Annals of Agricultural Science, Moshtohor (ASSJM)
https://assjm.journals.ekb.eg/
www.fagr.bu.edu.eg
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Original Article Vol. 62(1) (2024), 167 – 176 DOI: 10.21608/assjm.2024.290360.1281

Effect of Pre-Sowing Treatments on Cloves Germination and Bulb Yield and Quality of Garlic Plants

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Abstract

This work is aimed to evaluate the pre-sowing treatments (i.e., black net sheading, cooling at 5°C for 48 hr., soaking in seaweed extract at $2g^{-1}$ and GA_3 20 ppm compared to the control) on cloves germination and growth, bulb yield and bulb quality during the two growing seasons. The obtained results showed that the data confirmed that all garlic growth parameters significant and/or highly significant affected by all clove germination stimulants after 120 and 210 days of sowing in both seasons. Garlic plants was treated with seaweed extract at $2g^{-1}$ recorded the highest plant height, leaves fresh weight, plant fresh and dry weight in both seasons. The highest leaves number/plant and leave contents of total chlorophylls was found in plants that subjected to cooling at 5°C in both seasons. All tested germination stimulants superior the control treatment increase all yield traits in both seasons. Garlic cloves was treated with GA_3 had the highest neck thickness, bulb length and bulb weight in both seasons. Cloves was covered with black net recorded the highest bulb diameter and bulb yield in both seasons. Garlic cloves was subjected to 5°C of cooling had the highest shoot fresh weight, one bulb weight, number of cloves/bulb and the highest total cloves weight/bulb in both seasons. The highest bulb diameter was found in cloves that covered with black net while, the highest bulb length was found in garlic cloves was treated with GA_3 in the first and second seasons. in addition, the highest average of clove weight was found in cloves that treated with seaweed extract during both seasons.

Key words: Black net, Cooling, Clove germination, Sea weed, GA_3, Salicylic acid, Bulb quality, Bulb yield.

Introduction

Garlic (*Allium sativum L.*) is the oldest and important herb and nutrition plant. Garlic is well known around the globe as a cooking spice, medicinal plant **(Kimura *et al.*, 2017)** as well as a bio pesticide. The importance of garlic is due to its use not only for culinary but also for therapeutic and medicinal purposes in both traditional and modern medicine. It is consumed either as raw vegetable (fresh leaves or dried cloves), or after processing in the form of garlic oil, garlic extracts and garlic powder with differences in chemical composition and bioactive compounds content between the various forms **(Lanzotti *et al.*, 2014)**. In many rogations across the world as Egypt, the genus Allium is used continuously as a food condiment along with shallot and onion **(Hadianto *et al.*, 2019)**. The world total harvested area in 2022 season was 1.7 million hectares produced about 29.1 million metric tons while the total harvested area in Egypt in the same year was 17.9 thousand hectares with total production reached 396.4 thousand metric tons **(FAOSTAT, 2022)**.

Garlic cloves germination process is affected by many factors, such as temperature, moisture content, soil salinity, and cloves dormancy, which has a significant impact on the number of plants per unit area and the quantity and quality of the bulb yield (**Luz *et al.*, 2022**).Many methods are used as pre-planting treatments to break clove dormancy and improve germination especially at the hot temperature time. Most of these methods, whether mechanical or chemical, have the main purpose of increasing enzymatic activity especially germination and growth enzymes, which accelerates the cell division and increase growth (**Rahman *et al.*, (2006)**). Shading cloves during the germination stage is one of the methods that is widely used to break clove dormancy, as shading protects cloves from the heat, increases the process of cell division, and accelerates growth (**Anisuzzaman *et al.*, 2009**). In the same way, **Barakat *et al.*, (2019)** indicated that covering garlic plants with rice straw enhanced total bulbs yield of garlic and its components compared without covering soil. While, **Anwar et al. (2020)** showed that Black plastic covering resulting in the highest plant height, leaf number per plant, bulb diameter and bulbing ratio .Fresh and dry

