

## Influence of Seeds Soaking with Benzyladenine, Paclobutrazol, Algae Extract, Some Mineral Nutrients and Lithovit on Seeds Germination and Seedling Growth of *Moringa oleifera* Plant.

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### Abstract

Two laboratory experiments were conducted out at Agricultural Botany Department, Faculty of Agriculture, Moshtohor, Benha University, Qalyubia Governorate, Egypt, during two successive seasons of 2016 and 2017. The objective of this study was to evaluate the effect of soaking of seed with benzyl adenine (BA) at (25, 50 and 100 mg l<sup>-1</sup>), paclobutrazol (PP<sub>333</sub> at (5, 10 and 20 mg l<sup>-1</sup>), algae extract at (5, 10 and 20 ml<sup>-1</sup>), mineral nutrients (Ca, Mg and Fe chelated) at 500 mg l<sup>-1</sup> and treatment of lithovit at 500 mg l<sup>-1</sup> on seed germination (percentage, rate) and seedling growth of *Moringa oleifera* plant.

The obtained results reported that seed soaking with benzyl adenine (BA) at different tested concentrations enhanced seed germination and seedlings growth traits during the two seasons of study. Also, soaking seeds in 100 mg l<sup>-1</sup> benzyl adenine (BA) reflected the highest values of seed germination (rate and percentage) as well as growth of seedling measurements i.e., The radical and plumule lengths at 7, 10 and 13 days from soaking and absolute growth rate of root and stem after 10 and 13 days of seed treating followed by using lithovit at 500 mg l<sup>-1</sup>, Algae extract at 20 ml<sup>-1</sup>, benzyl adenine (BA) at 50 mg l<sup>-1</sup>, mineral elements at 500 mg l<sup>-1</sup> and benzyl adenine the at the lowest concentration i.e., 25 mg l<sup>-1</sup> in descending order.

On contrary, germination of seeds and seedlings growth traits were significantly decreased with paclobutrazol treatments in both seasons compared with the control treatment.

**Key words:** moringa, benzyl adenine, paclobutrazol, algae extract, lithovit and seed germination.

### Introduction

*Moringa oleifera* Lama is a species of mono generic Family Moringaceae, contains 13 species of trees and shrubs (Fahey 2005). *Moringa oleifera* is a crucial food commodity with a great deal of attention as a natural food for the tropics and subtropics. Various parts (leaves, fruit, flowers and immature pods) of this plant are used as a highly nutritious vegetable in many countries (Anwar et al., 2005). Also, it has an amazing range of medicinal uses owing to its high nutritional rate.

Moringa leaves have been reported to be a rich source of protein, vitamins, B-carotene, essential minerals (Ca and K), amino acids and a variety of phenolic compounds serving as a respectable source of natural antioxidants such as ascorbic acid, flavonoids, phenolics and carotenoids (Siddhuraju and Becker 2003). Moringa is sexually distributed through the seeds and vegetatively through the stem cuttings (Palada and Chang 2003).

Its germination percentage varies between 60% and 90% for fresh seed (Jahn et al., 1986) and germinates between 7 and 30 days after planting (Sharma and Raina 1982). Cultivation of moringa by seed is troublesome as seeds typically begin to lose viability within 2 months of storage. (Sharma and Raina 1982) recorded 60 percent, 48 percent and 7.5 percent germination of moringa seed after 1, 2 and 3 months of selection. Old moringa seed has problems with germination due to high oil content and insect attacks. There is a strong need to investigate ways to solve germination problems in Moringa seeds (Ahmed et al., 2014).

Various priming techniques have been developed to promote plants, such as hydropriming, osmopriming, matrimpriming, hardening, osmohardening, and hormonal primers (Basra et al., 2005) and (2006), respectively (Afzal et al., 2008). Main therapy decreases the date of onset and raises the percentage of final onset and onset index (Farooq et al., 2005), (2006b) and (2008). They also organize the emergence of seeds which result in even-handed growth and increased yield (Du and Tuong 2002); (Harris et al., 2002). (Tedonkeng et al., 2004) described that germination of older moringa seeds can also be enhanced by freshwater soaking, but no detailed research analysis on the consequences of different seed primers was published earlier on techniques of the emergence and seedling of moringa.

Consequently, it is important to find ways to disperse the plant rapidly, allowing farmers to maximize their production potential. The main objective of this research is therefore to investigate the effects of benzyl adenine, paclobutrazole, algae extract, mineral elements (Ca, Mg and Fe chelated) and lithovit on seed germination percent and rate, as well as the seedling strength guide for *Moringa oleifera* plant.

