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Enhancing Growth and Yield of Sesame Plant (*sesamum indicum* L.) by the Amendment of Benzyladenine, Yeast Extract and Mixed Amino Acids.

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Abstract

The aim of this research is to study the effects of foliar application of some growth stimulants, such as benzyladenine (BA), yeast extract (YE) and a mixed amino acids (MAA) on growth, Endogenous phytohormones, chemical content of leaves, yield characteristics, and chemical content of seeds, as well as seed yield, and oil yield of sesame plant (*Sesamum indicum* L. var. Sandawel 3) plants.

The received results were explained that the foliar application of growth stimulants as BA (25 and 50 mg L^{-1}), YE (50 and 100 ml L^{-1}) and MAA (4 and 6 ml L^{-1}) significant increased in all growth parameters (i.e., stem length (cm), leaf area(cm^2)/plant, fresh & dry weights (g) of stems and leaves, No. of flowers/plant, No. of capsules/plant, fruiting zone length (cm)/plant and seed yield (g)/pot).

Additionally chemical composition represented in photosynthetic pigments, minerals, crude protein contents, total sugars and carbohydrate and total free amino acids in sesame leaves and seeds were also increased by all studies treatments compared with the control, the highest value were MAA at 4 ml L^{-1} followed by YE at 100 ml L^{-1} in the two seasons. This increased improved seeds yield and it's components along with oil percentage and seed oil yield /plant.

Key words: Sesame (*Sesamum indicum*, L.), benzyladenine (BA), yeast extract (YE), mixed amino acids (MAA).

Introduction

Sesame (*Sesamum indicum* L.) is considered an important oil crop that is grown mainly to obtain its seeds, which are used in the production of some foodstuffs. Its seeds are rich in protein (15-25%), percentage of crude fibers, mineral substances especially (iron, calcium, phosphorus, zinc, and magnesium), oxalic acid, vitamin B-complex, amino acids and antioxidants **Hussain *et al.*, (2023).**

Sesame (*Sesamum indicum* L.) is an important oil seed crop mainly cultivated in the tropics. It contains a high percentage of oil, reaching 55-60%. The oil contains unsaturated fatty acids, particularly linoleic acid (37 - 47%), oleic acid (35 - 43%), palmitic acid (9 - 11%), and stearic acid (5 -10%) **Jahan *et al.*, (2019).**

According to the United Nations Food and Agriculture Organization **(FAO, 2020)** for the sesame crop in Egypt for the year 2020; Area harvested 29000 fed. , Yield 13103 tons, Production 38000 tons. **(FAO statistics 2020).**

Egypt imports large amounts of oil to face the great needs of the local oil production is a target to reduce the increasing gap between production and consumption of oil crops in Egypt. This could be achieved by increasing the cultivated areas of sesame and oil crops should be done outside the Nile Valley due to the competition of other main crops, and its productivity by application of some growth stimulants to improve growth and development, flowering, fruit set, seed formation and yield of sesame seed oil **Abd El-Dayem *et al.*,(2012)**.

In recent years a great deal of attention has been focused upon the application of certain bio regulators in order to improve productivity the yield of many crop plants. Positive response could be achieved depending on the plant species, the type and applied concentration of bio-regulators employed. Bio-regulators (plant growth regulators) such as benzyladenine (traditional plant growth regulator), putrescine and salicylic acid (non-traditional or new plant growth regulators) are among the growth regulators which in small amount induce a great changes the various morphological and physiological processes, increase yields and improve quality of plant products, as well as, they can increase number of buds, branches, flowers, pod/plant, seed index and yields with one application, alter growth patterns, nutritional components, chlorophyll contents and resistance to different kinds of stress (cold, heat, drought, insects and disease) when applied at exteremely low levels **Abd El-Dayem *et al.*,(2012)**.

Benzyladenine is one of the most important growth regulators, which belongs to the group of cytokinins. It stimulates cell division and dilation and causes the stimulation of cell dilation laterally, and plays a role in delaying leaf aging and stimulating the transport of nutrients in addition to its effects in activating the synthesis of mRNA and protein in cells and in this field clarified **Al-Hamdani and Al-Jubouri (2014) and Hamza and Al-Taey (2020)**.

Amino acids and small peptide-based bio stimulants have received increased attention for their positive effects on plant performance **(Colla *et al.*, 2017).** As a result, amino acids are emerging in many foliarly applied products superintendents and sports turf managers with claims of enhanced growth, greening, and increased resistance to stress. Using 15N-labeled glycine, L-glutamate, and L-proline, it was previously demonstrated that the nitrogen from these applied amino acids was absorbed into creeping bentgrass (Agrostis stolonifera L.) foliage to similar degrees as other nitrogen. **(McCoy *et al.*, 2020).**

Yeast contains significant levels of protein, carbohydrates, reducing sugars, amino acids, enzymes, mineral elements (N, P, K, Mg, Ca, Na, Mn, Zn, Cu, B, and Mo), and a natural source of many growth substances (thiamine, riboflavin, niacin, pyridoxine, and vitamins B1, B2, B3, and B12) **(Abdelaal *et al.*, 2017).** Yeast extract acts as a natural biological stimulant that improves the growth and yield of different crops **(Mahmoud *et al.*, 2016).** The effective influence of yeast may be attributed to its effect on enzymatic activity.

Yeast extract has a beneficial role during the vegetative growth and productivity stages through improving flower formation in some plants due to its high auxin and cytokinin contents. It also enhances carbohydrate accumulation **(Zewail *et al.*, 2019).**

Yeast extract improved the vegetative growth, chemical constituents of plant foliage, enzyme activity, phytohormones content, fruit yield productivity, and fruit quality of sweet pepper plant cv Zidenka grown under greenhouse conditions by using a foliar spray yeast extract **(Mohamed *et al.*, 2021).**

The aim of this study is to increase the growth, performing productivity and quality of sesame seeds per unit cultivated area by using some growth stimulants.

Material and methods

Two pot experiments were conducted at the experimental station of Agricultural Botany Department Faculty of Agriculture Moshtohor, Benha University during two growing successive 2022 and 2023 seasons to study the effect of foliar application with benzyladenine (BA) at 25 and 50 mg L^{-1}, yeast extract (YE) at 50 and 100 ml L^{-1} and Mixed amino acids (MAA) at 4 and 6 ml L^{-1} comparing with the control plant (sprayed with tap water) on the growth, morphological, physiological, anatomical, flowering and yield characteristics as well as seed quality, seed yield, oil content and chemical compositions of sesame (*Sesamum indicum* L. var. Shandawel 3) plant.

This investigation was carried out on sesame plants (*Sesamum indicum* L. var. Shandawel 3). Seeds of sesame plant were obtained from Agricultural Research Center, Giza, Egypt.

3.1. Plant material and procedure:

(*Sesamum indicum* L. var. Shandawel 3) were sown on 19th April 2022 and 2023 in the two successive seasons, in The Experimental Station of Agricultural Botany Department Faculty of Agriculture Moshtohor, Benha University. The used of plastic pots were 40 cm in diameter and filled with 8 kg of soil from mixture of clay and sand 2:1 w/w. Phosphorus fertilizers in the form of super phosphate (1.4 g) was added to each pot, ten seeds were sown in each pot. Then, pots irrigation was carried out according the usual practice by adding equal amounts of tap water after for each pot. After seedling emergence, three weeks after sowing, plant were thinned to four uniformed seedlings/pot. The plants were exposed to natural illumination. After thinning, plants were fertilized as recommended for this plant with 5gm ammonium nitrate (as two dose, first after thinning (2.5g) and the second at the beginning of flowering stage (2.5g).The pots were arranged in a complete randomized design was with 10 replicates Block (RCBD).

The experiment randomized complete block design (RCBD) with three replicates. This experiment included 6 treatments in addition to the control (tap water) all pots practices of growing *Sesamum indicum* L. plants including fertilization irrigation, manual weed control and soon were carried out as usual according to crop requirement recommended.

3.2. The experiment treatments were as follows:

This experiment included seven treatments as follows:

1. Control (tap water).
2. Benzyladenine (BA) at 25 and 50 mg L^{-1}.
3. Yeast extract at 50 and 100 ml L^{-1}.
4. Mixed amino acids at 4 and 6 ml L^{-1}.

3.3. Treatments source and preparing:

1-Benzyladenine (BA) was exported from TITAN Bio Tech Laboratory Chemicals INDIA, Authorized distributor in Egypt: Future Modern Lab 13, Elpetrol St, In front of El Marg El Gedida Station 7 th floor.

2-Yeast extracts were prepared according to **(Abd EI-Rahim *et al.*, 1988).**

3- Mixed amino acids was exported from El Nagmateen Company, 38 St., Gamal Salem, Dokky, Giza, Egypt (combination via grow Amino Tonic Liquid), chemical composition 25% amino acids and 10 % nitrogen.

Through plant growth and development, the growth substances treatments were applying as foliar spray three times started at 30 days after planting, then the spraying is repeated at an interval of 20 days for second and third one, respectively. The plants were sprayed with a hand pump. A surfactant (Tween 20) at a concentration of 0.01% was added to all tested solutions the control. The foliar spraying solution were added to the point of runoff.

3.4. Sampling and collecting data: -

3.4.1. Morphological measurements: -

Different morphological characteristics of sesame (*Sesamum indicum* L. var. Shandawel 3) plants at 82 days after sowing (DAS) were measured (flowering and fruiting stage) during 2022 and 2023 seasons.