weights of bulb as well as whole-plant increased by using plastic. Farmers also resort at other times to cooling the cloves to break dormancy and improve the germination by increase physiological process (**Atif *et al.*, 2019**). It was found that, a temperature of 5 °C increased the number of bulbs variables were enhanced with vernalization 0° for 20 days, although it did not significantly differ from the control (**Azmi *et al.*, 2022**). Also, **Luz *et al.*, (2022)** showed that below-zero temperatures resulted in better vegetative characteristics, yield increased after using below-zero temperatures to treat seed cloves with a VID of 60%. While, **Morais *et al.*, (2023)** showed that, seed cloves conditioned with negative temperatures increased the productivity of garlic grown in Mossoró, but with a lower average yield than garlic produced in São Miguel. The prevailing trend in breaking the dormancy is to soak cloves in some organic or chemical substances or growth regulators (**Gouda, 2008**). Seaweed extracts contain various micro elements such as (Cu, Zn, B, Co) in addition to macro elements and contain Auxins, Gibberellins and Cytokinins, when spray on plants lead to increase root growth ability, nutrient elements absorption, and stem thickness and growth significantly **(Jensen, 2004)**. **Muhie *et al.* (2020)** found that soaking cloves in seaweed extract significantly enhanced germination and seedling emergence compared to the control. The same concentration also showed significant effect on yield and bulb quality and recorded the highest value of (cloves weight (4.9 g) cloves number.bulb-1, bulbs weight and bulbs length, cloves length and cloves diameter compared with untreated plants, also seaweed extract showed significantly increase in nutrient percentage (N,P and K) in bulbs of garlic as compared with untreated plants **(Yousif, 2018)**.

Gibberellic acid (GA_3) is a growth regulator stimulating substance which promotes cell elongation and cell division thus help in the growth and development of many plants. GA_3 has the potentiality to break dormancy and accelerates the sprouting of garlic. GA play a major role in diverse growth processes including seed development, organ elongation, senescence and control of flowering time **(Ouzounidou *et al.*, 2008)**. **Lemdor and Deepanshu (2022)** found that the growth regulators, as GA was to be effective in terms of plant growth, yield and quality of garlic. The present study amid to evaluate the effects of some pre sowing treatments on garlic cloves germination, growth, yield and bulb quality.

Materials and Methods

The present experiments were conducted at the privet farm in El-Menya Governorate to evaluate the effects of some pre-sowing treatments (Black net sheading, cooling at $5^{o}C$ for 48 hr, soaking in seaweed extract at 5 ml^{-1} and GA_3 at 20 ppm compared to the control) on garlic cloves germination, plant growth, bulb yield and bulb quality during the two growing seasons 2021/2022 and 2022/2023.

Experimental Procedures

Soil analysis of experimental sites

Before sowing, soil samples were randomly taken to measure physical and chemical properties. A random sample was taken from surface layer up to 30 cm depth. It was air-dried, crushed, and tested for physical and chemical properties. Chemical and physical properties of the experimental soil are shown in Table 1.

Table 1. The experimental soil physical and chemical properties as the average of 2021/2022 and 2022/2023 seasons.

Physical Soil Analysis						
Particle size distribution			Texture	pH	EC $Ds.m^{-1}$	Organic Matter
Sand %	Silt %	Clay %				
19.02	25.78	54.20	Clay-Loamy	7.94	1.07	1.21%

Chemical Soil Analysis									
Available macronutrients (mg/kg)			Cations $meq.l^{-1}$				Anions $meq.l^{-1}$		
N	P	K	Na^{+}	K^{+}	Mg^{++}	Ca^{++}	So_{4-}	Cl	HCo_{3-}	Co_{3--}
22.50	9.10	64.00	3.91	0.84	1.65	3.36	1.79	3.82	4.15	-

Experiment layout:-

Cloves variety of Egaseed were obtained from Horticulture Department, Agricultural Research Center**,** Giza, Egypt. Cloves used in the present study were uniform in shape and free from physiological and disease infection. Planting was done on the 15th of September, in both seasons under surface irrigation system. The land was plowed well with the

addition of 20 m_3 of Municipal fertilizer, 400 kg of superphosphate, 100 kg of agricultural sulfur, and 50 kg of ammonium sulphate per feddan. Cloves were sown in rows with a row 4 meters long and 60 cm apart. Each plot was four rows and cloves were sown on both sides of the row, with 10 cm between hills.

Treatments

In this experiment cloves that used were divided into five equal parts according to the five tested treatments. Each part of the seeds were treated with its own treatment, and the treatments were as follows:

1. Shading cloves with black net.

2: Subjecting clove to cooling at 5 °C for 48 hours.

3: Soaking cloves in seaweed extract (2 g^{-1}) for 6 hours. Where, the extract contain algae extract of *Scophyllum nodotheum*, (Akadian) produced by Holding company for chemical industries.