Cytokinins are plant hormones, which control a variety of plant behavior, including seed germination (Graeber et al., 2012). They are active in all germination cycles (Chiwocha et al., 2005), (Nikolic et al., 2006), (Riefler et al., 2006). They can also influence the behaviors of meristemic cells in roots and shoots during the germination process.

Various activities of cytokinins, such as their effects on seed germination, have been qualified for

many roles of cytokines in various cell types. Plant hormones with cytokines are biological compounds that regulate a broad variety of physiological and biochemical reactions in plant life (Werner *et al.*, 2001). Nanotechnology is a hopeful field of interdisciplinary research. It opens up a wide range of opportunities in various fields including agriculture. The potential applications and benefits of nanotechnology are wide. Nanoparticles produce both positive and negative biological results in living cells (Nel *et al.*, 2006). There is a growing volume of research into the biological impact of nanoparticles on higher plants. Similarly, mixture of nanoscales hastened germination in soybean (Lu *et al.*, 2002). Prasad *et al.*, (2012) found that the treatment of nanoscales facilitated seed germination and seedling intensity and was successful in growing stem and root growth. (Hojjat 2015) suggest that nanoscales at their lower stage minimize Speed of germination, percent germination and earlier seedling growth in Fenugreek.

Paclobutrazol (PP<sub>333</sub>) is an effective plant growth retardant for use of the Plant Growth Control Society of America (PGRSA 2007). It plays a strong regulatory function in plant development. Paclobutrazol inhibits growth by inhibiting the biosynthesis of gibberellin (Rademacher 2000). Marshall *et al.*, (2000) reported that treatment of fresh silver maple seeds with paclobutrazol late germination and decrease root and shoot extension. Also, Mijajlović *et al.*, (2005) reported that paclobutrazole as a growth retardant-caused inhibition of centaury (*Centaureum erythraea* rafn) seed germination. Müller (2007) achieved reproducible results of paclobutrazol on the inhibition of seed germination of Townsville stylo (*Stylosanthes humilis*).

Algae extract has been promoted for several years as fertilizer additives and helpful results from their use have been reported (Ahmed and Shalaby 2012).

The importance of the extract of algae as a biofertilizer was due not only to the content of nitrogen, phosphorus and potassium, but also to the presence of trace elements and metabolites. These extracts enhance the germination of seeds and the absorption of nutrients by plants. The extract also includes phytohormones IAA, IBA, cytokinins, other trace elements (Fe, Cu, Zn, Co, Mo, Mn, Ni), Several vitamins and amino acids (Durand *et al.*, 2003), (Stirk *et al.*, 2003) and (Ördög *et al.*, 2004). Many experiments have demonstrated a wide variety of beneficial effects of algae extract submissions on plants, such as promoting the germination of watermelon and sesame seeds (Sunarpi *et al.*, 2007).

Algae extract was able to increase the growth as a result of enhancement of protein biosynthesis and cell division, and mobilization of elements needing for growth (Pascale *et al.*, 1993).

## Material and Methods

The present investigation was carried out during

the two successive seasons of 2016 and 2017 at laboratory of Agricultural Botany Department, Faculty of Agriculture, Moshtohor, Benha University.

The main objective of this research was to study the effect of benzyl adenine, paclobutrazole, algae extract, some mineral elements and Lithovit on the germination of seeds, the growth of seedlings (rate and percentage) and the growth of *Moringa oleifera* plants.

### I. Source of seeds, algae extract and lithovit:

*Moringa oleifera* Seeds were brought from the National Research Centre, Dokki. Giza, Egypt.

Algae extract was obtained from the Algae Biotechnology Unit, National Research Center, Dokki, Giza, Egypt, and prepared by dissolving 5, 10 and 20 ml<sup>-1</sup> of water. Lithovit as Nano-Particles (Calicum, Magnesium and Iron Nano or Micro-Particles) was acquired from the Agro-Link Firm (3 Ibn-Eyas. St., Roxy, Heliopolis, Cairo).

Lithovit was used in the German industrial commodity by Zeovito Company. The solution was prepared by dissolving 0.5 g/L of distilled water.

This experiment was done in laboratory by using 10 cm diameter petri dishes. Seeds of *Moringa oleifera* were soaked four hours in the following assigned treatments.