Three plants from each replicate were randomly taken and then separated into their organs and the following characteristics were recorded:

- (Stem plant height cm/plant, No. of leaves/plant, total leaves area cm^2/plant by using disk methods according to **(Brouwer *et al.,* 1973)**, fresh and dry weight of stems g/plant, fresh and dry weight of leaves g/plant, No. of flowers/plant and No. of capsules/plant).

The samples of the above ground i.e., vegetative parts were dried in the oven-dried for 48 h in 70°C to a constant weight and then the dry weight/plant was calculated. These dry samples of stems and leaves were kept for chemical analysis.

3.4.2. Photosynthetic pigments determination:

The photosynthetic pigments (chlorophyll a., b. and carotenoids) were extracted from fresh leaf sample (in the 4^{th} apical leaves) at 82 days after sowing (DAS) by pure acetone according to Fadeel's method **(Fadeel 1962).**

3.4.3. Endogenous phytohormones determination: -

Endogenous phytohormones were quantitatively determined in *sesamum indicum* L. shoot at 82 DAS during 2022 season, only in the best treatments (i.e., BA at 25 mg L^{-1}, YE at 100 ml L^{-1} and MAA at 4 ml L^{-1}) compared with the control. According to the method of **Koshioka *et al.,* (1983)** used for HPLC (High- Performance Liquid Chromatography) for the determination of auxin (IAA), gibberellic acid (GA_3) and abscisic acid (ABA). Meanwhile, cytokinins were determined by HPLC according to **Nicander *et al.,* (1993)**

3.4.4. Flowering stage zone measurements: -

At flowering stage, flowers numbers, flower setting percentage, flower abscission percentage, capsules number/ plants were recorded and calculated.

a) Total number of flowers / plant.

b) Abscission percentage: was calculated .

4. Yield and its component:

At harvest time (120 DAS in 2022 and 2023 seasons) three randomly plants from each replicate were taken for estimating the following characteristics:

- No. of capsules/plant, No. of seeds/capsules, weight of intact capsules g/plant, weight of empty capsules g/plant, total seed weight g/plant, weight of 1000 seeds g, seed yield g/pot, seed oil % yield/plant.

5. Chemical composition: -

Chemical analysis was carried out on the samples of dry shoot and seeds during two seasons (2022 and 2023)**.**

5.1. Determination of certain nutrient elements: -

Determination of N, P and K concentrations were carried out. The wet digestion of 0.2 g plant material with sulphoric and per-chloric acids was carried out on leaves and dry seeds according to **Piper, (1947)** during 2022 and 2023 seasons.

1. Total nitrogen and crude protein: -

Total nitrogen was determined in the dry matter using microkjeldahil method as described by **Horneck and Miller (1998)**, then calculated as percentage % of dry weight. Then, the crude protein was calculated according to the equation of **A.O.A.C. (2005)**.

Crude protein = Total nitrogen x 5.30

2. Phosphorus: -

It was determined calorimetrically according to the method of **Sandell (1950)** and calculated as mg g^{-1} dry weight.

3. Potassium: -

It was determined by the flame photometer model Carl-Zeiss according to the method described by **Hornbeck (1987)** and calculated as percentage % of dry weight.

5.2. Total carbohydrates content: -

Total carbohydrates were determined in the dry shoot at 82 DAS and in seeds at harvest time (120 DAS) in the second growing season by using phenol-sulphoric acid method according to **Dubois *et al.,* (1956)** and calculated as mg g^{-1} dry weight.

5.3. Determination of total sugars content:

The total sugars expressed as glucose were determined calorimetrically according to the method of **Dubois *et al., (*1956)**

5.4. Total free amino acids:

Total free amino acid was determined in the ethanolic extract with nunhydrine, buffer, solvent and boiling time calorimetrically according to **Muting and Kaiser (1963).**

5.5. Statistical analysis:

Data of morphological, flowering and yield characteristics were statistically analyzed and the means were compared using the Least Significant Difference test (L.S.D) at 5% according to **Duncan (1980)** and **Snedecor and Cochran (1989).**

Results and Discussion

The following results distinctly display the effects of foliar spraying of some growth stimulants such as benzyladenine (BA), yeast extract (YE) and mixed amino acids (MAA) on sesame plants for increasing the growth, productivity and quality of sesame seeds per unit cultivated area by using some growth stimulants.

1. Effect of applied treatments on vegetative growth characteristics: -

Data in **Table (1)** presented that each of stem height (cm), stems fresh and dry weight (g) /plant were gradually increased to reach the 5% level of significance with different applied treatments during 2022 and 2023 seasons compared with the control.

In connection with the stem height (cm), stem fresh and dry weight (g) /plant significant increase existed with all applied treatments during 2022 and 2023 seasons compared with the control treatment. The most surpassing treatments were mixed amino acids at 4 ml L^{-1} followed by yeast extract at 100 ml L^{-1} compared with control treatment, during both seasons.

With respect to the No. of leaves/plant, leaves fresh and dry weight (g)/plant and total leaf area (cm^2)/plant were significantly increased existed with all applied treatments during 2022 and 2023 seasons compared with the control treatment. The most superior treatments were mixed amino acids at 4 ml L^{-1} followed by yeast extract at 100 ml L^{-1} compared with the control, respectively.

In this regard, the results obtained clearly showed the effect of the different treatments used to improve the vegetative growth characteristics of sesame plants during 2022 and 2023 seasons. These results are of great importance, because at this early stage of growth there were significant simulation effects with the different applied treatments. This can extend to advanced growth stages including both the flowering stage and the final crop and its components.

In weaning growth measurements including plant height could be attributed to benzyl adenine effectiveness showed the increase in cell division and elongation; it also effect on the activation of RNA, thus increasing the vital reactions in the cell. It also affects the activation of enzymes necessary for vital reactions, and increases the building of chlorophyll and proteins, thus delaying the aging of leaves and increasing the transfer of nutrients to active tissues and their representation. **(Al-Waeli- Fatimah and Al-Khyyat 2023).**

Cytokinins allow the optimal growth and development of plants by promoting cell division and tissue growth and delaying leaf senescence **(Davies, 2010).** Furthermore, 6-BA is in a class of synthetic cytokinin PGRs that can significantly increase levels of endogenous cytokinins in crop plants **(Prerostova *et al.*, 2020).**

The impact of yeast extract on plant growth is due to some important chemical characters of yeast extract analysis (a natural source of phytohormones, especially gibberellins, auxins and cytokinins, amino acids (i.e., lysine, tryptophan, etc.), a source of nutrients for plants because it contains many macro elements, micronutrient and vitamins (i.e., B1, B2, B6, and B12)) **Mahmoud (2001); Abou El Yazied and Mady (2011) and Adam *et al.*, (2022).**

The profound effects of applied foliar application of mixed amino acid on increased plant growth may be because parameters providing readily source of growing substances which form the constitutes of protein in the living tissues. In general, Amino acids were found to increase No. of flowers, fruit setting and fruit yield **(Neeraja *et al.*, 2005).** In addition, Amino acids can affect the content of other compounds in plants **(Amin *et al.*, 2012).**

In contrast, it was reported that amino acids increased the transcription of genes involved in the transport of nitrates, ammonium, phosphates, magnesium, and iron **(Santi *et al.*, 2017).**

2. Effect of applied treatments on chemical compositions of leaves:

2.1 Photosynthetic pigments:

Data in **Table (2)** records the effect of different applied treatments (i.e., benzyladenine at 25 and 50 mg L^{-1}, yeast extract at 50 and 100 ml L^{-1}, as well as mixed amino acids at 4 and 6 ml L^{-1}) on photosynthetic pigments (i.e., chlorophyll a & b, Chl. (a + b) and Carotenoids) estimated in sesame plants at 82 DAS compared with those of the untreated plants in both seasons of this study. All treatments significantly enhanced all photosynthetic pigments content compared with the control treatment during both seasons.

Chlorophyll a and b were increased with different applied treatments compared with the control at 82 DAS during 2022 and 2023 seasons in **Table (2)**. The highest value of these traits was with BA at 50 mg L^{-1} (1.58 & 1.36 mg g^{-1} F.W.) and (0.48 & 0.49 mg g^{-1} F.W.) followed by MAA at 4 ml L^{-1} (1.57 &1.17mg g^{-1} F.W.) and (0.36 & 0.40 mg g^{-1} F.W.) at 82 DAS during 2022 and 2023 seasons respectively. Meanwhile, control treatment gave (1.04 & 0.89 mg g^{-1} F.W.) and (0.15 & 0.20 mg g^{-1} F.W.) at 82 DAS during 2022 and 2023 seasons respectively.

Carotenoids were promoted with different applied treatments compared with control at 82 DAS during 2022 and 2023 seasons in **Table (2)**. The highest value of these characteristics with MAA at 4 ml L^{-1} (0.75 and 0.65 mg g^{-1} F.W.) followed by MAA at 6 ml L^{-1} (0.72 and 0.63 mg g^{-1} F.W.) at 82 DAS during 2022 and 2023 seasons respectively. Meanwhile, control treatment gave (0.53 and 0.44 mg g^{-1} F.W.) at 82 DAS during 2022 and 2023 seasons, respectively. Also, it could be noticed that maximum significantly increasing of all these pigments was existed with MAA at 4 ml L^{-1}, straight.