4: Soaking the cloves in gibberellic acid (GA_3 at 20 ppm) for 6 hours. The commercial compound Perlix (40% gibberellic acid) produced by SHOURA Chemical Company.

5: The control treatment.

During the two growing seasons, all treated cloves were sowing in an experiment designed in randomized block design with three replicates.

All agricultural practices were carried out, including the application of herbicide, ridging, fertilization and pest control according to the technical recommendations for the crop issued by the Egyptian Ministry of Agriculture and Land Reclamation.

Data recorded

Vegetative growth traits

After 120 days from sowing, a random sample of five plants were taken from each plot to measure; Plant height (cm, Number of leaves/plant, Leaves fresh weight, Plant fresh weight (g), Plant dry weight (g) and leaves content of total chlorophyll.

To estimate foliage fresh and dry weight, five randomly chosen plants from each plot were weighed directly to determined average fresh weight/plant. Then the five selected plants were artificially dried in oven at 60 ^{o}C for 48 hr until reach a constant weight to estimate average dry weight/plant.

Leaves total chlorophyll contents (mg/100 g f.w) it was estimated in samples of fresh leaves according to **Moran (1982).**

Yield measurements after 120 days of sowing:

After 120 days from sowing, a random sample of five plants were taken from each plot to measure: Neck thickness (cm), bulb diameter (cm), bulb length (cm), bulb weight (g) and bulb yield (g).

Yield measurements after 210 days of sowing.

After 210 days from sowing, a random sample of five plants were taken from each plot to measure: Plant fresh weight (g), One bulb weight (g), bulb diameter (cm), bulb length (cm), Number of cloves/bulb, Total clove weight/bulb (g) and average clove weight (g).

Statistical analysis

The data were subjected and analyzed by using **one-way** ANOVA followed by LSD test through SPSS 16 (version 4). The treatments means were compared using least significant difference (LSD) tested at 5% level of probability as described by **Gomez and Gomez (1984)**.

Results

Effect of some garlic clove germination stimulants on the growth and yield of garlic plants after 120 days of sowing.

Growth characteristics after 120 days of sowing:

The presented data in Tables 2 and 3 confirmed that all garlic growth parameters significant and/or highly significant affected by all clove germination stimulants after 120 days of sowing in both growing seasons of this study.

Plant height of garlic plants significantly differ under all used germination stimulants in both seasons (Table 2). The highest plant height was recorded in plants that treated with seaweed extract (86.33 and 88.00 cm) followed by plants the sheading with black net (84.42 cm) then plants that treated with GA3 (83.75 and 86.42 cm) in both seasons, respectively. In contrast of this, garlic plants under the control treatment had the shortest plants with averages of 81.25 and 77.92 cm. Data in Table 2 revealed that leaves number/plant significantly affected by all tested germination stimulants in both seasons. The highest leaves number/plant was found in cloves that subjected to cooling at 5oC (11.92 and 11.92) followed plants the sheading with black net (11.92 and 11.42) then plants that treated with seaweed extract (11.67 and 11.25) in in the first and second seasons, respectively. The exceeded of cooling treatment did not differ significant with black net in the first season. On the other side, garlic plants in the control treatment had the lowest leaves number/plant with averages of 11.08 and 10.92 in the two seasons of the study, respectively. The obtained results in Table 2 showed that leaves fresh weight significantly influenced by all tested germination stimulants in both seasons. The highest leaves fresh weight was found in garlic cloves that treated with seaweed extract (72.67 and 74.08 g) followed cloves that treated with GA3 (71.50 and 74.08 g) without any significant differ between the two treatments then

cloves that subjected to cooling (69.17 and 69.92 g) while the lowest leaves fresh weight was found in the control treatment (60.92 and 65.83 g) in both seasons, respectively.

Table 2. Effect of some garlic clove germination stimulants on plant height, number of leaves/plant and leaves fresh weight of garlic plants after 120 days of sowing during 2020/2021 and 2021/2022 seasons.