### The applied treatments as following:

- 1- Control (distilled water)
- 2- Benzyl adenine at 25, 50 and 100 mgL<sup>-1</sup>
- 3- Paclobutrazol at 5, 10 and 20 mgL<sup>-1</sup>
- 4- Algae extract at 5, 10 and 20 ml<sup>-1</sup>
- 5- Mineral nutrients (Ca, Mg and Fe chelated) at 500 mgL<sup>-1</sup>
- 6- Lithovit (nanoparticles) at 500 mgL<sup>-1</sup>

The seeds with uniform size and weight were chosen for the experimental study. The seeds surface were sterilized with 0.2% Hg cl<sub>2</sub> solution for 5 minutes and washed thoroughly with distilled water.

Petri dishes (10 cm in diameter) is sterilized and then filtered to hold moisture for the germination of the seeds.

### II. Soaking treatment:

Thirty (30) moringa seeds were soaked in 200 ml for each treatment and deposited for 4 hours for each treatment, on May 5 in both seasons.

Then, the seeds of different levels of each treatment were transferred into petri dishes, 10 seeds were placed in each petri dish at equal distance in 3 replicates and then these were incubated at room temperature. Also, filter papers were kept always wet. Maintaining sufficient moisture, 5 ml/petri distilled dishes are taken as a control.

### III. Collection of data for germination and growth parameters as follows:

Data for day-to-day germination of seed was collected before germination is done (maximum up to 13 days). Seeds with a growth rate of 0.5 mm or more have been counted as germinated seeds.

Every three days, the germination in each replicate

was removed from the petri dishes for measurements of radical and plumule length till the end of the experiment (13 days).

**Then the following measurements were estimated:**

#### 1- The Germination percentage:

The Germination percentage of seeds was calculated as the method described by (Scott *et al.*, 1984) as germinated seeds from the total seed of each treatment on the day of completion according to the following equation:

$$\text{Germination \%} = \frac{\text{Number of the germinated seeds}}{\text{Number of total seeds}} \times 100$$

#### 2- Germination rate:

Data of germination rate were recorded at three periods, (4, 6 and 8 days) from soaking. Germination rate was expressed as the mean number of days required for germination (M days) according to the formula of (Edmond and Drapala 1958):

$$M \text{ days} = \frac{(N_1 \times G_1) + (N_2 \times G_2) + \dots + (N_n \times G_n)}{G_1 + G_2 + \dots + G_n}$$

$N_1$ = Number of days passed from soaking till first count.

$N_2$ = Number of days passed from soaking till second count to  $N_n$ .

$G_1$ =Number of seeds germinated at the first count.

$G_2$ =Number of germinated seeds at the second count..... to  $G_n$ .

#### 3- Root and stem length:

The root and stem lengths were slow with the help of a thread and scale. Root length was measured from the point below the cotyledons to end of the tip root and stem length was taken from the point of cotyledons up to the plumule.

#### 4- Seedling vigour index:

The seedling vigour index was calculated by using the formula according to (Abdul boki and Anderson 1973).

**Seedling vigour index** = (Average root length cm + Average stem length in cm) x Germination percentage.

#### 5- Absolute growth rate of stem and root

Absolute growth rate of stem and root were calculated according to the formula of (Cairo *et al.*, 2008):  $AGR = \frac{(PDW_f - PDW_i)}{(t_f - t_i)}$  (expressed in g day<sup>-1</sup>), where PDW<sub>f</sub> and PDW<sub>i</sub> are the plant dry weights at the start and the end of the experiment,  $t_f$  and  $t_i$  correspond to the final and initial period of the experiment in days.

#### IV. Statistical analysis:

Data of seeds germination and seedlings growth were statistically analyzed and the means were compared by using the Least Significant Difference test (L.S.D) at 5% level according to (Snedecor and Cochran 1989).

## Results

### 1- Seed germination (percentage and rate) and seedling vigour index:

Data presented in Table (1) demonstrate the impact of seed soaking treatment with BA at (25, 50 and 100 mg l<sup>-1</sup>), PP<sub>333</sub> at (5, 10 and 20 mg l<sup>-1</sup>), algae extract at (5, 10 and 20 ml l<sup>-1</sup>), mineral elements i.e. (Ca, Mg and Fe chelated) at 500 mg l<sup>-1</sup> and lithovit at 500 mg l<sup>-1</sup> for seed germination. (rate and germination percentage) and seedling vigour index of moringa grown under the laboratory conditions during the two seasons of 2016 and 2017. Herein, it was clear that soaking the seeds in benzyl adenine solution in different tested concentrations enhanced all forementioned seed germination and seedling vigour index during the two seasons of this study.