In this respect, the stimulation of photosynthetic pigments formation could be attributed to the vigorous growth obtained in **Tables (1).** These results are of great importance, because they are lightly considered direct for more dry matter production and distribution in shoots of sesame plants as affected by different applied treatments.

These results are in agreement with those reported by **Bondok (1996)** on sugar beet plants and **Abd El-Dayem (1999)** on fodder beet plants; However, similar promoting effect of BA on photosynthetic pigments content in different plants was reported by **Abd El-Dayem *et al.*, (2012)** and **Ismail and Halmy (2018).**

In addition to, **Zewail *et al.*, (2019)** indicated that foliar application of benzyladenin and yeast extract increased photosynthetic pigments content (chlorophyll a, b, carotenoids and total chlorophylls) in soybean leaves.

Yeast extract activity as a bio-growth regulator may be responsible for the enhancement of photosynthetic pigments **Mahmoud (2001); Abou El Yazied and Mady (2011) and Adam *et al.*, (2022)**, because its influences on the balance among photosynthesis in plants **(Olaiya 2010)**. Furthermore, using yeast extract can improve chlorophyll a and b concentrations due to its rich contents from many essential vitamins, elements and amino acids, which **(Abdelaal *et al.*, 2019)**. Simultaneously, yeast extract works on CO_2 release, which is positively reflected on the increase of the total production of photosynthesis **(Khalil and Ismael 2010).**

Obviously; the increase in leaf photosynsitic pigments, due to application of amino acids, has been reported in other studies **(Fahimi *et al.*, 2016; Mohammadipour and Souri 2019)**. The maximum chlorophyll content of leaves may be due to the effect of amino acids on chlorophyll biosynthesis and decrease in chlorophyll degradation, as well **(Souri *et al.*, 2017)**. Amino acids can probably act against oxidation, peroxidation and degradation of cell components, particularly chlorophylls, and therefore they increase the life span of cells. The bio-protection effect of amino acids has been based on several studies **(Khan *et al.*, 2012; Souri and Hatamian 2019)**.

2.2 Chemical constituents of leaves on sesame plant:

2.2.1. Minerals concentration of sesame leaves:

Data in **Tables (3)** illustrate that all spray foliar treatments were effectively increased N, P and K concentrations of treated plants compared with those of the untreated plant during 2022 and 2023 seasons. In this respect the most effective treatments were MAA at 4 ml L^{-1} followed by MAA at 6 ml L^{-1}.

The simulative effect of these treatments may be due to the higher mineral metabolic requirements to face the higher obtained vigorous growth and yield potentialities there by more minerals uptake and translocation **Hafez *et al.*, (2021).**

2.2.2. Crude Protein content of leaves in sesame plants:

Furthermore, crude protein concentration, data in **Table (3)** recorded that different applied treatments were effectively increased crude protein concentration during 2022 and 2023 seasons compared with control treatment. The most effective treatments were MAA at 4 ml L^{-1} followed by MAA at 6 ml L^{-1}.

2.2.3. Total carbohydrates of leaves in sesame plants:

In the same data in **Table (4)** indicates that all applied treatments increased total carbohydrates content in sesame leaves during 2023 season compared with control. In addition the most effective treatments for increasing total carbohydrates, was recorded with YE at 100 ml L^{-1} followed by YE at 50 ml L^{-1} compared with the control, consecutively.

In this regard, increase total carbohydrates with different applied treatments considered as a direct result of increasing both photosynthesis rate and efficiency. Also, this is preceded with large photosynthetic area and high concentration of photosynthetic pigments **Hammad and Ali (2014).**

2.2.4. Total soluble sugars of leaves in sesame plants:

As data in **Table (4)** clearly records that total soluble sugars in sesame leaves were highly increased with different applied treatments at 82 DAS during 2023 season compared with those of control. Also, the highest value of these traits was with YE at 100 ml L^{-1}; followed by YE at 50 ml $^{-1}$L compared with the control.

Increment of total soluble sugars in leaves on sesame plants with different applied treatments considered a direct result of the obtained vigorous growth that being accompanied with high photosynthesis efficiency. Thereby, could be give high yield with high quality **(Ewais *et al.*, (2013); Eid-Rania (2020) and Živanović *et al.*, (2020)).**

2.2.5. Total free Amino acids of leaves in sesame plants:

Concerning data in **Table (4)** distinctly shows that total free amino acids in sesame leaves were highly increased with different applied treatments at 82 DAS during 2023 season compared with those of control. Like that, the most effective treatments were MAA at 4 ml L^{-1} followed by MAA at 6 ml L^{-1} compared with the control, sequentially.

However, the increase in protein and total free amino acids in leaves was accompanied by increase in total N **(Table, 3)** parallel to growth rate, stimulation of amino acids into protein and translocation of sugars and free amino acids to young leaves.

These increases in total sugars, total carbohydrate and crude protein content in leaves of sesame plants in response to benzyladenine, yeast extract and mixed amino acids application were supported by stimulation of total leaves area **(Table, 1)** and photosynthetic pigments **(Table, 2)** and accumulation of leaves dry weight **(Table, 1).** In addition, the increment in minerals content (N, P and K) of sesame plants leaves may be attribute to increasing in absorption with different applied treatments.

In this respect, the notability of some applied treatments in increasing the percentage of determined N, P, K, total soluble sugars and total carbohydrate as well as crude protein percentage may be due to its effects on root absorption to macro elements and carbohydrates assimilation during photosynthesis and accumulation in plant. **(Ewais *et al.*, 2013; Zewail 2014 and Eid-Rania 2020).**

Foliar application with benzyladenine significantly increased lupine plant chemical composition **(Mahmoud *et al.*, 2016).** These results of benzyladenine are in conformity with those obtained by **(Zewail *et al.*, 2019)** on soybean plants. Like this increase in the bio constituent's content with benzyladenine application may be attributed to the role of benzyladenine in the promotion effects on chlorophyll biosynthesis and/or inhibition of chlorophyll degradation also retard the senescence of leaves **(Duszka *et al.*, 2009).**

Many investigators found that growth stimulants benzyladenine not only promote photosynthetic activity, but also increased RNA and protein synthesis by **Abo El-Saoud (2005); Papadakis and Roubelakis-Angelakis (2005); Ibraheem (2007).**

On the other hand, application of yeast extract resulted an increase in nitrogen, potassium and calcium contents of faba bean leaves reported by **Abdel-Gawad and Youssef (2019) and Eid-Rania (2020).**

Conserves, the effect of yeast extract application on protein was previously studied in other lupine plant species by **Mahmoud *et al.*, (2016)** and on sugar beet plants by **Eid-Rania (2020).**

Foliar application with amino acids increased total soluble sugars content compared with control treatment this reported by **Sadak- Mervat *et al.*, (2015) and Rashid and Al-Atrushy (2023).** Foliar application of amino acids significantly increase the concentration of amino acids in plant this in agreement with **Amin *et al.*, (2011) and Teixeira *et al.*, (2017).** Foliar applications of amino acids led to a significant increase in N,P, K, concentrations comparing with the control this is in harmony with (**Abo Sedera *et al.*, (2014); Zewail (2014); Mohammadipour and Souri (2019); Noroozlo *et al.*, (2019); Salim *et al.*, (2021) and Hussain *et al.*, (2022)).**

2.3. Endogenous phytohormones:

Data in **Table (5)** recorded change in endogenous phytohormones, as gibberellins , auxins , cytokinins and abscisic acid of sesame plant treated with (i.e., benzyladenine at 25 and 50 mg L^{-1} , yeast extract at 50 and 100 ml L^{-1}, as well as mixed amino acids at 4 and 6 ml L^{-1}). The most effective treatments, which greatly improved the morphological, metabolical performances of sesame plant as obvious from the previously mentioned and discussed results obtained in the present study) at 82 DAS during 2022 season.

Regarding to gibberellins, different applied treatments were significantly increased gibberellins concentration in sesame plant leaves at 82 DAS during 2022 season. In this respect, yeast extract at 100 ml L^{-1} gave the highest value followed by mixed amino acids at 4 ml L^{-1}, when compared with control during 2022 season.

For auxin level, it was highly increased in sesame leaves with different assigned treatments compared with that of untreated plant. Yeast extract at 100 ml L^{-1} was the most effective value followed mixed amino acids at 4 ml L^{-1} during 2022 season, respectively compared with control.

Concerning cytokinins, different applied foliar treatments increased cytokinins concentration in leaves of sesame plant compared with control treatment. Also, benzyladenine at 25 mg L^{-1} gave the highest value followed by yeast extract at 100 ml L^{-1} during 2022 season, respectively compared with control.

