri, Saad Adnan Manhal. (2013). Effect of quantities and dates of adding potassium fertilizer on the growth, yield and oil quality of sunflower (Helianthus annuus L. Var. Flame). Master Thesis . Field Crops Division. faculty of Agriculture . Al-Muthanna University .

[2] The narrator, Adawiya Sajit, Medhat Majeed Al-Sahoki and Fadel Younes Bektaş. (2013). Selection by beehive for the weight of the seed in the sunflower. Iraqi Journal of Agricultural Sciences 44(2): 143-153 .

[3] Al-abar, s. t. k., and Al-jobouri, s. mi. (2021). Yield and its components response of three wheat varieties (Triticum aestivum L.) for split application of

nitrogen fertilizer and flag leaf removal. plant cell biotechnology and molecular biology, 7-27 .

[4] Anisimov, M. M., and Chaikina, E. L. (2014). Effect of seaweed extracts on the growth of seedling roots of soybean (Glycine max L.) Merr.) seasonal changes in the activity. International Journal of Current Research and Academic Review, 2(3), 19-23 .

[5] Altai, D. S., Alhasany, A. R., Noaema, A. H., Idan, W. J., and Al-Farhan, I. M. (2019). Effectiveness of Azolla Extract in Reducing Use of Mineral Fertilizers (NPK) and Increasing Productivity of Wheat under New Reclaimed Soils. Journal of Plant Production, 10(10), 859-866 .

[6] Abd EL-Satar, M. A., and Hassan, T. H. A. (2017). Response of seed yield and fatty acid compositions for some sunflower genotypes to plant spacing and nitrogen fertilization. Information processing in agriculture, 4(3), 241-252 .

[7] Al-Sahoki, Medhat Majid, Francis Oraha and Ahmed Shehab. (1996). Changes of growth and yield of sunflower by the effect of the variety and planting date - Iraqi Journal of Agricultural Sciences 27(2);77-88 .

[8] Abedi, Jalil Asbahi. (2011). Guide to the use of chemical and organic fertilizers in Iraq. The General Authority for Agricultural Extension and Cooperation. Ministry Of Agriculture . Iraq .

[9] Al-Rifai, Shaima Ibrahim Mahmoud and Dhafer Abdel Rahim Shaker. (2021). The effect of fractionation of phosphate fertilizer on yield and its components of sunflower crop. Helianthus annuus L. Al-Muthanna Journal of Agricultural Sciences 8(4): 68-83 .

[10] Kosalaraman, K., and Munisamy, S. (2015). Yield and oil content of peanut (var. TMV-7) and sunflower (var. Co-2) applied with bio-stimulant manufactured from seaweed. African Journal of Agricultural Research, 10(25), 2537-2543 .

[11] Al-Mughayer, Haider Abdul-Hussein Mohsen. (2019). The effect of organic acids and NPK and its fractionation on the growth and yield of sunflower (Helianthus annuus L.). PhD thesis. faculty of Agriculture. Al-Muthanna University .

[12] Nasrallah, Adel Youssef, Intisar Hadi Al-Halfi, Hadi Muhammad Al-Aboudi, Aws Ali Muhammad and Ahmed Mahdi Mahmoud. (2014). Effect of spraying some plant extracts and antioxidants on the growth and yield of sunflower. Iraqi Journal of Agricultural Sciences 45 (7): 651-659 .