In this regard, the soaking seeds in 100 mg l<sup>-1</sup> benzyl adenine provided substantially higher seed germination rates and percentages as well as the seedling vigour index at 7, 10 and 13 days following soaking in both study seasons accompanied by the use of lithovit at 500 mg l<sup>-1</sup>, algae extract at 20 ml l<sup>-1</sup>, benzyl adenine at 50 mg l<sup>-1</sup>, mineral elements at 500 mg l<sup>-1</sup> and benzyl adenine at the lowest concentration 25 mg l<sup>-1</sup> in descending order when compared with the control treatment.

On the other hand, the soaking of seeds at various tested concentrations of paclobutrazol reduced seed germination (rate and percentage) and the seedling vigour index relative to control during both study seasons.

### 2- Growth of seedlings (radical and plumule length):

As shown in Table (2), different estimated growth characteristics of moringa seedlings (average radical and plumule length) grown in laboratory conditions treatment of seeds such as benzyl adenine at (25, 50 and 100 mg l<sup>-1</sup>), paclobutrazole at (5, 10 and 20 mg l<sup>-1</sup>), algae extract at (5, 10 and 20 ml l<sup>-1</sup>), mineral elements i.e. (Ca, Mg and Fe chelated) at 500 mg l<sup>-1</sup> and lithovit at 500 mg l<sup>-1</sup> were affected during the two seasons of 2016 and 2017.

Also, the same data illustrate that soaking seeds in benzyl adenine solution in different tested concentrations enhanced seedling radicals and plumule growths during both seasons of study. In this respect, soaking seeds in 100 mg l<sup>-1</sup> benzyl adenine gave the highest values of seedling growth measurements i.e., radical and plumule lengths at 7, 10 and 13 days from soaking followed by using lithovit at 500 mg l<sup>-1</sup>, algae extract at 20 ml l<sup>-1</sup> and benzyl adenine at 50 mg l<sup>-1</sup> in descending order when compared with the control treatment.

The same data also confirmed the stimulatory and significantly effects of different applied treatments upon seedlings growth (radical and plumule lengths).

On the other side, soaking seeds in different tested concentrations of paclobutrazol decreased seedling growth parameters compared with the control treatment during the two seasons of study.

**Table 1.** Effect of seed soaking treatments with benzyl adenine, paclobutrazol, algae extract, some elements (Ca, Mg and Fe in chelated form) and lithovit on seeds germination (rate and percentage) and seedling vigour index of *Moringa oleifera* grown under laboratory conditions during seasons of 2016 and 2017.

Characteristics Treatments		Number of germinated seeds		Germination Rate		Germination Percentage (%)		Seedling vigour index	
		Seasons						2016	2017
		2016	2017	2016	2017	2016	2017		
Control	0.0	8	7	5.8	6.2	80	70	402	483
	25 mg <sup>l</sup> <sup>-1</sup>	9	8	4.8	5.4	90	80	594	662
Benzyl adenine	50 mg <sup>l</sup> <sup>-1</sup>	10	10	4.4	4.4	100	100	840	1040
	100 mg <sup>l</sup> <sup>-1</sup>	10	10	4.0	4.0	100	100	1200	1350
	5 mg <sup>l</sup> <sup>-1</sup>	7	6	6.4	7.0	70	60	263	320
Paclobutrazol	10 mg <sup>l</sup> <sup>-1</sup>	6	5	7.0	7.6	60	50	197	229
	20 mg <sup>l</sup> <sup>-1</sup>	4	3	7.8	7.8	40	30	111	121
	5 ml <sup>l</sup> <sup>-1</sup>	8	7	5.2	6.0	80	70	442	525
Algae extract	10 ml <sup>l</sup> <sup>-1</sup>	9	8	4.8	5.2	90	80	628	727
	20 ml <sup>l</sup> <sup>-1</sup>	10	10	4.2	4.3	100	100	1010	1153
Elements	500 mg <sup>l</sup> <sup>-1</sup>	10	10	4.4	4.8	100	100	785	981
Lithovit	500 mg <sup>l</sup> <sup>-1</sup>	10	10	4.0	4.2	100	100	1096	1253
L.S.D.	0.05	1.21	1.75	0.21	0.17	6.98	7.74	64.93	79.92

**Table 2.** Effect of seed soaking treatments with benzyl adenine, paclobutrazol, algae extract, some elements (Ca, Mg and Fe in chelated form) and lithovit on seedling growth (radical and plumule length) of *Moringa oleifera* at 7, 10 and 13 days after soaking grown under laboratory conditions during seasons of 2016 and 2017.