Generally, total phytohormones those promote growth aspects i.e., growth promoters (gibberellins, auxins and cytokinins) were increased with different applied foliar treatments during 2022 season, when compared with control treatment. Here, yeast extract at 50 ml L^{-1} gave the highest value of total promoters followed by mixed amino acids at 4 ml L^{-1} of sesame leaves during 2022 season, when compared with control. Also, increment of endogenous hormones in sesame plant obtained in the present study could be interpret both of the obtained improvement of growth **(Table, 1)** and photosynthetic pigments content **(Table, 2)** as well as yield characteristics **(Table, 7)** and may be stimulate cell division and enlargement as well as No. of flower and set %. For example, increasing endogenously cytokinins could be in favor of increasing No. of formed branches and that could also increase growth on the longitudinal one as well as increasing of sink organs (i.e., seeds) ability to accumulate and storage more assimilates **(Souri and Hatamian 2019; El-Anany 2020 and Mohamed *et al.*, 2021).**

With regard to, the growth inhibitor, (abscisic acid) its level was recorded with various assigned treatments during 2022 season compared with control, this reduction was more obvious with yeast extract at 50 ml L^{-1} followed by benzyladenine at 25 mg L^{-1} of sesame leaves during 2022 season, compared with control.

In this respect, these results being of great interest for interpreting each of the obtained vigorous growth and improving yield of sesame plant attained in the present study.

This increase in the endogenous growth promoters and decreases in growth inhibitor substances in response to applied treatments may be attributed to their effect on enhancing the biosynthesis of growth promoters and decreasing the biosynthesis and action of growth inhibitors (abscisic acid).

These results are in agreement with those reported by **(Mahmoud *et al.*, 2016; Zewail *et al.*, 2019; El-Anany 2020; Mohamed *et al.*, 2021 and Khater *et al.*, 2023)** for yeast extract; (**Amin *et al.*, 2011 ; Abd El-Aal and Eid-Rania 2018 and Souri and Hatamian 2019)** for mixed amino acid; **(Haroun *et al.*, 2011; Mahmoud *et al.*, 2016; Zewail *et al.*, 2019; El-Anany 2020 and Hussein-Suzan and Al-Doori 2021)** for benzyladenine.

3. **Effect of applied treatments on flowering Characteristics of sesame plants at flowering stage during 2022 and 2023 seasons**:

Data in **Table (6)** appeared that all applied spray treatments were significantly increased No. of flowers/plant, No. of capsules/plant and flower setting percentage during flowering stage when compared with the control during 2022 and 2023 seasons. Also, it could be noticed that maximum increase of No. of flowers/plant, No. of capsules/plant, flower setting percentage during this stage was existed in case of MAA at 4 m L^{-1} followed by YE at 100 m L^{-1} treatments during the two growing seasons when compared with the control. Meanwhile, flowers abscission percentage was decreased with all applied treatments during the two seasons compared with control.

Increasing of flower measurements during flowering stage specially No. of flowers plant, flowers setting percentage and reducing of flowers abscission are considered a good indicators for role of different applied treatments for increasing yield and yield measurements **(Table 7).** The stimulating effect of BA, YE and MAA on No. of flowers/plant, No. of capsules/plant, flower setting percentage may be due to the critical role of growth stimulants in enhance various processes of reproductive growth such as: a) Increasing flowers bud formation (flower bud initiation differentiation and development), b) Delaying flower abscission (decrease shedding %), c) Enhancing pollination, fertilization and development of fruit, d) Increasing fruit set which in turn increasing capsules/plant, e) Enhancing transport of photo assimilates and nutrients from leaf towards fruits (sinks) there by, which reflect on the fruits formation **(Abd El-Aal and Eid Rania 2018; Hussein-Suzan and Al-Doori 2021 and Mohamed *et al.*, 2021).**

4. Effect of applied treatments on yield and its components:

With regard to data in **Table (7)**, cleared that different applied foliar treatments increased yield characters during 2022 and 2023 seasons compared with control treatment; MAA at 4 ml L^{-1} gave the highest significant increase in all yield characteristics followed by YE at 100 ml L^{-1} when compared with control during 2022 and 2023 seasons. In addition, we can concerning that the seed yield in the first year (2022) of the experiment was higher than in the second year (2023).

This results are in harmony with **Mahmoud *et al.*, (2016)** who reported that yeast extract reached a significant increase in No. of seeds/pod and weight of 100 green seeds of pea plants and this foundby **Mahmoud *et al.*, (2013)** on pea plants and **Abo-El-Hamd *et al.*, (2015)** on faba bean.

Meanwhile, these increases in capsules No. were accompanied by increasing flowers numbers and decreased shedding of flowers. The primitively effect of growth stimulants BA treatments on capsules numbers may be attributed to its effect on multiple No. of flowers on node, floral bud formation and opposite leaf arrangement encourages multiple flowering in the leaf axils of lower and middle nods on the main stem **(Abd El-Dayem *et al.*, 2012)**.

As well as, mixed Amino acids are essential ingredients in the action of protein synthesis. The elicitation requirements of mixed amino acids are of extremely important to reinforce yield quality and overall the plant growth especially at the critical stages of growth. **(Khodair and Abd El-Rahman 2021).**

5. Effect of applied treatments on chemical composition of sesame seeds (seeds quality):

Data in **Table (8)** illustrate that all applied treatments were effectively increased all chemical composition of seeds of treated plants compared with those of the untreated plant during 2022 and 2023 seasons.

Finally, The increase in yield and its components in sesame plants with some growth stimulant used in this experiment may be attributed to an increase in the vigorous growth **(Table, 1)**, photosynthetic pigments content **(Table, 3)**, the amount of metabolites synthesis (carbohydrates, protein and free amino acid in leaves **(Table, 5)**, absorption and translocation of nutrient elements **(Table, 4)** and enhance sink activity by increasing the rate of net amount of photo assimilates transport from sites of synthesis in leaf tissue (source) to sites of accumulation in developing seeds or storage organs (sink) and decrease shedding of reproductive organs, which reflected upon yield and its contains **(Eisa- Salwa 2011; Amin 2018 and Ahmed *et al.*, 2023).**

Table 1. Effect of different applied treatments on some morphological characteristics (Stem and Leaves) of sesame plants (*Sesamum indicum* L. var. Shandawel 3) at 82 DAS during 2022 and 2023 seasons.

Characters / Treatments	Stem height (cm)	Stem fresh weight (g)	Stem dry weight (g)	No. of Leaves/ plant	Leaves fresh weight (g)	Leaves dry weight (g)	Total leave area (cm^2)/ plant
1st season (2022)							
BA at 25 mg L^{-1}	**67.67**	**30.64**	**5.81**	**20.00**	**31.03**	**4.70**	**5.37**
BA at 50 mg L^{-1}	**62.00**	**29.39**	**4.50**	**16.67**	**25.73**	**4.19**	**3.70**
YE at 50 ml L^{-1}	**75.00**	**31.48**	**5.33**	**24.00**	**28.47**	**4.67**	**5.86**
YE at 100 ml L^{-1}	**80.00**	**41.46**	**8.39**	**28.67**	**31.09**	**4.80**	**10.75**
MAA at 4 ml L^{-1}	**83.00**	**47.68**	**8.96**	**29.67**	**35.98**	**6.04**	**12.00**
MAA at 6 ml L^{-1}	**78.67**	**36.19**	**5.60**	**25.33**	**26.21**	**4.25**	**6.72**
Control	**54.00**	**26.64**	**3.77**	**12.00**	**16.02**	**2.68**	**3.23**
L.S.D. at 5 %	**4.51**	**4.76**	**0.71**	**3.63**	**7.66**	**1.61**	**2.32**
2nd season (2023)							
BA at 25 mg L^{-1}	**54.67**	**24.65**	**5.07**	**26.00**	**21.85**	**4.12**	**12.24**
BA at 50 mg L^{-1}	**52.67**	**22.39**	**4.15**	**20.00**	**18.43**	**2.87**	**9.87**
YE at 50 ml L^{-1}	**58.00**	**25.52**	**5.73**	**30.00**	**30.34**	**7.04**	**13.21**
YE at 100 ml L^{-1}	**64.00**	**31.66**	**7.19**	**38.00**	**41.49**	**8.60**	**16.47**
MAA at 4 ml L^{-1}	**70.00**	**35.42**	**7.69**	**42.00**	**53.89**	**10.78**	**16.66**
MAA at 6 ml L^{-1}	**59.33**	**27.61**	**6.46**	**34.00**	**34.15**	**7.59**	**14.31**
Control	**47.00**	**19.49**	**4.01**	**14.00**	**10.61**	**2.61**	**8.40**
L.S.D. at 5 %	**4.75**	**2.32**	**0.94**	**3.29**	**6.18**	**1.27**	**2.15**

Table 2. Effect of different applied treatments on photosynthetic pigments mg/g F.W. of sesame plants (*Sesamum indicum* L. var. Shandawel 3) at 82 DAS during 2022 and 2023 seasons.

Characters / Treatments	Chlorophyll a (mg g^{-1} F.W.)	Chlorophyll b (mg g^{-1} F.W.)	Chlorophyll (a + b) (mg g^{-1} F.W.)	Carotenoids (mg g^{-1} F.W.)
		1st season (2022)		
BA at 25 mg L^{-1}	**1.54**	**0.39**	**1.93**	**0.67**
BA at 50 mg L^{-1}	**1.58**	**0.48**	**2.06**	**0.66**
YE at 50 ml L^{-1}	**1.29**	**0.18**	**1.47**	**0.69**
YE at 100 ml L^{-1}	**1.55**	**0.30**	**1.85**	**0.70**
MAA at 4 ml L^{-1}	**1.57**	**0.36**	**1.93**	**0.75**
MAA at 6 ml L^{-1}	**1.38**	**0.19**	**1.57**	**0.72**
Control	**1.04**	**0.15**	**1.19**	**0.53**
		2nd season (2023)		
BA at 25 mg L^{-1}	**1.14**	**0.32**	**1.46**	**0.49**
BA at 50 mg L^{-1}	**1.36**	**0.49**	**1.85**	**0.48**
YE at 50 ml L^{-1}	**1.00**	**0.22**	**1.22**	**0.50**
YE at 100 ml L^{-1}	**1.15**	**0.30**	**1.45**	**0.61**
MAA at 4 ml L^{-1}	**1.17**	**0.40**	**1.57**	**0.65**
MAA at 6 ml L^{-1}	**1.07**	**0.24**	**1.31**	**0.63**
Control	**0.89**	**0.20**	**1.09**	**0.44**

Table 3 Effect of different applied treatments on some macro nutrient and crude protein in leaves of sesame plants (*Sesamum indicum* L. var. Shandawel 3) at 82 DAS during 2022 and 2023 season.

