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The Effect of Brassınolıde on the Yıeld Components, Seed and Oıl Yıelds of some Sunflower Cultıvars

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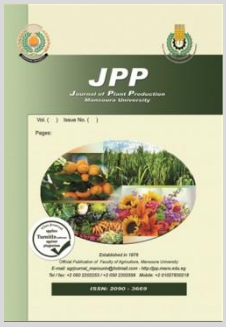

ABSTRACT

The field experiment was carried out in the spring season of 2019 in the Research Station at the College of Agriculture, University of Anbar.This experiment was aimed to study the effect of spraying different concentrations of Brassinolide (0, 0.5, 1, 1.5 mg L^{-1}) on the yield and quality of three vareities of sunflower (Ishaqi 1, Akmaar, and Sakha). The experimental design was split-plots experiment under the Randomized Completely Block Design (RCBD) with three replicates. The three vareities were distributed in the main-plots and the concentrations of Brassinolide were distributed in the sub-plots. A significant effect of the cultivars and the concentrations of the Brassinolide on the studied response variables. The sprayed plants with 1.5 mg L^{-1} concentration achieved highest number of seeds per disc (833 seed $disc^{-1}$), weight of 1000 seeds (65.08 g), percentage of fertility in the seeds (93.89%), total seed yield (3573 kg ha^{-1}) and oil yield (1586 kg ha^{-1}). The vareities were significantly different for all studied traits. Sakha cultivar recorded the highest values for the number of seeds per disc, the percentage of fertility in the seeds, the total yield of seeds and the oil yield (708 seed $disc^{-1}$, 93.05%, 2810 kg ha^{-1}, 1217 kg ha^{-1}, respectively), whereas Ishaqi 1 was superior in terms of the weight of 1000 seeds (61.33 g) and Akmaar was superior in terms of oil content (46.16%). Sakha cultivar was the most responsive to the addition of Brassinolide and achieved a high average for the seed yield and oil.

***Keywords*:** Sunflower , *Hellanthus annuus* L., brassinolide, growth regulator, oil yield, oil content.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one of the world's most important oil crops, ranking third after soybean and canola in terms of oil content. Its seeds have high oil content that can reach up to % 50. It is used in nourishment and industry, such as the manufacturing of soap, and paint. The seed meal can be used to feed the cattle and poultry due to its high content of nutrients (% 40), protein, and carbohydrates (% 20) (Al-Awdah *et al.*, 2009).

Growth regulators, on the other hand, play a crucial function in increasing production and enhancing quality. Brassinosteroids are one of these regulators (BRs). Those a new category of vegetable hormones that have multiple hydroxyl steroid structures, which show an organizational activity for the growth of the plant (Latha and Vardhini, 2016). They help increase the production of crops through their role in metabolism inside the plant (Vogler, 2014). It also regulates photosynthesis and increases efficiency (Hayat and Ahmed, 2011). It also contributes to the division and elongation of the cells and the delay of aging (Favero *et al.*, 2014). Bera *et al.* (2014) mentioned that using Brassinosteroids on sunflower as a result of which there was a significant increase in the weight of 1000 seeds and seed yield and oil content. Gao *et al.*, (2017) found that using Brassinolide on corn as a result of which there was a significant increase in the weight of 1000 seeds and total grain yield.

Therefore, the study aims to know the effect of different concentrations of Brassinolide on the yield components, seed yield and oil yield of three cultivars of sunflower.

