Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
September-October 2022 Page No. 1488 – 1497
Article History: Received: 06 April 2022, Revised: 28 April 2022, Accepted: 04 May 2022, Publication: 15 May 2022

Impact of Melatonin Spraying on Growth and Yield of Some Sesame Varieties

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Abstract. There is minimal information on the melatonin spraying to different sesame varieties and their effect on growth and yield attributes. The goal of this study was to examine the influence of different doses of melatonin on agronomic parameters and yield of sesame varieties. The experiment was conducted by constructing split plots according to the randomized complete block design (RCBD) and with three replications. four different melatonin concentrations were tested in the main plots, and four different sesame kinds were tested in the sub-plots (Rafidain, Sumer, Wadaa and Had). Plant height, leaf area, capsule number, seed number per capsule, and seed output were all considerably better with 30 mg L^{-1} melatonin than with 20 mg L^{-1} dry weight, according to the results of this study. Rafidain variety exhibited highest plant height while recorded the lowest value of 1000 seed weight. Had cultivar was much superior in leaf area. Wadaa variety achieved the greatest rate dry weight, number of capsules per plant, number of seeds per capsule and seed production. Sumer seeds achieved the maximum value of 1000 seed weight while recorded the lowest rate of plant height, leaf area, dry weight, number of capsules per plant, and number of seeds per capsule.
Keywords: Melatonin; Sesame; Varieties; Leaf area

INTRODUCTION

Sesame crop (Sesamum indicum L.) is one of the oldest crops oil known to man [1,2]. Because of its high content in healthy unsaturated fatty acids, sesame has been cultivated since antiquity with the goal of harvesting seeds with a high oil content of between 50 and 60 percent [3]. In addition to the fact that the seeds have antioxidant compounds, which makes them preserve their natural properties [4,5], the seeds also contain a high percentage of proteins and carbohydrates [6,7]. The sesame crop suffers from several challenges that follow its production and that contribute to the degeneration of its vegetative potentials and reduction of the yield in quantity and quality as a result of inadequate service practice of the crop. In order to reverse the fall in production and bring it up to global standards, numerous scientific and applied studies are needed. High-yielding varieties adapted to the most common environmental circumstances provide the foundation for expanding crop cultivation and boosting its productivity per unit area, and the products of photosynthesis can be converted into an economic yield to increase seed yields. Consequently, future study is desired to develop nutritious and healthy sesame-based foods that have been vital in the country. The method of this plant is utilized, similar other crops which are impacted by many

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aspects including genotype, temperature, light, humidity, sowing date, density, soil fertility and growth stimulants [8].

Growth regulators play an essential function in the field of plant response to environmental change, by spraying the leaves, it easily enters the bio-membranes and the waxy surface [9,10]. Plant research has demonstrated that melatonin has an important part in a wide range of processes, from seed germination to the growth and development of leaves and roots, as well as cell division. Organ development, like as roots and fruiting, is complicated without it. It plays a key role in delaying the aging of leaves and fruits, protects the photosynthetic process, and is a regulator of enzymes involved in the metabolism of carbohydrates, amino acids, lipids, sulfur, phosphorus and nitrogen. There are a number of other plant growth regulators whose production is similarly controlled by gibberellin as well [11,12,13]. In addition to its potential to boost the efficiency of photosynthesis, minimize leaf aging and increase dry matter production, it is dubbed a multi-regulating hormone [14]. The study's goal is to determine the effects of various melatonin concentrations on agronomic metrics and sesame variety yields.

MATERIAL AND METHODS

Sesame yield and agronomic parameters were studied using an RCBD design and three replications during the summer of 2021 at the College of Agriculture University in Anbar's research station in order to determine the effect of melatonin concentrations on the yield and some agronomic parameters of several sesame varieties. four different melatonin concentrations were tested in the main plots, and four different sesame kinds were tested in the sub-plots (Rafidain, Sumer, Wadaa and Had). Preparation of the field for experimentation was followed by the division of the field into homogeneous experimental plots, each measuring 9 m2 and having dimensions of (3x3) m. To avoid suffocation by water, sesame seeds were sown in the upper third of the row on May 20 / 2021 at a rate of three to five seeds per hole. The amount of water that a plant requires, as well as the moisture content of the soil, determine how much water should be applied. During the first two weeks after planting, we thinned by leaving two plants in the hole, then a second thinning operation by leaving one plant in the hole, and we weeded as needed in the meantime. Phosphorus and nitrogen fertilizer were applied to all experimental plots before planting at a rate of 80 kg ha-1 and in two batches, the first two weeks after planting and the second two weeks after flowering. urea, which contains nitrogen at a rate of 46 percent. The first batch was applied two weeks after planting and the second batch at flowering [15].