Characters / Treatment	N %	P %	K %	crude Protein %
1 st season (2022)				
BA at 25 mg L^{-1}	**2.54**	**0.43**	**2.00**	**13.46**
BA at 50 mg L^{-1}	**2.45**	**0.42**	**1.89**	**12.99**
YE at 50 ml L^{-1}	**2.50**	**0.44**	**2.22**	**13.25**
YE at 100 ml L^{-1}	**2.60**	**0.45**	**2.30**	**13.78**
MAA at 4 ml L^{-1}	**2.80**	**0.49**	**2.45**	**14.84**
MAA at 6 ml L^{-1}	**2.66**	**0.46**	**2.41**	**14.10**
Control	**2.31**	**0.40**	**1.83**	**12.24**
2 nd season (2023)				
BA at 25 mg L^{-1}	**2.50**	**0.32**	**2.48**	**13.25**
BA at 50 mg L^{-1}	**2.38**	**0.31**	**2.37**	**12.61**
YE at 50 ml L^{-1}	**2.51**	**0.33**	**2.51**	**13.30**
YE at 100 ml L^{-1}	**2.80**	**0.34**	**2.54**	**14.84**
MAA at 4 ml L^{-1}	**3.02**	**0.37**	**2.87**	**16.01**
MAA at 6 ml L^{-1}	**2.99**	**0.35**	**2.61**	**15.85**
Control	**2.21**	**0.29**	**2.30**	**11.71**

Table 4. Effect of different applied treatments on total carbohydrate , total sugars and total free amino acids in Leaves of sesame plants (*Sesamum indicum* L. var. Shandawel 3) at 82 DAS during 2022 and 2023 seasons.

Characters / Treatment	Total Carbohydrates %	Total sugars %	Total free Amino acids (mg g^{-1} F.W.)
	1 st season(2022)		
BA at 25 mg L^{-1}	**38.31**	**2.09**	**37.81**
BA at 50 mg L^{-1}	**36.51**	**1.67**	**36.31**
YE at 50 ml L^{-1}	**39.03**	**2.49**	**43.71**
YE at 100 ml L^{-1}	**44.23**	**2.61**	**44.95**
MAA at 4 ml L^{-1}	**38.85**	**2.31**	**54.55**
MAA at 6 ml L^{-1}	**38.67**	**2.22**	**46.75**
Control	**35.51**	**1.55**	**35.05**
	2 nd season (2023)		
BA at 25 mg L^{-1}	**34.05**	**6.29**	**45.83**
BA at 50 mg L^{-1}	**33.66**	**6.28**	**38.34**
YE at 50 ml L^{-1}	**35.59**	**6.45**	**46.35**
YE at 100 ml L^{-1}	**35.72**	**6.53**	**49.53**
MAA at 4 ml L^{-1}	**35.04**	**6.32**	**69.01**
MAA at 6 ml L^{-1}	**34.62**	**6.30**	**54.82**
Control	**32.24**	**6.09**	**36.25**

Table 5. Effect of different applied treatments on endogenous phytohormones content in sesame (*Sesamum indicum* L. var. Shandawel 3) shoot at 82 days after sowing during 2022 season.

Plant hormones / Treatments	Gibberellins µg g^{-1} F.w.	Auxins µg g^{-1} F. w.	Cytokinins µg g^{-1} F.w	Total Promoters µg g^{-1} F.w.	Abscisic acid µg g^{-1} F.w.	Total Promoters/ Inhibitors µg g^{-1} F. w.
Benzyladenine at 25 mg L^{-1}	**25.54**	**22.20**	**30.41**	**78.15**	**3.80**	**20.57**
yeast extract at 100 ml L^{-1}	**63.51**	**28.23**	**29.78**	**121.52**	**4.19**	**29.00**
Mixed amino acids at 4 m L^{-1}	**37.45**	**27.46**	**28.27**	**93.18**	**2.38**	**39.15**
Control	**24.49**	**10.91**	**23.52**	**58.92**	**6.14**	**9.59**

Table 6. Effect of different applied treatments on flowering characteristics of Sesame plant (*Sesamum indicum* L. var. Shandawel 3) at flowering stage zone during 2022 and 2023 seasons.

Characters / Treatments	No. of flowers / plant	No. of capsules/plant	Flowers setting (%)	Flowers abscission (%)
		1st season (2022)		
BA at 25 mg L^{-1}	**95.00**	**84.00**	**88.42**	**11.58**
BA at 50 mg L^{-1}	**88.00**	**77.33**	**87.88**	**12.12**
YE at 50 ml L^{-1}	**102.67**	**89.67**	**87.34**	**12.66**
YE at 100 ml L^{-1}	**115.67**	**102.00**	**88.18**	**11.82**
MAA at 4 ml L^{-1}	**112.67**	**105.00**	**93.19**	**6.81**
MAA at 6 ml L^{-1}	**109.00**	**95.33**	**87.46**	**12.54**
Control	**75.00**	**65.67**	**87.56**	**12.44**
L.S.D. at 5 %	**6.10**	**5.10**	**1.12**	**1.66**
		2nd season (2023)		
BA at 25 mg L^{-1}	**95.00**	**87.67**	**92.28**	**7.70**
BA at 50 mg L^{-1}	**85.00**	**79.67**	**93.73**	**6.22**
YE at 50 ml L^{-1}	**104.67**	**96.33**	**92.03**	**7.94**
YE at 100 ml L^{-1}	**120.00**	**115.33**	**96.11**	**3.89**
MAA at 4 ml L^{-1}	**130.00**	**125.00**	**96.15**	**3.85**
MAA at 6 ml L^{-1}	**117.67**	**113.00**	**96.03**	**3.97**
Control	**63.67**	**53.00**	**83.24**	**16.82**
L.S.D. at 5 %	**7.96**	**6.96**	**1.90**	**1.90**

Table 7. Effect of different applied treatments on yield and yield components of sesame plants (*Sesamum indicum* L. var. Shandawel 3) at 120 DAS (at harvest) during 2022 and 2023 seasons.

Characters / Treatments	Fruiting zone length (cm)	No. of Terminal capsules	No. of Intermediate capsules	No. of Basal capsules	Weight of intact capsule (g)	Weight of empty capsules (g)	No. of seeds in one capsule	Total seed weight (g)	1000 seed weight (g)	Seed yield/pot (g)
1st season (2022)										
BA at 25 mg L^{-1}	**97.67**	**35.00**	**37.00**	**18.00**	**40.73**	**0.31**	**44.00**	**15.94**	**2.73**	**124.67**
BA at 50 mg L^{-1}	**89.00**	**28.00**	**34.00**	**17.00**	**36.67**	**0.33**	**43.00**	**13.50**	**2.67**	**118.00**
YE at 50 ml L^{-1}	**103.00**	**42.00**	**40.00**	**19.00**	**42.50**	**0.27**	**47.67**	**18.03**	**3.40**	**151.33**
YE at 100 ml L^{-1}	**112.00**	**54.00**	**49.00**	**23.00**	**48.73**	**0.25**	**63.00**	**26.13**	**3.60**	**154.00**
MAA at 4 ml L^{-1}	**120.33**	**62.00**	**52.33**	**26.00**	**60.17**	**0.22**	**72.00**	**31.80**	**4.20**	**161.67**
MAA at 6 ml L^{-1}	**105.00**	**49.00**	**46.00**	**22.00**	**47.57**	**0.26**	**56.00**	**21.41**	**4.10**	**152.67**
Control	**78.67**	**20.00**	**29.67**	**14.00**	**31.87**	**0.42**	**35.00**	**11.74**	**2.23**	**103.00**
L.S.D. at 5 %	**5.89**	**6.59**	**3.68**	**3.47**	**4.47**	**0.04**	**6.11**	**2.54**	**0.20**	**9.39**
2nd season (2023)										
BA at 25 mg L^{-1}	**115.33**	**35.00**	**23.00**	**16.00**	**43.63**	**0.32**	**58.67**	**20.94**	**3.20**	**39.00**
BA at 50 mg L^{-1}	**114.00**	**32.00**	**21.00**	**15.00**	**40.07**	**0.33**	**56.00**	**17.70**	**2.90**	**33.33**
YE at 50 ml L^{-1}	**116.33**	**45.00**	**24.00**	**17.00**	**48.17**	**0.28**	**58.00**	**21.92**	**3.20**	**47.00**
YE at 100 ml L^{-1}	**119.33**	**49.00**	**35.00**	**19.00**	**51.63**	**0.25**	**66.00**	**27.20**	**3.50**	**64.33**
MAA at 4 ml L^{-1}	**122.33**	**72.00**	**44.33**	**22.33**	**56.73**	**0.22**	**68.00**	**33.38**	**4.27**	**70.00**
MAA at 6 ml L^{-1}	**118.00**	**46.00**	**32.00**	**18.00**	**50.53**	**0.26**	**63.67**	**23.09**	**4.20**	**60.67**
Control	**86.00**	**22.67**	**15.00**	**12.00**	**35.33**	**0.44**	**45.67**	**12.41**	**2.20**	**32.67**
L.S.D. at 5 %	**6.03**	**6.63**	**5.39**	**3.15**	**6.62**	**0.04**	**7.23**	**2.76**	**0.35**	**5.71**

Table 8. Effect of different applied treatments on some macro nutrients, crude protein, total carbohydrate, total sugars and oil % in seeds of sesame plants (*Sesamum indicum* L. var. Shandawel 3) during 2022 and 2023 season.