Treatments	Plant height (cm)		Number of leaves		Leaves fresh weight (g)	
	1St season	2nd season	1St season	2nd season	1St season	2nd season
Black net	84.42 b	87.58 ab	11.92 a	11.42 b	69.17 b	69.50 b
Cooling (5 °C)	83.42 c	84.92 c	11.92 a	11.92 a	66.08 c	69.92 b
Seaweed extract at $2g^{-1}$	86.33 a	88.00 a	11.67 b	11.25 c	72.67 a	74.08 a
GA_3 at 20 ppm	83.75 c	86.42 b	11.58 b	11.08 d	71.50 a	74.08 a
Control	81.25 d	77.92 d	11.08 c	10.92 e	60.92 c	65.83 c
LSD 5%	0.61	1.37	0.11	0.13	1.57	1.16
Significant	**	**	*	*	*	**

The obtained results in Table 3 indicated that Plant fresh weight significantly differ under all used germination stimulants in both seasons. The highest plant fresh weight was found in cloves that treated with seaweed extract (150.00 and 145.50 g) followed by GA3 (140.33 and 144.08 g) then plants that covered with black net (136.33 and 140.17 g) in both seasons, respectively. On the other hand, garlic plants under the control treatment had the lowest plant fresh weight with averages of 128.75 and 135.25 g. Data illustrated in Table 3 cleared that plant dry weight significantly affected by the used germination stimulants in both seasons. The highest plant dry weight was found in cloves that treated with seaweed extract (25.92 and 27.46 g) followed by black net (25.38 and 20.67 g) then plants subjected to cooling for 5oC (23.13 and 20.33 g) in both seasons, respectively. On the other hand, garlic plants under the control treatment had the lowest plant dry weight with averages of 21.54 and 19.29 g. The results presented in Table 3 showed that leaves content of total chlorophyll significantly influenced by all tested germination stimulants in both seasons. The highest leaves content of total chlorophyll was found in cloves that subjected to 5oC of cooling (66.18 and 70.28mg/100g FW) followed b plants that treated with seaweed extract (65.39 and 69.91 mg/100 g FW) then GA3 (65.98 and 68.83 mg/100 g FW) in both seasons, respectively without any significant differ between the three treatments in the first season. Also, cooling treatment did not differ significant with seaweed extract in the second season. The lowest leaves content of total chlorophyll was found in the control treatment (56.18 and 67.08 mg/100 g FW) in both seasons, respectively.

Table 3. Effect of some garlic clove germination stimulants on plant fresh and dry weight and leaves content of total chlorophyll of garlic plants after 120 days of sowing during 2020/2021 and 2021/2022 seasons.

Factors	Plant fresh weight (g)		Plant dry weight (g)		Leaves content of total chlorophyll (mg/100g FW)	
	1St season	2nd season	1St season	2nd season	1St season	2nd season
Black net	136.33 c	140.17 c	25.38 b	20.67 b	63.18 b	67.26 c
Cooling (5 °C)	131.75 d	138.33 d	23.13 c	20.33 bc	66.18 a	70.28 a
Seaweed extract at $2g^{-1}$	150.00 a	145.50 a	25.92 a	27.46 a	65.39 a	69.91 a
GA_3 at 20 ppm	140.33 b	144.08 b	22.21 d	19.92 bc	65.98 a	68.83 b
Control	128.75 e	135.25 e	21.54 e	19.29 c	56.18 c	67.08 c
LSD 5%	2.77	1.40	0.64	1.12	1.40	0.49
Significant	**	**	**	*	*	*

Yield characteristics after 120 days of (early yield):

The data in Table 4 and 5 revealed that garlic yield measurements significantly affected by all tested seed germination stimulants after 120 days of sowing in both seasons of the study. Results in Table 4 showed that neck thickness of garlic plants significantly affected by all used germination stimulants in both seasons. The highest neck thickness was recorded in plants that treated with GA3 , followed by seaweed extract , then plants that subjected to 5°C of cooling in both seasons, and without any significant differ among the three treatments in the first season. In contrast of this,

garlic plants under the control treatment had the lowest neck thickness with averages of 1.57 and 1.54 cm. Data in Table 4 revealed that bulb diameter significantly affected by all tested germination stimulants in both seasons. The highest bulb diameter was found in cloves that covered with black net, followed plants that treated with GA3 , then plants that treated with seaweed extract , in the first and second seasons,. On the other side, garlic plants in the control treatment had the lowest bulb diameter with averages of 2.98 and 2.88 cm in the two seasons of the study, respectively. The obtained results in Table 4 cleared that bulb length significantly influenced by all tested germination stimulants in both seasons. The highest bulb length was found in garlic cloves that treated with GA3 (3.51 and 3.91 cm) followed cloves that covered with black net (3.48 and 3.63 cm) without any significant differ between the two treatments in the first season then cloves that seaweed extract (3.36 and 3.48 cm) while the lowest bulb length was found in the control treatment (2.98 and 3.10 cm) in both seasons, respectively.