MATERIALS AND METHODS

A field experiment was conducted during the spring season for 2019 in a Research Station at the College of Agriculture, University of Anbar, located within 27-30 latitude and 27-43 longitude and 49 m altitude.The purpose of the study was to show the effect of spraying different concentrations of Brassinolide (0, 0.5, 1, 1.5 mg L^{-1}) on the yield components, seed and oil yields as well as seed oil content for three varieites of sunflower (Ishaqi 1, Akmaar, and Sakha). The experimental design was Split-Plots trail under the Randomized Completely Block Design (RCBD) with three replicas. The three varieties were randomizedly distributed in the main-plots and the concentrations of Brassinolide were randomizedly distributed in the sub-plots. The land of the experiment was prepared and divided using the aforementioned design. The area of the experimental unit was (9 m^2) consisted of 5 lines. The plant density was 66666 plants ha^{-1}. The distance between each unit was 2 m. The experiment was started on 15/3/2019, irrigated repeatedly depending on the moisture of soil and the demands of the plant. When the plants reached the five leaves stage, they were minimized to one plant per seedling bed. The reduction was done twice throughout the season to eliminate the weeds that are competing with the crop. Spraying of Brassinolide at the early stage of germination using a 20 L sprayer. Each level was sprayed until the complete wetness of leaves was achieved.

Response variables: Ten plants of sunflower were selected randomly from the middle of each experimental unit to study the following responses:

1- Seeds number per disc: This was calculated as an average for the number of seeds for the ten harvested discs.

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2- Weight of 1000 seeds (g): It was calculated by taking a random 1000 seeds from the total seed yield and weighing it with the sensitive electronic scale.
3- Seed fertility percentage (%): A random sample of 50 g was taken from each unit, and the number of empty and full seeds was calculated using the equation:

Seed fertility percentage (%) = [Number of full seeds / (number of empty seeds + number of full seeds)] × 100

4- Total yield (kg ha^{-1}): The total yield for seeds according to the following equation:

Seed yield per unit area = Plant density × average plant seed yield per treatment

It was thereafter transformed to kg ha^{-1}

5- Oil content %: This was calculated based on the dry weight of the seeds using Soxhlet according to the methodology in the American Association of Analytical Chemistry (A.O.A.C, 1980).
6- Oil yield (kg ha^{-1}) was calculated based on the following equation:

Oil yield= yield of seeds (kg ha^{-1}) × ratio of oil %

Statistical Analysis: Data were analysed using the experimental design that was Split-Plots with the Randomized Complete Block Design (RCBD) with three replicats, analyised procedure of Genestat Software for Windows Software (Version, 6.1). The Least Significant Differences (LSD) test was used to recognize the different means on a probability level of 0.05.

RESULTS AND DISCUSSION

Seeds number per disc: Results in Table 1 indicate the significance of the effect of genotypes , the concentration of Brassinolide, and their interaction on the number of seeds per disc. Sakha genotype was superior with the highest average for this response, which was 708 seeds $disc^{-1}$ compared to Akmaar and Ishaqi 1, which gave the lowest value for that response 575 seeds $disc^{-1}$. This was due to the larger size of the dish and the increase in Seed fertility percentage thereby increasing the number of seeds per disc. This comes in agreement with (Mehmood *et al.*, 2018 and Ahmad *et al.*, 2019) who referred to significant differences between genotypes of sunflower in this characteristic. Also, results show that the increase in the concentration of spraying with Brassinolide came along with a significant increase in the average of seeds per disc. The high concentration (1.5 mg L^{-1}) gave the highest value for the response, 833 seed $disc^{-1}$ with a 70.34, 37.91, and 26.98% increase compared to 0, 0.5, and 1 mg L^{-1} concentrations, respectively. This increase possibly is due to the activity of Brassinolide in increasing the area of leaves and the results of photosynthesis, which reflects upon the increase in the volume of the disc, Seed fertility percentage, and the number of seeds. Those results confirm what (Talaat *et al.*, 2015) found. Results from the interaction in the table above show that Sakha cultivar achieved the highest number of seeds, 898 seed $disc^{-1}$ due to the effect of spraying with 1.5 mg L^{-1} concentration of Brassinolide and it was significantly superior to the other interaction factors in which the cultivar was given Ishaqi 1 with the comparison treatment the lowest average for these reached 420 seed $disc^{-1}$

Weight of 1000 seeds (g): Table 2 shows that Ishaqi1cultivar had achieved the highest average for 1000 seeds weight, which was 61.34 g and it was significant compared to Sakha (59.01 g) and Akmaar (54.08 g) with an increase of 3.95% and 13.42% respectively. The two other genotypes were significantly different compared to each other as well. Those results confirm with (Demir, 2019 and Rehman *et al.*, 2019) who found similar results of variance for sunflower in the 1000 seeds weight values.