Characters / Treatment	N %	P %	K %	crude Protein %	Total Carbohydrates %	Total sugars %	oil percentage %	oil yield / plant %
				1 st season(2022)				
BA at 25 mg L^{-1}	5.03	0.52	1.47	26.66	22.85	7.29	50.11	7.99
BA at 50 mg L^{-1}	4.83	0.50	1.45	25.60	21.95	7.24	43.88	5.92
YE at 50 ml L^{-1}	5.54	0.54	149	29.36	23.87	7.32	51.37	9.26
YE at 100 ml L^{-1}	5.80	0.58	1.53	30.74	26.89	7.35	53.48	13.97
MAA at 4 ml L^{-1}	5.90	0.60	1.61	31.27	30.23	7.37	53.71	17.08
MAA at 6 ml L^{-1}	5.60	0.57	1.52	29.68	25.01	7.34	51.92	11.12
Control	4.02	0.48	1.40	21.31	19.50	7.20	42.03	4.93
				2 nd season (2023)				
BA at 25 mg L^{-1}	4.85	0.52	1.58	25.71	24.11	7.28	41.70	8.73
BA at 50 mg L^{-1}	4.78	0.51	1.55	25.33	23.83	7.25	39.50	6.99
YE at 50 ml L^{-1}	5.05	0.53	1.61	26.77	25.28	7.33	43.80	9.60
YE at 100 ml L^{-1}	5.85	0.55	1.65	31.01	26.74	7.52	47.30	12.87
MAA at 4 ml L^{-1}	5.99	0.56	1.68	31.75	27.37	7.54	48.80	16.29
MAA at 6 ml L^{-1}	5.54	0.54	1.63	29.36	25.34	7.43	44.60	10.30
Control	4.04	0.47	1.50	21.41	21.72	7.18	36.90	4.58

Concerning, the effect of BA on mineral contents in sesame seeds may be due to their effects on membrane permeability, ions uptake and increase the rate of ion entry through the membrane, which reflected on translocation of mineral nutrients to shoot and consequently to fruits. Also, these growth stimulants treatment improved photosynthetic efficiency, activity and consequently more synthesis of sugars and increases the mobilization, partitioning and translocation of photosynthetase material (sugars) to seeds in fruits of sesame plants **(Abd El-Dayem *et al.*, 2012)**.

In this regard, mixed amino acids are essential ingredients in the action of protein synthesis **Khodair and Abd El-Rahman, (2021).**

Concerning, **Nassar- Rania *et al.*, (2011)** cleared that foliar application with yeast extract at 100 and 150 ml L^{-1} improved significantly the percentage of crude protein in seeds of Kidney bean 'Giza 6' in both studied seasons. However, high used concentration of 10 g L^{-1}; induced significant enhancement in the percentages of total carbohydrates and protein in fresh pods of snap beans compared to the control.

Conclusions

Ultimately, it could be recommended that spraying sesame plants with a growth stimulant mixed amino acids at a concentration of 4 ml L^{-1} or yeast extract at a concentration of 100 ml L^{-1} at the ages of 30 60 and 85 DAS, to enhance growth, seed quality and oil yields and improve the productivity and quality of the oil seed of sesame plant, variety Shandawel "3".

References

A.O.A.C., Association of Official Agriculture Chemists (2005). Official methods of analysis of association of official analytical chemists. 17th ed. Washington, DC, USA.

Abd El-Aal, M. M. M. and Eid-Rania, S.M. (2018), Effect of foliar spray with lithovit and amino acids on growth, bio constituents, anatomical and yield features of soybean plant, 4th International Conference on Biotechnology Applications in Agriculture: Plant biotechnology, Benha University, Moshtohor, Egypt, pp 187–202.

Abd El-Dayem, H.M.; Mady; M.A.; El-Desouky, S.A. and Eid, R.S.M. (2012). Effect of some bioregulators on growth, yield, chemical composition of sesame (*Sesamum indicum* L). 1st international conference on biotechnology Applications in Agriculture, Benha University, Moshtohor and Hurghada, 18-22 Fabruary 2012, Biofertilizer Technique 23-34.

Abd El-Dayem, H.M.M (1999). Effect of foliar spray with benzyladenine and gibberellic acid on growth, yield and some chemical constituents of fodder beet plant (Beta vulgaris L.). Annals of Agric. Sci., Moshtohor, 37 (1): 249-274.

Abdelaal, K. A.; El-Maghraby, L. M.; Elansary, H.; Hafez, Y. M.; Ibrahim, E. I.; El-Banna, M.; ... and Elkelish, A. (2019). Treatment of sweet pepper with stress tolerance-inducing compounds alleviates salinity stress oxidative damage by mediating the physio-biochemical activities and antioxidant systems. *Agronomy*, *10*(1), 26.

Abdelaal, K.A.; Hafez, Y.M.; El Sabagh, A. and Saneoka H. (2017) Ameliorative effects of Abscisic acid and yeast on morpho-physiological and yield characteristics of maize plant (*Zea mays* L.) under water deficit conditions. Fresenius Environ. Bull., 26, 7372–7383.

Abdel-Gawad, A. M. A. and Youssef, M. A. (2019). Effects of soil application of different fertilizers and foliar spray with yeast extract on growth and yield of faba bean plants. *Egy. J. of Agric. Sci.*, *70*(4), 461-473.

Abdel-Rahim, E.A.; Shallan, M.A. and El-Scheik, A.M. (1988). Biochemical studies on production of newthermophilic yeast alkaline proteases applied for the purposes of laundry detergents industry. J. Agric. Sci. Mansoura Univ., 21(5):1971-1985.

Abo El-Saoud, M. S. (2005). Physiological studies on the role of some bioregulators in growth, flowering and yield of snap bean. Ph.D. Thesis, Fac. of Agric., Moshtohor, Benha Univ, Egypt.

Abo Sedera, F. A.; Shafshak, N. S.; Mohamed, M. H. M.; Elkoumy, H. M. and El-Shafay, H. S. S. (2014). Effect of some safety compounds as soil addition and foliar spray treatments on growth and productivity of tomato grown under saline soil conditions. *Annals of Agric. Sci.*, *Moshtohor*, *52*(3), 333-346.

Abo-El-Hamd, A.S.; Ibrahim, M. M.; Azzaz, N.A.E.; Khalif, Y.A.M. and Ahmed, H.A. (2015). Effect of foliar application with salicylic acid and yeast extract on production and quality of two faba bean (Vicia faba, L.). Minia Journal of Agricultural Research and Development, volume (35): In press.

Abou El-Yazied, A. and Mady, M. A. (2011). Effect of naphthalene acetic acid and yeast extract on growth and productivity of tomato (*Lycopersicon esculentum* Mill.) plants. *Res. J. Agric. & Biol. Sci*, *7*(2), 271-281.

Adam, A. R.; Allafe, M. A. and Omar, E. A. (2022). Biostimulants Influence (Licorice and Yeast Extract) on Vegetative Growth of Faba Bean

(*Vicia faba* L.). *Journal of Plant Production*, *13*(7), 321-324.

Ahmed, A. A. O.; Salah, A., Sedik, F. and Ghanim, A. (2023). Effect of foliar treatment with yeast and nitrogen fertilization on the productivity of sesame. *Aswan University Journal of Environmental Studies*, *4*(2), 15-24.

Al-Hamdani, K. A. S. and Al-Jubouri, M. N. H. (2014). The effect of spraying benzyl adenine, urea, iron, boron and Nu film-17 evaporator on nodes, precipitation and some characteristics of vegetative growth in local oranges (*Citrus sinensis*). Tikrit University Journal for Agricultural Sciences, Special issue of the proceedings of the Third Specialized Conference/Plant Production. *Republic of Iraq*.

Al-Waeli- Fatima K. M. and Al-Khayyat, B. S. M. (2023). Response of Olive Seedlings (*Olea europaea* L.) Manzinilo Cultivar to Spraying with Potassium Silicate and Ascorbic Acid. In IOP Conference Series: Earth and Environmental Science 1214, (1), 012013. IOP Publishing.

Amin, A. A.; Gharib, F. A.; El-Awadi, M. and Rashad, E. S. M. (2011). Physiological response of onion plants to foliar application of putrescine and glutamine.*129* (3), 353-360.