Table 4. Effect of some garlic clove germination stimulants on neck thickness, bulb diameter and bulb length of garlic plants after 120 days of sowing during 2020/2021 and 2021/2022 seasons.

Factors	Neck thickness (cm)		Bulb diameter (cm)		Bulb length (cm)	
	1St season	2nd season	1St season	2nd season	1St season	2nd season
Black net	1.63 b	1.56 c	3.70 a	3.94 a	3.48 a	3.63 b
Cooling (5 ^{o}C)	1.71 a	1.57 c	3.36 b	3.18 c	3.01 c	3.47 c
Seaweed extract at 2g^{-1}	1.71 a	1.73 b	3.41 b	3.23 bc	3.36 b	3.48 c
GA_3 at 20 ppm	1.72 a	1.84 a	3.43 b	3.31 b	3.51 a	3.91 a
Control	1.57 c	1.54 c	2.98 c	2.88 d	2.98 c	3.10 d
LSD 5%	**0.02**	**0.04**	**0.09**	**0.13**	**0.08**	**0.10**
Significant	*	*	*	*	*	**

The results in Table 5 revealed that bulb weight significantly differ under all used germination stimulants in both seasons. The highest bulb weight was found in cloves that treated with GA3, followed by black net covering, then plants that seaweed extract, in both seasons. On the other hand, garlic plants under the control treatment had the lowest bulb weight with in the first and second seasons. Data presented in Table 5 cleared that bulb yield significantly affected by the used germination stimulants in both seasons. The highest bulb yield was found in cloves that covered with black net, followed by cooling treatment, then plants that treated with GA3, in both seasons. On the other hand, garlic plants under the control treatment had the lowest bulb yield with in both seasons.

Table 5. Effect of some garlic clove germination stimulants on bulb weight and bulb yield after 120 days of sowing during 2020/2021 and 2021/2022 seasons.

Factors	Bulb weight (g)		Bulb yield (g)	
	1St season	2nd season	1St season	2nd season
Black net	35.08 b	26.92 b	153.25 a	139.75 a
Cooling (5 ^{o}C)	27.92 d	25.67 b	138.50 b	128.42 b
Seaweed extract at 2g^{-1}	32.50 c	26.92 b	128.33 d	120.00 c
GA_3 at 20 ppm	40.17 a	40.58 a	130.92 c	128.17 b
Control	27.58 d	22.50 c	124.08 e	113.00 d
LSD 5%	**1.75**	**2.33**	**3.82**	**3.35**
Significant	**	*	**	**

Yield characteristics after 210 days of sowing:

The presented data in Table 6 and 7 showed that garlic yield measurements significantly influenced by clove germination stimulants after 210 days of sowing in both seasons of the study. The Results illustrated in Table 6 showed that shoot fresh weight of garlic plants significantly affected by all used germination stimulants in both seasons. The highest shoot fresh weight was recorded in plants that subjected to 5^{o}C of cooling, followed by GA3, then seaweed extract, in both seasons, respectively and without any significant differ between seaweed extract and GA3 in the first season. In contrast of this, garlic plants under the control treatment had the lowest shoot fresh weight in the first and second seasons. The Results illustrated in Table 6 showed that one bulb weight of garlic plants significantly differ all used germination stimulants in both

seasons. The highest one bulb weight was recorded in plants that subjected to 5°C of cooling, followed by GA3, then black net covering, in both seasons. On the other side, garlic plants under the control treatment had the lowest one bulb weight in the first and second seasons, respectively.

Data also, in Table 6 revealed that bulb diameter significantly affected by all tested germination stimulants in both seasons. The highest bulb diameter was found in cloves that covered with black net, followed plants that treated with GA3, then plants that subjected to 5°C of cooling, in the first and second seasons. On the other hand, garlic plants in the control treatment had the lowest bulb diameter in the two seasons of the study. The obtained results in Table 6 cleared that bulb length significantly influenced by all tested germination stimulants in both seasons. The highest bulb length was found in garlic cloves that treated with GA3, followed cloves that subjected to 5°C of cooling without any significant differ between the two treatments in the second season then cloves that treated with seaweed extract, while the lowest bulb length was found in the control treatment in both seasons, respectively.

Table 6. Effect of some garlic clove germination stimulants on shoot fresh weight, one bulb weight, bulb diameter and bulb length of garlic plants after 210 days of sowing during 2020/2021 and 2021/2022 seasons.