By dissolving 10, 20, or 30 mg of pure melatonin per 1 L of water, the requisite concentrations may be achieved. To get precise weights, we employed a sensitive scale. After 30 days of seeding, a 15-liter back spray was used to apply the melatonin to the plant. Following maturity indicators, the harvest was carried out on 9/18/2021 with five plants randomly selected from each experimental plot in the middle rows and vegetative growth characteristics measured. For drying and testing the characteristics of the yield, the plants were tied in a packet with the capsules facing outward, labels attached, and then moved to an open area where they could dry.

DATA COLLECTION

1. **Height of plant (cm):** Five plants were randomly chosen from the middle rows of the experimental plots and their height was measured using a measuring tape from the soil surface level to the plant's greatest height.

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2. **Leaf area (cm^2 $plant^{-1}$):** The following equation was used to calculate the leaf area [16].

$$s = 0.3552 \times c$$

where s = leaf area cm^2
c = maximum length of leaf cm

3. **Dry weight:** The total dry weight of the plant was determined when the plants reached 75% blooming. Using a random process, we chose five plants from the middle rows and dried them out in the open air until they were steady weights of one pound.
4. **Capsules per plant:** was determined by averaging the capsules produced by the five plants randomly selected from each experimental plot.
5. **Number of seeds per capsule:** The average number of seeds contained in each capsule was calculated by randomly selecting 50 capsules from each of the five plants and calculating the number of seeds contained in each capsule.
6. **Weight of 1000 seeds:** We took 1000 seeds and weighed them using a sensitive scale.
7. **Seed yield:** A single plant's average yield (average yield of five plants from each experimental plot x plant density) was used to compute the average yield of one plant.

STATISTICAL ANALYSIS

A split plot arrangement with three replications of randomized complete blocks was used to evaluate the data once it had been collected and tabulated. Finally, significant differences between the means were examined using the LSD test, with the significance threshold of 5%. It was utilized in the statistical analysis of Genstat's program [17]. The average values in the tables were used to interpret the results.

RESULTS AND DISCUSSION

Height of plant; As indicated in Table 1, the melatonin 30 mg L^{-1} concentration had the highest rate of 150.69 cm for the plant height characteristic when compared to the other concentrations, while the comparison treatment had the lowest rate. When compared to the other concentrations, the high melatonin concentration exhibited the highest value for the plant height characteristic at 150.69 cm. Melatonin protects and regulates enzymes involved in glucose and amino acid synthesis during photosynthesis; it also regulates gibberellin, auxin, and cytokinin production, which improves the pace of plant height development [11,13]. Melatonin has been demonstrated to increase plant height [18,19].

The results of Table 1 indicated the supremacy of the Rafidain variety in terms of plant height, with a value of 151.06 cm, followed by the Wadaa variety with 146.56 cm, and Sumer with a value of 126.69 cm. The reason for this increase could be due to a genetic difference between the varieties, as well as the variety's response to melatonin spraying, which resulted in the improvement of vital processes and the activation of growth regulators, including auxin, which plays a critical role in increasing the plant's height. These results corroborate those of [20,21,22], who proved that sesame cultivars differ genetically, as evidenced by differences in plant height.

According to the results in Table 1, where the concentration treatment of 30 mg L^{-1} when combined with the Rafidain variety resulted in the highest value for this trait (163.25 cm) and the comparison treatment of melatonin when combined with Sumer resulted in the lowest

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value for this trait 117.92 cm, there were significant interactions between melatonin concentrations and sesame varieties. The fact that the Rafidain type grew taller than the others may be owing to its distinct genetic makeup, which is more sensitive to low melatonin levels and an increase in physiological activity.

Table (1) Effect of varieties and melatonin concentrations and the interaction between them Height of plant of sesame crop

Melatonin Concentrations (mg L^{-1})	Sesame Varieties				Mean
	Rafidain	Sumer	Wadaa	Had	
0	140.83	117.92	136.83	123.17	129.69
10	145.67	122.50	140.75	127.33	134.06
20	154.50	127.67	149.50	133.17	141.21
30	163.25	138.67	159.17	141.67	150.69
Mean	151.06	126.69	146.56	131.33	
L.S.D 0.05	**Varieties**		**Concentrations**		**Interaction**
	0.810		1.327		1.793

Leaf area (cm^2 $plant^{-1}$): Table 2 demonstrates that melatonin concentrations and kinds, as well as their results on leaf area, differ significantly. There was a substantial difference in the melatonin concentrations used in this study compared to the comparison treatment, with the comparison treatment recording the lowest value of this feature at 11147.8 cm2 $plant^{-1}$. Melatonin doses up to 30 mg L^{-1} produced the greatest value for this characteristic at 16405.8 cm2 plant-1, exceeding all other melatonin treatments [23]. These results corroborate those of [19], who discovered an association between increasing melatonin levels and an increase in leaf area.