Amin, M. A. (2018). Comparative studies on growth, metabolism and yield of sesame plant by using seaweed, plant extracts and some growth regulators. *Al-Azhar Bulletin of Science*, *29*(1-C), 19-28.

Amin, M. A.; Hazzazi, O. A.; Kandemirli, F. and Saracoglu, M. (2012). Inhibition performance and adsorptive behavior of three amino acids on cold-rolled steel in 1.0 M HCl—chemical, electrochemical, and morphological studies. *Corrosion*, *68*(8), 688-698.

Bondok, M.A. (1996): Hormonal balance, root development and sugar accumulation in sugar beet (*Beta vulgaris* var. vulgaris L.) as affected by kinetin. J. Agric. Sci. Mansoura Univ., 21(9): 3161-3179.

Brouwer R; Kleinendorst, A. and Locher, J.T.H. (1973) Plant Response to Climatic Factors. Proc Uppsala Symp (1970), Unesco Paris, France, 169-174.

Colla, G.; Hoagland, L.; Ruzzi, M.; Cardarelli, M.; Bonini, P.; Canaguier, R. and Rouphael, Y. (2017). Biostimulant action of protein hydrolysates: Unraveling their effects on plant physiology and microbiome. *Frontiers in plant science*, *8*, 2202.

Davies, P. J. (2010). The plant hormones: their nature, occurrence, and functions. In Plant hormones: biosynthesis, signal transduction, action! (pp. 1-15). Dordrecht: Springer Netherlands.

Dubois, M.; Gilles, K. A.; Hamilton, J. K.; Rebers, P. T. and Smith, F. (1956). Colorimetric method for determination of sugars and related substances. *Analytical chemistry*, *28*(3), 350-356.

Duncan, G. M. (1980): Formulation and statistical analysis of the mixed, continuous/discrete dependent variable model in classical production theory. *Econometrica: J. of the Econometric Society*, 839-852.

Duszka, K.; Clark, B. F.; Massino, F. and Barciszewski, J. (2009). Biological activities of kinetin. *Herbal Drugs: Ethnomedicine to Modern Medicine*, 369-380.

Eid-Rania, S. (2020). Influence of Foliar Application by Benzyladenine and Yeast Extract on Growth, Root Yield, Quality and Chemical Compositions of Sugar beet (*Beta vulgaris* L.) Plant. *Journal of Plant Prod.*, *11*(12), 1341-1347.

Eisa-Salwa, A. I. (2011). Effect of amendments, humic and amino acids on increases soils fertility, yields and seeds quality of peanut and sesame on sandy soils. Agriculture and Biological Science, 7(1), 115-125.

El-Anany, A. M. A. (2020). Studies on improving potato growth, yield and quality. *Annals of Agric. Sci.*, *Moshtohor*, *58*(4), 963-976.

Ewais, E. E. D. A., Sharaf, A. E. M. M., ABD EL-Azim, E. A., Ismail, M. A. and Amin, M. A. (2013). Improving growth, yield quality and chemical constituents of sesame plants by foliar application of ascorbic acid, benzyl adenine and paclobutrazol. Al-Azhar Bulletin of Science, 24(2-C), 1-16.

Fadeel, A. A. (1962). Location and properties of chloroplasts and pigment determination in roots. *Physiologia plantarum*, *15*(1).

Fahimi F.; Souri M.K. and Yaghobi F. (2016). Growth and development of greenhouse cucumber under foliar application of Biomin and Humifolin fertilizers in comparison to their soil application and NPK. J. of Sci. and Tech. of Greenhouse Culture, 7(25), 143-152.

Food and Agriculture Organization [FAO] (2020). Datos Sobre Alimentación en Agricultura – FAOSTAT. Rome: FAO.

Hafez, E. M.; Osman, H. S.; El-Razek, U. A. A.; Elbagory, M.; Omara, A. E. D.; Eid, M. A. and Gowayed, S. M. (2021). Foliar-applied potassium silicate coupled with plant growth-promoting rhizobacteria improves growth, physiology, nutrient uptake and productivity of faba bean (*Vicia faba* L.) irrigated with saline water in salt-affected soil. Plants, 10(5), 894.

Hammad, S. A. and Ali, O. A. (2014). Physiological and biochemical studies on drought tolerance of wheat plants by application of amino acids and yeast extract. Annals of Agricultural Sciences, 59(1), 133-145.

Hamza, O. M., and Al-Taey, D. K. (2020). A study on the effect of glutamic acid and benzyl adenine application upon growth and yield parameters and active components of two Broccoli hybrids. *Int. J. Agricult. Stat. Sci*, *16*(2), 1163-1167.

Haroun, S. A.; Shukry, W. M.; Abbas, M. A. and Mowafy, A. M. (2011). Growth and physiological responses of Solanum lycopersicum to atonik and benzyl adenine under vernalized conditions. *J. of Ecology and the Natural Env.* , *3*(9), 319-331.

Hornbeck, J. W. (1987). *The northern hardwood forest ecosystem: ten years of recovery from clearcutting* (Vol. 596). US Department of Agriculture, Forest Service, Northeastern Forest Experiment Station.

Horneck, D. A. and Miller, R. O. (1998). Determination of total nitrogen in plant tissue. In Handbook of Reference Methods for Plant Analysis.Karla Y.P. (Ed.): 75-83.

Hussain, A.; Shuaibu, A. D.; Shaikh, A. J. and Khan, A. M. (2022). Exploring the effects of selected essential amino acids on the self-association of sodium dodecyl sulphate at different temperatures. *J. of Molecular Liquids*, *347*, 118003.

Hussain, M.; Ul-Allah, S. and Farooq, S. (2023). Sesame (*Sesamum indicum* L.). In *Neglected and Underutilized Crops* (pp. 733-755). Academic Press.

Hussein-Suzan, A. and Al-Doori, M. F. (2021, November). The effect of spraying with calcium, boron and benzyl adenine on the quantity and quality of yield for strawberry plants (*Fragaria Ananassa* Duch) CV. Rubygem. In *IOP Conference Series: Earth and Env. Sci.* 910 (1) p. 012066. IOP Publishing.

Ibraheem, A. A. A. (2007). Polyamines as modulators of wheat growth, metabolism and reproductive development under high temperature stress. Ph.D. Thesis, Fac. of Science, Ain Shams Univ., Egypt.

Ismail, E. E. M. and Halmy, M. M. (2018). Effect of proline and potassium humate on growth, yield and quality of broad bean under saline soil conditions. *J. of Plant Prod.*, *9*(12), 1141-1145.

Jahan, N.; Alam, A. S., Mitu, A. S.; Habib, M. A.; Khan, M. and Ali, J. (2019). Effect of zinc on the growth and yield of sesame. *Inte. J. of Natural and Social Sci.*, *6*(3), 11-16.

Khalil, S. E., and Ismael, E. G. (2010). Growth, yield and seed quality of Lupinus termis as affected by different soil moisture levels and different ways of yeast application. J. of American Sci., 6(8), 141-153.

Khan, A. S.; Bilal Ahmad, B. A.; Jaskani, M. J.; Rashid Ahmad, R. A. and Malik, A. U. (2012). Foliar application of mixture of amino acids and seaweed (*Ascophylum nodosum*) extract improve growth and physicochemical properties of grapes. Int. J. Agric. Biol, 14(3), 383-388.

Khater, M. A.; Zaki, F. S.; Dawood, M. G.; El-Din, K. G.; Sadak, M. S.; Shalaby, M. A. and El-Awadi, M. E. (2023). Changes in some physiological and biochemical parameters of lupine plant via two bio-stimulant yeast extract and folic acid. *J. Mater. Environ. Sci.*, *14 (3)*, *373*, *383*.

Khodair, O. A. and Abd El-Rahman, A. (2021). Response of manfalouty Pomegranate trees to foliar application of humic acid and amino acids. *SVU-Int. J. of Agric. Sci.*, *3* (1), 10-17.

Koshioka, M.; Harada, J.; Takeno, K.; Noma, M.; Sassa, T.; Ogiyama, K.; … and Pharis, R. P. (1983). Reversed-phase C18 high-performance liquid chromatography of acidic and conjugated gibberellins. *J. of Chromatography A*, *256*, 101-115.

Mahmoud, H. I.; Azzaz, N. A.; Khalifa, Y. A.; Mahmoud, M. A. and Fakhry, G. (2016). Effect of foliar application with active yeast extract and benzyladenine on some vegetative growth criteria and chemical composition of lupine (*Lupinus termis* L.) plants. *Minia J Agric Res Develop*, *36*, 193-214.

Mahmoud, R.A; M, El-Desuki, M.; Abdel.mouty and Ali, A.H.(2013). Effect of compost levels and yeast extract application on the pea plants and quality. Jour. Appl. Sci. 9 (1):149-155.

Mahmoud, T. R. (2001). Botanical studies on the growth and germination of mahnolia (*Magnolia grandiflora* L.) plants. M. Sci. Thesis. Fac. of Agric. Moshtohor, Zagazig Univ., Egypt.

McCoy, R. M., Meyer, G. W., Rhodes, D., Murray, G. C., Sors, T. G. and Widhalm, J. R. (2020). Exploratory study on the foliar incorporation and stability of isotopically labeled amino acids applied to turfgrass. Agronomy, 10(3), 358.