Factors	Plant fresh weight (g)		One bulb weight (g)		Bulb diameter (cm)		Bulb length (cm)	
	1St Season	2nd Season	1St season	2nd season	1St Season	2nd season	1St season	2nd season
Black net	42.07 c	38.71 d	93.92 b	88.08 c	6.07 a	6.07 a	4.69 d	4.22 c
Cooling (5 °C)	49.59 a	44.20 a	99.42 a	100.50 a	5.94 b	5.81 c	4.81 b	4.43 a
Seaweed extract at $2g^{-1}$	44.10 b	40.33 c	91.42 c	86.25 c	5.88 c	5.62 d	4.76 c	4.35 b
GA_3 at 20 ppm	44.22 b	41.67 b	97.83 a	98.42 b	6.05 a	5.88 b	4.84 a	4.45 a
Control	41.72 c	36.15 e	85.08 d	81.83 d	5.87 c	5.61 d	4.58 e	4.16 d
LSD 5%	**1.05**	**1.01**	**1.89**	**2.69**	**0.03**	**0.06**	**0.03**	**0.04**
Significant	*	**	*	**	*	*	**	**

The Results shown in Table 7 cleared that number of cloves/bulb significantly affected by tested germination stimulants in both seasons. The highest number of cloves/bulb was recorded in plants that subjected to 5°C of cooling, followed by seaweed extract, then GA3, in both seasons. In contrast of this, garlic plants under the control treatment had the lowest number of cloves/bulb in the first and second seasons. The Results in Table 7 showed that total cloves weight/bulb significantly differed under all used germination stimulants in both seasons. The highest total cloves weight/bulb was recorded in plants that subjected to 5°C of cooling, followed by GA3 without any significant differ between the two treatments then black net covering in both seasons. On the other way, garlic plants under the control treatment had the lowest total cloves weight/bulb in the first and second seasons, respectively.

Data in Table 7 indicated that average of clove weight significantly affected by all tested germination stimulants in both seasons. The highest average of clove weight was found in cloves that treated with seaweed extract followed by covering with black net then plants that treated with GA3 in the first and second seasons. On the other hand, garlic plants in the control treatment had the lowest average of clove weight with in the two seasons of the study.

Table 7: Effect of some garlic clove germination stimulants on number of clove/bulb, clove weight and average of one clove weight after 210 days of sowing during 2020/2021 and 2021/2022 seasons.

Factors	Number of bulb seeds/bulb		Total clove weight/bulb (g)		Average clove weight (g)	
	1St season	2nd season	1St season	2nd season	1St season	2nd season
Black net	17.83 c	20.33 c	77.08 b	72.50 b	4.23 b	4.21 a
Cooling (5oC)	28.83 a	25.92 a	80.33 a	74.58 a	3.38 c	3.16 c
Weed extract	25.75 b	25.25 a	75.92 b	69.25 c	5.13 a	4.26 a
GA3 (20 ppm)	25.33 b	22.08 b	81.25 a	74.58 a	3.40 c	3.65 b
Control	17.08 c	18.08 d	72.17 c	68.42 c	2.74 d	2.75 d
LSD 5%	**1.74**	**1.10**	**1.21**	**0.97**	**0.31**	**0.22**
Significant	**	**	*	*	**	*

Discussion

Growth characteristics

The present study confirmed that garlic plants that treated with seaweed extract recorded the highest plant height, leaves fresh weight, plant fresh and dry weight in both seasons. seaweed extracts contain various micro elements (Cu, Zn, B, Co) in addition to macro elements and contain Auxins, Gibberellins' and Cytokinins, when spray on plants lead to increase growth ability **Jensen (2004), Vernieri *et al.* (2005) and Khan *et al.* (2009)**. While, **Gouda, (2008)** inoculation of garlic plants with seaweed extract significantly increased all plant growth parameters. In the same way, **Zabape *et al.* (2008)** showed that seaweeds as a product can improve seeds germination, seedlings development, and enhance plant growth and yield. Our results are in similar with those obtained by, **Yousif, (2018)** who found that sprayed seaweed extracts at (8 m.L-1) recorded the highest value of leaves number plant-1, stem diameter and chlorophyll content of garlic as compared with untreated plants. However, **Hidangmayum and Sharma (2017), Abbas *et al.* (2020) and Muhie *et al.* (2020)** found in onion that seaweed extract was to be the best treatment in terms of leaf number (9.08/plant), plant height, and Crop growth rate.