The results of Table (2) demonstrated that the varieties differed greatly in leaf area, with Had achieving the highest value of 16377.7 cm2 $plant^{-1}$ and Sumer achieving the lowest value of 12402.9 cm^2 $plant^{-1}$. Perhaps the reason for this variation in leaf area between variants is due to genetic variability between species. Additionally, there was variation in the physiological responses of the types to melatonin treatment, which was positively reflected in the increase in leaf area. This conclusion is similar with the findings of [24,25] who established that sesame varieties differed in leaf area.

The connection between melatonin concentrations and diversity is seen in Table 2. The comparison treatment of melatonin with Sumer variety resulted in the lowest value for this trait of 9946.0 cm^2 $plant^{-1}$, whereas the concentration treatment with Had variety resulted in the highest value for this trait of 18874.7 cm^2 $plant^{-1}$. The increase in leaf area is due to the concentration treatment 30 mg L^{-1} superiority in all vegetative development characteristics, which was reflected positively in the rise in leaf area.

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Table (2) Effect of varieties and melatonin concentrations and the interaction between them on the Leaf Area of sesame crop

Melatonin Concentrations (mg L^{-1})	Sesame Varieties				Mean
	Rafidain	Sumer	Wadaa	Had	
0	10819.3	9964.0	11520.0	12288.0	11147.8
10	12310.7	11735.3	13995.0	15557.0	13399.5
20	15138.0	13909.3	17487.0	18791.0	16331.3
30	15226.0	14003.0	17519.3	18874.7	16405.8
Mean	13373.5	12402.9	15130.3	16377.7	
L.S.D 0.05	**Varieties**		**Concentrations**		**Interaction**
	27.26		31.92		53.80

Dry weight: The results of Table (3) indicated that there were significant differences in the dry weight of the plant between the treatments of melatonin concentrations and sesame varieties, as the treatment of 30 mg L^{-1} of melatonin was significantly superior in this trait, followed by the treatment of 20 mg L^{-1}, which did not differ significantly from it, and where the highest rate for trait was 164.57 and 159.45 g, respectively. The increase in dry weight could be due to melatonin's critical role in activating numerous physiological processes in plants and regulating enzymes involved in photosynthesis and respiration, as evidenced by an increase in the rate at which growth-supporting substances such as carbohydrates and proteins are synthesized [11,13].

The results of Table (3) indicated that there were significant differences in the dry weight of sesame kinds. The Wadaa variety achieved the greatest rate of 165.60 gm $plant^{-1}$, followed by the Had variety at 161.48 mg $plant^{-1}$, and Sumer at 133.70 gm $plant^{-1}$. The reason for this increase in dry weight is related to the genetic makeup of each variety and the degree to which it responds to melatonin spraying. These results corroborate [21,25]. Who established the difference in dry weight between sesame cultivars.

Table (3) Effect of varieties and melatonin concentrations and the interaction between them on the dry weight of sesame crop

Melatonin Concentrations (mg L^{-1})	Sesame Varieties				Mean
	Rafidain	Sumer	Wadaa	Had	
0	131.30	119.90	146.45	140.77	134.60
10	137.60	129.21	156.08	148.50	142.85
20	145.76	141.85	173.10	179.10	159.45
30	148.15	143.83	186.76	179.54	164.57
Mean	140.70	133.70	165.60	161.48	
L.S.D 0.05	**Varieties**		**Concentrations**		**Interaction**
	4.534		5.886		9.212

The results of Table (3) revealed significant differences in the interaction between concentration treatments and variety treatments in dry weight, with the Wadaa variety interacting with a concentration of 30 mg L^{-1} 186.76, which did not differ significantly from

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the Had variety interacting with concentrations of 30 and 20 mg. L^{-1} of melatonin recorded 179.54 and 179.10 gm plant^{-1}, respectively, while the interaction between Sumer and the comparison treatment recorded the lowest rate for the trait at 119.90 gm plant^{-1}. This result may be attributed to the fact that the variety Wadaa is genetically more heterogeneous than the other varieties and demonstrated a greater response to melatonin spraying, thus recording the highest rate interaction in dry weight (Figure 2).