Table 1. Effect of different Brassinolide levels on average seeds number per disc for sunflower cultivars

Brassinolide levels (Mg L^{-1})	Cultivars			Mean
	Ishaqi 1	Akmaar	Sakha	
0	420	567	480	489
0.5	546	562	705	604
1	545	673	750	656
1.5	792	809	898	833
Mean	575	653	708	
LSD 0.05	V	T	T×V	
	37.15	42.9	74.30	

The table also shows that the increase in the concentration of spraying with Brassinolide was significant for the 1000 seeds weight. The 1.5 mg L^{-1} concentration achieved the highest value at 65.08 g giving an increase of 26.54, 17.09, and 7.59% compared to the concentrations (0, 0.5, and 1 mg L^{-1}) respectively. These results confirm the findings of (Lauren, 2017 and Meena, 2017). The interaction shows that Ishaqi1 that sprayed with 1.5 mg L^{-1} concentration gave the highest value at 68.93 g and was significant compared to other interaction variables where the lowest value was 45.80 g, which was achieved by the interaction of Akmaar cultivar and the standard variable.

Table 2. Effect of different Brassinolide levels on average weight of 1000 seeds (g) for sunflower cultivars

Brassinolide levels)Mg L^{-1}(	Cultivars			Mean
	Ishaqi 1	Akmaar	Sakha	
0	57.33	45.80	51.17	51.43
0.5	59.23	50.97	56.53	55.58
1	59.87	58.17	63.43	60.49
1.5	68.93	61.40	64.90	65.08
Mean	61.34	54.08	59.01	
LSD 0.05	V	T	T×V	
	1.215	1.403	2.430	

Seed fertility percentage(%): Table 3 shows that the Sakha cultivar achieved the highest average for this property 93.06% and was significant compared to Akmaar and Ishaqi1, which gave the lowest value at 80.75%. Also, the later genotypes were significantly different as well. This result confirms (Abduallah, 2008) who referred to differences between types in terms of the Seed fertility percentage.

From Table 3, it turns out that the increase in the concentration of Brassinolide when spraying resulted in a high Seed fertility percentage. The highest concentration for the Brassinolide (1.5 mg L^{-1}) resulted in the highest value of Seed fertility percentage 93.90 %, with an increase of 15.44, 9.26, 4.76 % for the concentrations (0, 0.5, 1 mg L^{-1}) respectively. The interaction shown in the table indicates that Sakha achieved the highest average Seed fertility percentage, 97.61%. This high figure was affected by the spraying with a 1.5 mg L^{-1} concentration of the Brassinolide. It was superior compared to other interactions, where the lowest value was achieved by the Ishaqi 1 cultivar with standard treatment it stood at 73.30%.

Seed yield (kg ha^{-1}): The results of Table 4 show a significant effect of genotypes of sunflower , concentration of Brassinolide and their interaction on the seed yield. Sakha genotype was superior achieving the highest average 2799 kg ha^{-1} In comparison to other genotypes, Akmaar had the lowest average

(2367 kg ha^{-1}), which was not significant from the remaining genotype, Ishaqi1. The high results of the Sakha genotype due to its superiority in the properties of the number of seeds per disc and the increase in the number of fertile seeds (table 1 and 3). This is confirmed by (Abd *et al.*, 2019 and Al-Refai, S. I. & Dhafer, 2019. Results also show that increasing the spraying concentration results in an increase in the seed yield. The highest Brassinolide concentration (1.5 mg L^{-1}) gave the highest results for the response, 3573 kg ha^{-1} with an increase of 117.46, 60.87, 36.11 % for the concentrations (0, 0.5, 1 mg L^{-1}) respectively. Those findings come in agreement with (Bera *et al.*, 2014 and Faizan *et al.*, 2017).