Also the results in the present study revealed that the highest leaves number/plant and leaves content of total chlorophyll was found in cloves that subjected to cooling at 5oC in both seasons. Low temperature strongly affect garlic morphology and plant development as well as increase the leaf elongation of garlic and this may increase the surface area of the leaves that subjected to lights and increase chlorophyll concentration caused large induce on photosynthesis process **(Kamenetsky *et al.*, 2004)**. However, the conditioning during 5 weeks at 5◦C accelerated the crop cycle, decreased plant height and increased the synthesis of phenolic compounds and anthocyanins in the outer scale leaves compared to plants from "seed" bulbs stored at room temperature and that indicates a possible stress for low temperature **(Guevara-Figueroa *et al.*, 2015)**. Our data are in harmonic with **Luz,*et al.* (2022)** who showed that below-zero temperatures resulted in better vegetative characteristics. Also, **Azmi *et al.* (2022)**, **Luz *et al.* (2023) and Morais *et al.* (2023)** found positive effect of low temperature on garlic growth and development.

Yield Characteristics

Garlic cloves that treated with GA3 had the highest neck thickness, bulb length and bulb weight after 120 days of sowing in both seasons. Also, the highest bulb length was found in garlic cloves that treated with GA3 after 210 days of sowing in the first and second seasons. the positive effect of GA3 in garlic yield were found before by; **El-Sayed *et al.* (2007)** who found that Gibberellic acid application at 10 ppm caused significant increases on neck diameter, bulb length and diameter, total yield of garlic (ton/fed), bulb diameter and bulb weight in both seasons. **Ahmed and Hemada (2012)** indicated that soaking garlic cloves in water or 5 ppm GA3 for 24 hours improved bulb fresh weight, total fresh yield and cured yield. Also, **Maji *et al.* (2015)** showed that application of Gibberellic acid (GA3) at 30 ppm improving neck thickness, bulb length, bulb diameter, bulb yield and fresh and dry weight of bulb and TSS. Moreover, **Singh *et al.* (2018)** showed that yield attributing parameters were also observed better in terms of length and diameter of bulb, fresh weight of bulb and yield/ha under GA 3 at 50 ppm. In the same way, **Bista *et al.* (2022)** found that application of 150 mg L-1 GA3 at 7 leaf stage resulted in highest values bulb diameter and length as well as fresh weight. While, **Desta *et al.* (2022)** showed that GA3 influence bulb diameter, average bulb weight, and total bulb yield. **Lemdor and Deepanshu (2022)** found that Gibberellic acid (150ppm) proved to be most effective in term of neck thickness, polar diameter of bulb, equatorial diameter of bulb, fresh bulb weight per plot, marketable bulb weight per plot, fresh yield per plot, marketable yield per plot and bulb yield.

Our findings revealed that cloves that covered with black net recorded the highest bulb diameter after 120 and 210 days of sowing and bulb yield after 120 days of sowing in both seasons. in the same trend of our results, **Bhuiya *et al.* (2003)** reported maximum bulb weight, higher yield per plot, bulb and neck diameter were recorded from water hyacinth and straw covers respectively than un-covered plots. Also, **Jamil *et al.* (2005)** observed that straw and plastic covers increased the bulb yield and yield components. **Karaye and Yakubu (2006)** Indicated that cured bulb yield responded significantly to covering. **Islam *et al.* (2007)** found that the highest diameter of bulb, highest dry weight of bulb and maximum bulb weight were was obtained from black polyethylene cover. In the same line, **Walters (2008)** showed that black plastic provided greater winter protection for garlic (95% survival rate) compared with bare soil (85% survival rate) and resulted in greater marketable weight sand bulb diameters compared to wheat straw cover treatment. In addition, **Najafabadia *et al.* (2012)** obtained the highest fresh weight of bulb, dry weight of bulb, bulb diameter, yield per plot was achieved from straw cover. **Moravcevic *et al.* (2014)** reported that soil covering increased the quality and the bulb yield of garlic. The increase in yield was up to 140%. **Kabir *et al.* (2016)** revealed that the highest bulb yield was obtained from rice straw cover. Moreover,

Anwar *et al.*, (2020) stated that black plastic covering resulting in the highest bulb diameter, bulbing ratio, fresh and dry weights of bulb. Straw or plastic covers plus compost significantly increased average total bulb fresh yield per feddan and relative yield percentage.