Mohamed, M. H.; Sami, R.; Al-Mushhin, A. A.; Ali, M. M. E.; El-Desouky, H. S.; Ismail, K. A.; ... and Zewail, R. M. (2021). Impacts of effective microorganisms, compost tea, fulvic acid, yeast extract, and foliar spray with seaweed extract on sweet pepper plants under greenhouse conditions. *Plants*, *10*(9), 1927.

Mohammadipour, N., and Souri, M. K. (2019). Effects of different levels of glycine in the nutrient solution on the growth, nutrient composition, and antioxidant activity of coriander (*Coriandrum sativum* L.). *Acta Agrobotanica*, *72*(1).

Muting, D. and Kaiser, E. (1963). Spectrophotometric methods of determining of amino-N in biological materials by means of the ninhydrin reactions. *Hoppe-Seyler's Zeitschrift fur physiologische Chemie*, *323*, 276-281.

Nassar-Rania, M., Ahmed, Y. M. and Nassar, D. M. (2011). Effect of foliar spray with active yeast extract on morphological, anatomical and yield characteristics of kidney bean (*Phaseolus vulgaris* L.). *Australian J. of Basic and App. Sci.*, *5* (5), 1071-1079.

Neeraja, G.; Reddy, I.P. and Gautham, B. (2005). Effect of growth promoters on growth and yield of tomato cv. Marutham. J.-of-Res.-ANGRAU., 33(3): 68-70.

Nicander, B., Ståhl, U., Björkman, P. O. and Tillberg, E. (1993). Immunoaffinity co-purification of cytokinins and analysis by high-performance liquid chromatography with ultraviolet-spectrum detection. Planta, 189(3), 312-320.

Noroozlo, Y. A.; Souri, M. K. and Delshad, M. (2019). Effects of foliar application of glycine and glutamine amino acids on growth and quality of sweet basil. *Advances in Horti. Sci.*, *33*(4), 495-502.

Olaiya, C. O. (2010). Presowing bioregulator seed treatments increase the seedling growth and yield of tomato (*Solanum lycopersicon*). *J. of plant growth reg.*, *29*, 349-356.

Papadakis, A. K. and Roubelakis-Angelakis, A. K. (2005): Polyamines inhibit NADH oxidase – mediated superoxide generation and putrescine prevents programmed cell death induced by polyamine oxidase-generated hydrogen peroxide. Planta, 220:826-837.

Piper, C. S. (1947). Mechanical analysis. *Soil and plant analysis*, Univ. of Adelaide, Australia, 368.

Prerostova, S.; Dobrev, P. I.; Kramna, B.; Gaudinova, A.; Knirsch, V.; Spichal, L. and Vankova, R. (2020). Heat acclimation and inhibition of cytokinin degradation positively affect heat stress tolerance of Arabidopsis. *Frontiers in plant sci.*, *11*, 87.

Rashid, D. A. and Al-Atrushy, S. M. (2023). Effect of Foliar Applications of Amino Acids, Benzyl Adenine and Nano-Fertilizers on Yield Quantity and Quality of Grapevine cv.'Thompson Seedless'. In *IOP Conference Series: Earth and Environmental Sci.* 1158 (4) 042072. IOP Publishing.

Sadak- Mervat, Sh.; Abdelhamid, M. T. and Schmidhalter, U. (2015). Effect of foliar application of aminoacids on plant yield and some physiological parameters in bean plants irrigated with seawater. *Acta biológica colombiana*, *20*(1), 141-152.

Salim, B.; Salama, Y. A.; Hikal, M. S.; El-Yazied, A.; El-Gawad, A. and Hany, G. (2021). Physiological and biochemical responses of tomato plant to amino acids and micronutrients foliar application. *Egyp. J. of Botany*, *61*(3), 837-848.

Sandell, E. B. (1950). The primary dissociation constant of diphenylthiocarbazone. *Journal of the Amer. Chem. Soc.*, *72*(10), 4660-4661.

Santi, C.; Zamboni, A.; Varanini, Z. and Pandolfini, T. (2017). Growth stimulatory effects and genome-wide transcriptional changes produced by protein hydrolysates in maize seedlings. *Frontiers in Plant Sci.*, *8*, 254805.

Snedecor, G. W. and Cochran, W. G. (1989): Statistical Method 8th Ed., lowa State Univ. Press. Ames. lowa, USA.

Souri M.K. and Hatamian M. (2019). Aminochelates in plant nutrition: a review.Journal of Plant Nutrition, 42(1), 67-78.

Souri, Z.; Karimi, N. and Sandalio, L. M. (2017). Arsenic hyperaccumulation strategies: an overview. *Frontiers in cell and developmental biology*, *5*, 67.

Teixeira, W. F.; Fagan, E. B.; Soares, L. H.; Umburanas, R. C.; Reichardt, K. and Neto, D. D. (2017). Foliar and seed application of amino acids affects the antioxidant metabolism of the soybean crop. *Frontiers in plant sci.*, *8*, 245273.

Zewail, R. M. Y. (2014). Effect of seaweed extract and amino acids on growth and productivity and some biocostituents of common bean (*Phaseolus vulgaris* L.) plants. *Journal of Plant Production*, *5*(8), 1441-1453.

Zewail, R.M.Y.; Khedr. Z.M.A.; Ismaeil, F.H.M. and Abd El-Hameed, E.F. (2019): Enhancement of soybean (*glycine max* L.) plants growth, yield and seed quality by using putrescine, benzyladenine and yeast extract. Annals of Agric. Sci. Moshtohor, 57(2):493-506.

Živanović, B.; Milić Komić, S.; Tosti, T.; Vidović, M.; Prokić, L. and Veljović Jovanović, S. (2020). Leaf soluble sugars and free amino acids as important components of abscisic acid—mediated drought response in tomato. *Plants*, *9* (9), 1147.

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تحسين نمو و محصول نبات السمسم بإستخدام البنزيل أدنين و مستخلص الخميرة و مخلوط الأحماض الأمينية

تم إجراء هذه الدراسة في أصص خلال موسمي 2022 و 2023 في المحطة البحثية الخاصه بقسم النبات الزراعي بكلية الزراعة بمشتهر – جامعة بنها – بمحافظة القليوبية بهدف دراسة تأثير الرش الورقى ببعض منشطات النمو كالبنزيل أدينين بتركيزات 25 و 50 ملجم لتر$^{-1}$ و مستخلص الخميرة بتركيزات 50 و 100 مل لتر$^{-1}$ و مخلوط الأحماض الأمينية بتركيزات 4 و 6 مل لتر$^{-1}$ علي النمو و المحتوى الهرموني والمحتوي الكيميائي للأوراق و صفات المحصول و المحتوي الكيميائي للبذور ومحصول البذرة والزيت لنبات السمسم صنف شندويل "3".

وتم الرش الورقى لنباتات السمسم بمنشطات النمو السابقة الذكر بعد 30 و 60 وكذلك 85 يوم من الزراعة خلال موسمي الدراسة 2022 و2023؛ و أدي الرش الورقى بمنشطات النمو كالبنزيل أدينين ، مستخلص الخميرة و مخلوط الأحماض الأمينية إلي زيادة معنوية في صفات النمو الخضرية التى تم دراستها مثل (طول الساق ، مساحة الأوراق ، الوزن الطازج والجاف لكل من الساق والأوراق/ نبات و عدد الأزهار و الكبسولات للنبات) في عمر 82 يوم من الزراعة و أيضاً محصول البذور و مكوناته مثل (عدد الكبسولات والوزن الكلى للبذور بالجرام و عدد البذور في الكبسولة الواحدة و وزن ال1000 بذرة ومحصول البذرة بالجرام للأصيص) لنبات السمسم خلال موسمي الدراسة 2022 و 2023 . كما أدي الرش الورقى بمنشطات النمو إلي زيادة محتوى الأوراق من صبغات البناء الضوئى وهي الكلورفيلات (أ ، ب) وكذلك الكاروتينويدات ، كما أدت جميع المعاملات المختلفة المستخدمة من منشطات النمو إلي زيادة النسبة المئوية من محتوي العناصر المعدنية (النيتروجين والفوسفور والبوتاسيوم) في أوراق نبات السمسم ، و زيادة محتوي الأوراق من السكريات الكلية الذائبة والأحماض الأمينية الكلية والبروتين الخام والكربوهيدرات الكلية في عمر82 يوم من الزراعة في موسمي النمو 2022 و 2023، كما أدي الرش بجميع المعاملات المختلفة المستخدمة من منشطات النمو إلي زيادة النسبة المئوية من محتوي العناصر المعدنية (النيتروجين والفوسفور والبوتاسيوم) في بذور نبات السمسم ، و زيادة محتوي البذور من السكريات الكلية الذائبة والبروتين الخام والكربوهيدرات الكلية و النسبة المئوية للزيت من البذور.

عموماً أوضحت النتائج أن معاملات الرش الورقي لنبات السمسم بالتركيز المنخفض من منشط النمو مخلوط الأحماض الأمينية بتركيز 4 مل لتر$^{-1}$ و التركيز المرتفع من مستخلص الخميرة بتركيز 100 مل لتر$^{-1}$ فى عمر 30 و 60 وكذلك 85 يوم من الزراعة أفضل المعاملات لزيادة النمو و محصول البذور والزيت وتحسين إنتاجية و جودة زيت البذرة لنبات السمسم صنف شندويل "3".