Table 3. Effect of different Brassinolide levels on seed fertility percentage (%) for sunflower cultivars

Brassinolide levels)Mg L^{-1}(	Cultivars			Mean
	Ishaqi 1	Akmaar	Sakha	
0	73.30	81.76	88.95	81.34
0.5	77.17	86.50	91.70	85.12
1	82.17	92.73	94.00	89.63
1.5	90.37	93.73	97.61	93.90
Mean	80.75	88.68	93.06	
LSD 0.05	V	T	T×V	
	1.107	1.278	2.214	

Results of interaction show that Sakha achieved the highest average for seeds 3838 kg h^{-1} when exposed to spraying with 1.5 mg L^{-1} concentration, and was superior to other interactions with an increase of (2248 kg ha^{-1}) compared to Eshaaqi genotype where the lowest value was achieved, 1590 kg ha^{-1}.

Table 4. Effect of different Brassinolide levels on average seed yield (kg ha^{-1}) for sunflower cultivars

Brassinolide levels)Mg L^{-1}(	Cultivars			Mean
	Ishaqi 1	Akmaar	Sakha	
0	1590	1716	1623	1643
0.5	2136	1889	2595	2207
1	2152	2585	3139	2625
1.5	3605	3277	3838	3573
Mean	2371	2367	2799	
LSD 0.05	V	T	T×V	
	45.61	52.67	91.22	

Seed oil content (%): The results in Table 5 indicate that there are significant differences among sunflower genotypes in the seed oil content, Akmar genotype had highest means (٤٦,٥٦%) compared with Sakha genotype which had lowest means (٤٤,٠٤%) for.The superiority of the Akmar genotype may be due to its genetic nature and their response to environmental conditions (Rehman *et al.*, 2019). The concentrations of brassinolide significantly differed in this trait, the spraying of brassinolide at 1.5 achieved the highest means(٤٥,١٥%), compared with spraying of brassinolide at 1 mg L^{-1} which gave the lowest means (44.86 %) The positive effect of brassinolide in increasing the leaf area was positively reflected in increasing the photosynthesis products, which in turn were transferred to the seeds (sinks) and then increase the percentage of oil stored in the seeds. These results are in agreement with (Bera *et al.*, 2014).The interaction between two factors was significant effect on the seed content of oil, the Akmar genotype with spraying of brassinolide at 1.5 mg L^{-1} gave the highest values (46.91%) whereas the Sakha genotype with control treatment gave the lowest values (44.00%).

Table 5. Effect of different Brassinolide levels on seed oil content (%) for sunflower cultivars

Brassinolide levels)Mg L^{-1}(	Cultivars			Mean
	Ishaqi 1	Akmaar	Sakha	
0	44.25	46.50	44.00	44.91
0.5	44.41	46.33	44.08	44.94
1	44.25	46.50	43.83	44.86
1.5	44.28	46.91	44.25	45.15
Mean	44.30	46.56	44.04	
LSD 0.05	V	T	T×V	
	0.106	0.074	0.154	

Oil yield (Kg ha^{-1}): Table 6 shows that Sakha achieved the highest average for the oil yield at 1217 kg h^{-1} and it was superior to Akmaar (1095 kg ha^{-1}) and Ishaqi1 (1044 kg ha^{-1}) respectively. Besides, The last two genotypes differed greatly from one another. The Sakha genotype's excellent performance are attributable to its greater seed output (Table 4) which is reflected positively in the oil yield.

The Table above indicates that increasing the amount of Brassinolide sprayed increases the oil output. The characteristic with the greatest average was 1586 kg ha^{-1} at the highest concentration 1.5 mg L^{-1} with an increase of 116.37%, 61.83%, 35.09% for the concentrations (0, 0.5, 1 mg L^{-1}), respectively. The higher concentration's superiority in this attribute was related to its superior seed output (Table 4). Table 6 shows the results of the interaction, which show that the Sakha genotype was sprayed with 1.5 mg L^{-1} concentration gave the highest oil yield(1672 kg ha^{-1}) and it was significant compared to other interactions with an increase of 974 kg ha^{-1} compared to Ishaqi1 which gave the lowest average of 698 kg ha^{-1}.