Number of capsules per plant: The results of Table (4) indicated a significant effect of melatonin concentrations and sesame cultivars, as well as their interaction, on the number of capsules per plant. Melatonin concentrations (10, 20 and 30) mg L^{-1}, with rates of (148.67, 171.92, and 189.83) capsules plant^{-1}, respectively, increased capsules per plant, but the comparator treatment showed a lower capsules per plant rate of 133.08. A possible explanation for the increase in capsule production is melatonin's beneficial effect on photosynthesis and the increased supply of materials to the reproductive parts (flowers) as a result of its superiority in plant height and leaf area, as shown in tables 1 and 2, and the resulting increase in leaf efficiency in light capture and carbon fixation. These results corroborate [26,23].

As demonstrated in Table 4, the quantity of capsules generated per plant varied significantly among the tested results. It is possible that this increase is due to the genetic differences between varieties, and that the Wadaa variety's response to high melatonin concentrations resulted in an increase in vital and physiological processes, as evidenced by the variety's record of 171.50 capsules plant^{-1}, compared to the variety Sumer's rate of 151.25 capsules plant-1. Numerous studies have demonstrated that the amount of capsules used in sesame produces considerably different results [27,25].

There was a significant association between plant type and melatonin content in the capsules per plant results, as indicated in Table (4), While the Sumer variety and comparison treatment interaction recorded the lowest value for the characteristic at 116.67 capsule plant $^{-1}$, this could be related to the genetic makeup of the Wadaa variety and the amount to which it responded to spraying with 30 mg L^{-1} melatonin. This could be because when the Wadaa variety interacted significantly with the concentration treatment, its greatest trait value was 204.00 capsule plant $^{-1}$.

Table (4) Effect of varieties and melatonin concentrations and the interaction between them on the number of capsules per plant of sesame crop

Melatonin Concentrations (mg L^{-1})	Sesame Varieties				Mean
	Rafidain	Sumer	Wadaa	Had	
0	134.67	116.67	144.33	136.67	133.08
10	145.67	145.00	153.33	150.67	148.67
20	160.33	165.67	184.33	177.33	171.92
30	180.67	177.67	204.00	197.00	189.83
Mean	155.33	151.25	171.50	165.42	
L.S.D 0.05	**Varieties**		**Concentrations**		**Interaction**
	2.939		2.636		5.499

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Number of seeds per capsule: The results of Table (5) indicated an increase in the number of seeds per capsule in correlation with an increase in melatonin concentrations. The 30 mg L^{-1} melatonin concentration treatment significantly increased the number of seeds per capsule compared to the other concentrations, recording the highest rate of 72.75 seed $capsule^{-1}$, while the comparison treatment of melatonin recorded the lowest rate of the trait at 64.17 seed capsule-1. This increase could be attributed to melatonin's critical role in activating various physiological processes, including photosynthesis [23,28].

According to Table (5), the amount of seeds included in each capsule varied greatly according to the type of sesame used. The Wadaa variety plants achieved the highest rate for trait, 71.67 seeds $capsule^{-1}$, while Sumer plants achieved the lowest rate, 65.08 seeds $capsule^{-1}$. The reason for this increase may be attributed to the Wadaa variety's genetic structure, its response to melatonin spraying, and its adaptability to environmental conditions, or it may be due to this variety's superiority in the dry weight characteristic [21,25].

The results of Table (5) indicated that there was no significant interaction between sesame types and melatonin concentrations in terms of seeds per capsule.

Table (5) Effect of varieties and melatonin concentrations and the interaction between them on the number of seeds per capsule of sesame crop

Melatonin Concentrations (mg L^{-1})	Sesame Varieties				Mean
	Rafidain	Sumer	Wadaa	Had	
0	62.67	61.00	67.33	65.67	64.17
10	65.33	64.33	70.67	69.67	67.50
20	68.33	65.67	72.33	73.33	69.92
30	70.67	69.33	76.33	74.67	72.75
Mean	66.75	65.08	71.67	70.83	
L.S.D 0.05	**Varieties**		**Concentrations**		**Interaction**
	0.681		0.981		N.S

Weight of 1000 seeds: When 1000 seeds were weighed, the concentration treatments of 30 and 20 mg L^{-1} melatonin produced the highest weight results (3.779 and 3.696 g, respectively), while the comparison treatment gave the lowest value for the trait It reached 3.213 g, Table 6. and this increase can be attributed to melatonin's critical and significant role in activating vital and physiological processes within the plant, including photosynthesis and the transmission of the products of these processes from the source to the sink, which are the seeds, resulting in their fullness and weight increase. These results corroborate those of [29].