Garlic cloves that subjected to 5oC of cooling had the highest shoot fresh weight, one bulb weight, number of cloves/bulb and the highest total cloves weight/bulb after 210 days of sowing in both seasons. 5◦C accelerated the crop cycle, decreased plant height and increased the synthesis of phenolic compounds and anthocyanins in the outer scale leaves of the bulbs at harvest time compared to plants from "seed" bulbs stored at room temperature and that indicates a possible stress for low temperature **(Guevara-Figueroa *et al.*, 2015).** Our data are in agreeing with those of; **Lopes *et al.* (2016)** who found the maximum height of 49.14 cm when garlic was treated for 64 days at a temperature of 4oC. **Azmi *et al.* (2022)** revealed that a temperature of 5 °C increased the number of cloves and bulbs were enhanced with vernalization 0°Cor 20 days, although it did not significantly differ from the control. In the same way, **Luz*, et al.*, (2022)** revealed that the yield and cloves numbers increased after using below-zero temperatures by 60%. Also, **Atif *et al.* (2019)** revealed that longer photoperiod (14 h or 16 h) and higher temperature (25^{o}C or 30^{o}C) treatments significantly improved the garlic bulbing imparting maximum bulb diameter, height, bulbing index, and the shortest growth period. Whereas, 12 h photoperiod had maximum bulb weight.

In the present study, the highest average of clove weight was found in cloves that treated with seaweed extract in both seasons. Similar results were found previously by, **Hidangmayum, and Sharma (2017)** confirmed that that treatment seaweed extract was found to be the best treatment in terms of fresh bulb diameter, bulb fresh weight, cloves number and weight and harvest index.

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تأثير معاملات ما قبل الزراعه على أنبات الفصوص والمحصول وخصائصه لنبات الثوم

أجريت التجارب الحالية في أحد المزارع الخاصة التابعة لمحافظة المنيا لتقييم تأثير بعض معاملات ما قبل الزراعة (التغطية بالشبكة السوداء، التبريد عند درجة حرارة 5 درجة مئوية لمدة 48 ساعة، النقع في مستخلص الأعشاب البحرية والنقع في 20 جزء في المليون GA3 مقارنة بالكنترول) على نمو نباتات الثوم ومحصول الأبصال وجودتها. خلال موسمي النمو 2022/2021 و2023/2022. وقد أكدت البيانات أن جميع صفات النمو الخضرى لنباتات الثوم تأثرت معنويا تحت جميع محفزات إنبات الفصوص بعد 120 يوماً من الزراعة في كلا موسمي الدراسة حيث تفوقت جميع المعاملات المستخدمة معنوياً على معاملة الكنترول في جميع صفات النمو في كلا الموسمين. سجلت المعاملة بمستخلص الطحالب البحرية لنباتات الثوم أعلى ارتفاع للنبات ووزن الأوراق الطازجة ووزن النبات الطازج والجاف في كلا الموسمين. وجد أعلى عدد أوراق / نبات ومحتوى الأوراق من الكلوروفيل الكلي في النباتات النتاجة من الفصوص التي خضعت للتبريد عند درجة حرارة 5 مئوية في كلا الموسمين. تفوقت جميع منشطات الإنبات المختبرة على معاملة الكنترول في زيادة جميع صفات المحصول في كلا الموسمين. كانت للنباتات الناتجة من فصوص الثوم المعاملة بحامض الجبريليك هي الأعلى سمكاً للعنق وطول البصلة ووزنها في كلا الموسمين. سجلت النباتات الناتجة من الفصوص المغطاة بشبكة سوداء أعلى قطر للأبصال وإنتاجية للأبصال في كلا الموسمين. أظهرت البيانات أن قياسات محصول الثوم تأثرت معنوياً بمنشطات إنبات الفصوص بعد 210 يوم من الزراعة في كلا موسمي الدراسة. اظهرت نتائج نباتات بذور الثوم التي خضعت للتبريد على درجة حرارة 5م أعلى وزن طازج للمجموع الخضرى, اعلى وزن البصلة الواحدة، أعلى عدد فصوص/البصلة، وأعلى وزن كلى للفصوص/البصلة في كلا الموسمين. وجد أن أعلى قطر للبصلة في النباتات المغطاة بشبكة سوداء، بينما أعلى طول للبصلة وجد في بذور الثوم المعاملة بحامض الجبريليك في الموسمين الأول والثاني. كما أن أعلى متوسط لوزن الفصوص وجد في النباتات المعاملة بمستخلص الأعشاب البحرية في كلا الموسمين.