Table 6. Effect of different Brassinolide levels on average oil yield (kg ha^{-1}) for sunflower cultivars

Brassinolide levels)Mg L^{-1}(	Cultivars			Mean
	Ishaqi 1	Akmaar	Sakha	
0	698	789	714	733
0.5	948	885	1109	980
1	945	1201	1375	1174
1.5	1584	1504	1672	1586
Mean	1044	1095	1217	
LSD 0.05	V	T	T×V	
	23.56	27.20	47.11	

CONCLUSION

According to the findings, increasing the concentration of Brassinolide resulted in a considerable increase in the yield components and the percentage of fertility in the seeds. The Sakha cultivar was the most responsive to the addition of Brassinolide and achieved a high average for the seed yield and oil.

REFERENCES

A.O.A.C .1980. Official Methods Analysis (13th Ed) Washington, USA Association of Official Analysis chemists.

Abd S. A., Jassem, K. A. & Mohsen, B. M. 2019. Response of Four Sunflower Genotype (Helianthus Annuus L.) to Different Planting Dates. Muthanna Journal of Agriculture Science .7(2):98-105.

Ahmad, S., Sobia M., Muhammad, W. Y., Ijaz H., Muhammad W., Abu Bakar, Z., Iqra G., & Muhammad Z. N.2019. Influence of planting methods on (growth, achene yield & oil contents) of various sunflower genotypes under an arid climate. The International Journal of Biological Research , (1):93-99.

Al-Awdah, A. S., Maha, L. H. & Youssef N.2009. Oil and sugar crops and their technology. Faculty of Agricultural Engineering. university of Damascus. 225-310.

Al-Refai, S. I. & Dhafer, A. S.2019. Effect of Partitioning of Phosphorus Fertilizer on Growth and Yield of Sun Flower Helianthus annuus L. Muthanna Journal of Agriculture Science ,7(3):287-297.

Abduallah, B. H.2008. Response of growth and yields of three sunflower genotypes (Helianthus annuus L.) to arrangement system of plants in farm. Anbar Journal of Agricultural Sciences, 6 (1):49-72.

Bera, A., Pramanik, K. & Mandal, B.2014. Response of biofertilizers and homo-brassinolide on growth, yield and oil content of sunflower (Helianthus annuus L.). African Journal of Agricultural Research, 9(48): 3494-3503

Demir, I.2019. The effects of sowing date on growth, seed yield and oil content of sunflower (Hellanthus annuus L.) cultivars under rain fed conditions . Fresenius Environmental Bulletin. 28 (9): 6849-6857

Faizan. M., Faraz, A., Sami, F., Siddiqui, H. & Hayat, S.2017. Brassinosteroids: A New plant growth regulator. Journal of Biological and Chemical Research . 34 (2): 908-917.

Favero, D. S., Le, K. N. & Neff, M. M.2017. Brassinosteroid signaling converges with suppressor of phytochrome B4-#3 to influence the expression of small auxin up RNA genes and hypocotyl growth. Plant Journal, 89(6): 1133–1145.

Gao, Z., Liang, X. G., Zhang, L., Lin, S., Zhao, X., Li –zhou, L., Shen, S. & Li-Zhou, S.2017. Spraying exogenous 6- benzyladenine and Brassinolide at tasseling increases maize yield by enhancing source and sink capacity. Field Crops Research 211:1-9

Hayat, S. & Ahmed , A.2011. Brassinosteroide: A Class of Plant Hormone. Springer, Berlin. Germany.PP:245.

Latha, P. & Vardhini, B. V.2016. Effect of brassinolide on the growth of mustard crops grown in semi-arid tropics of nizamabad. International Journal Plant & Soil Science, 9(1): 1-5.

Lauren, S., Yishi, W. & Ann, S.2017. Plant growth regulators ameliorate or exacerbate abiotic and biotic stress effects on Zea mays kernel weight in a genotype-specific manner University of North Carolina Wilmington. Environmental and Experimental Botany, 147:197-188.