The results of Table (6) indicated that sesame cultivars varied significantly in 1000 seed weight. Sumer seeds had the highest value of 3.596 g, followed by Had, which was not significantly different at 3.583 g, and Rafidain seeds had the lowest value of 3.371 g, and the reason for this difference could be attributed to genetic variation between varieties, their response to melatonin spraying, and the difference in environmental conditions, or the reason for this increase could be due to the fact that the Some seeds are more mature. These results corroborate [30,21].

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There was a strong correlation between melatonin concentrations and sesame variety, as shown in Table (6). The highest value for this trait, 3.933 g, was obtained from the interaction between Had variety and 30 mg L^{-1}, whereas the interaction between Had variety and 20 mg L^{-1}, which produced a value of 3.867 g, was not significantly different in this trait, and the interaction between comparison treatment and Rafidain produced the lowest value for this trait amounted to 3.083 g. There are several possible explanations for this weight gain, including the variety's genetic makeup, its response to melatonin spraying, and the variety's superiority in Leaf Area Table (2), all of which could be related to an increase in photosynthesis products and their subsequent transformation into the sink, which are the seeds.

Table (6) Effect of varieties and melatonin concentrations and the interaction between them on Weight of 1000 seeds of sesame crop

Melatonin Concentrations (mg L^{-1})	Sesame Varieties				Mean
	Rafidain	Sumer	Wadaa	Had	
0	3.083	3.383	3.167	3.217	3.213
10	3.333	3.467	3.433	3.317	3.388
20	3.467	3.733	3.717	3.867	3.696
30	3.600	3.800	3.783	3.933	3.779
Mean	3.371	3.596	3.525	3.583	
L.S.D 0.05	**Varieties**		**Concentrations**		**Interaction**
	0.0638		0.0406		0.1148

Seed yield: The results of Table (7) indicated that seed yield increased significantly with increasing melatonin spray concentrations, with the highest rates for characteristic amounted to (1814.2, 2378.5, and 2795.8) kg ha^{-1} for the concentration treatments of 10, 20, and 30 mg L^{-1}, respectively, while the comparison treatment recorded the lowest rate for characteristic amounted to 1462.0 kg ha^{-1}, and this increase in seed yield could be explained by the vital anthocyanin's. These results corroborate [26].

Table (7) revealed that the types varied greatly in results of seed production. The Wadaa variety was significantly superior in this trait, as it produced the highest rate of 2352.1 kg ha^{-1}, while the Rafidain variety produced the lowest rate of 1894.5 kg ha^{-1}, which was not significantly different from the Sumer variety, which produced 1925.15 kg ha^{-1}. This may be due to the genetic nature of the Wadaa variety and its superiority in the capsules per plant and seed per capsule characteristics (Tables 4.5), respectively. These findings corroborate the findings [22,25].

The table (7) illustrates the significant variation in the results of the interaction between sesame kinds and melatonin concentrations. Seed yield was highest when the Wadaa variety was treated with 30 mg L^{-1} melatonin, followed by the Had variety, which was not significantly different from the Wadaa variety and produced 3093.7 kg ha^{-1} seeds, and the Sumer variety, which was treated with the comparison treatment, produced 1314.7 kg L^{-1} seeds, the lowest average for trait.

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Table (7) Effect of varieties and melatonin concentrations and the interaction between them on seed yield of sesame crop

Melatonin Concentrations (mg L^{-1})	Sesame Varieties				Mean
	Rafidain	Sumer	Wadaa	Had	
0	1409.0	1314.7	1640.7	1483.7	1462.0
10	1692.7	1724.3	1983.7	1856.3	1814.2
20	2025.7	2165.3	2641.7	2681.3	2378.5
30	2450.7	2496.3	3142.3	3093.7	2795.8
Mean	1894.5	1925.15	2352.1	2278.75	
L.S.D 0.05	**Varieties**		**Concentrations**		**Interaction**
	54.81		62.71		107.58

CONCLUSIONS

In the current study, it revealed that there was major effect with increase spraying of melatonin notably the high concentration in growth and yield parameter compared with control treatment. We can deduce that melatonin spraying serves a variety of critical functions in a variety of plant treatments. Therefore, Wadaa variety was much superior in seed yield while Sumer seeds attained the maximum value 1000 seed weight.

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