Meena. B.P., Singh, P., Meena ,V. K., Ram, H., Meena, R. K., Yadav, M. R., Kumar, R. & Puniya, M. M.2017. Performance of summer maize (Zea mays L.) under varying irrigation levels and agro-chemicals in sub-humid southern plains of Rajasthan. Indian Journal of Agronomy 62(1):54-58.

Mehmood, A., Saleem, M. F., Tahir, M., Sarwar, M. A., Abbas, T., Zohaib, A., &Abbas, H. T.2018. Sunflower (Helianthus annuus L.) growth, yield and oil quality response to combined application of nitrogen and boron. Pakistan Journal of Agricultural Research, 31(1):86-97.

Rehman, A.U., Ali, U.I., Qamar, R., Rehman, A., Hussain, M., Javeed, H.M.R. & Ahmad, S.2019. Boron foliage application mediates growth, oil yield and quality of sunflower in yermosols of southern Punjab. **:** International Journal of Agriculture and Biology , 21 (1):209-214.

Talaat, N. B., Shawky, B. T. & Ibrahim, A. S. 2015. Alleviation of drought-induced oxidative stress in maize (Zea mays L.) plant by dual application of 24-epibrassinolide and spermine. Environmental and Experimental Botany,113:47-58.

Vogler, F., Schmalzl, C., Englhart, M., Bircheneder, M. & Sprunck, S.2014. Brassinosteroids promote Arabidopsis pollen germination and growth. Plant Reproduction**,** 27(3):153–167.

تأثير البراسينولايد على مكونات الحاصل وحاصل البذور والزيت لبعض أصناف زهرة الشمس

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نفذت تجربة حقلية في الموسم الربيعي لعام ٢٠١٩ في محطة أبحاث كلية الزراعة ـ جامعة الأنبار، بهدف دراسة تأثير رش تراكيز مختلفة من البراسينولايد (٠، ٠,٥، ١، ١,٥ ملغم لتر$^{-1}$) على بعض صفات الحاصل ونوعيتة لثلاثة أصناف من زهرة الشمس (اسحاقي١، أقمار، سخا). تم تنفيذ تجربة قطع منشقة في تصميم قطاعات كاملة العشوائية في ثلاث مكررات، حيث وزعت الأصناف عشوائيا على القطع الرئيسية، بينما وزعت تراكيز البراسينولايد عشوائيا على القطع الشقية. أظهرت نتائج التحليل الاحصائي معنوية تأثير الأصناف وتراكيز البراسينولايد في الصفات المدروسة ، إذ حققت النباتات المرشوشة بتركيز البراسينولايد ١,٥ ملغم لتر$^{-1}$ أعلى القيم لعدد البذور بالقرص (٨٣٣ بذرة قرص$^{-1}$) ووزن ١٠٠٠ بذرة (٦٥,٠٨ غم) ونسبة العقد (٩٣,٨٩%) والحاصل الكلي للبذور(٣٥٧٣ كغم هـ$^{-1}$) وحاصل الزيت (١٥٨٦ كغم هـ$^{-1}$)، كما اختلفت الأصناف معنوياً في أغلب الصفات المدروسة، إذ سجل الصنف سخا أعلى القيم لعدد البذور بالقرص و ونسبة العقد والحاصل الكلي للبذور وحاصل الزيت (٧٠٨ بذرة قرص$^{-1}$ و ٩٣,٠٥% و ٢٨١٠ كغم هـ$^{-1}$ و١٢١٧ كغم هـ$^{-1}$) بالتتابع في حين تفوق الصنف اسحاقي١ بوزن ١٠٠٠ بذرة (٦١,٣٣ غم) والصنف أقمار بنسبة الزيت (٤٦,١٦%). كان الصنف سخا الأكثر استجابة لإضافة البراسينوليد وحقق أعلى متوسط لمحصول البذور والزيت.

الكلمات الدالة: البراسينولايد، منظمات نمو، زهرة الشمس، *Helianthus annuus* L.