Characters Treatments		Average of radical length (cm) seedling <sup>-1</sup>						Average of plumule length (cm) seedling <sup>-1</sup>																
		Seasons																						
		2016			2017			2016			2017													
													Days after soaking											
													7	10	13	7	10	13	7	10	13	7	10	13
Control	0.0	1.95	2.67	3.80	2.70	4.00	5.20	1.50	2.35	3.20	1.80	2.90	4.30											
	25 mg <sup>l</sup> <sup>-1</sup>	2.83	3.70	5.00	3.50	4.88	6.18	1.80	2.90	4.00	2.10	3.40	5.00											
Benzyl adenine	50 mg <sup>l</sup> <sup>-1</sup>	4.00	5.00	6.39	4.90	6.45	7.95	2.10	3.40	4.70	2.43	3.95	5.75											
	100 mg <sup>l</sup> <sup>-1</sup>	5.67	7.20	9.10	6.50	8.35	10.15	2.80	4.80	6.80	3.12	5.15	7.45											
	5 mg <sup>l</sup> <sup>-1</sup>	1.70	2.00	3.00	1.95	2.95	3.90	1.25	1.75	2.25	1.58	2.38	3.48											
Paclobutrazol	10 mg <sup>l</sup> <sup>-1</sup>	1.45	1.65	2.80	1.65	2.45	3.25	1.15	1.63	2.08	1.45	2.13	3.12											
	20 mg <sup>l</sup> <sup>-1</sup>	1.20	1.32	2.55	1.46	2.15	2.90	1.03	1.45	1.85	1.33	1.88	2.58											
	5 ml <sup>l</sup> <sup>-1</sup>	2.15	2.93	4.15	3.00	4.30	5.50	1.70	2.60	3.50	2.00	3.20	4.70											
Algae extract	10 ml <sup>l</sup> <sup>-1</sup>	3.00	3.88	5.30	4.00	5.44	6.84	1.93	3.10	4.27	2.25	3.65	5.35											
	20 ml <sup>l</sup> <sup>-1</sup>	4.70	6.10	7.90	5.45	7.10	8.70	2.30	4.00	5.70	2.83	4.43	6.33											
Elements	500 mg <sup>l</sup> <sup>-1</sup>	3.66	4.60	6.00	4.50	6.00	7.45	2.00	3.25	4.50	2.36	3.81	5.56											
Lithovit	500 mg <sup>l</sup> <sup>-1</sup>	5.15	6.61	8.55	6.10	7.83	9.53	2.50	4.35	6.15	2.85	4.70	6.80											
L.S.D.	0.05	0.20	0.20	0.20	0.19	0.25	0.25	0.20	0.20	0.19	0.14	0.23	0.19											

### 3- Absolute growth rate of seedlings:

Absolute growth rate of seedlings related patterns are seen in **Table (3)** on the results of seed soaking treatments with BA at (25, 50 and 100 mg l<sup>-1</sup>), PP<sub>333</sub> at (5, 10 and 20 mg l<sup>-1</sup>), extract of algae at (5, 10 and 20 ml l<sup>-1</sup>), mineral elements i.e. (Ca, Mg and Fe chelated) at 500 mg l<sup>-1</sup> and lithovit at 500 mg l<sup>-1</sup> at an absolute growth rate (g day<sup>-1</sup>) of moringa seedling root and stem under the laboratory conditions during the two seasons of 2016 and 2017. The same data shows that the seeds soaking in benzyl adenine solution with varying concentrations tested were the most successful treatment that resulted in the absolute growth rate of the highest seedling values during the two study season.

In this regard, soaking seeds in 100 mg l<sup>-1</sup> benzyl adenine substantially improved seedling absolute root

and stem growth rates after 10 and 13 days following seed treatment in both study seasons followed by lithovit at 500 mg l<sup>-1</sup>, algae extract at 20 ml l<sup>-1</sup>, benzyl adenine at 50 mg l<sup>-1</sup> and mineral elements at 500 mg l<sup>-1</sup>, and benzyl adenine at the lowest concentration at 25 mg l<sup>-1</sup> in descending order when compared with the control treatment.

In addition, root seedlings and stem biomass were substantially improved with a number of therapies. It was clear from the same evidence that the calming and important results of the applied treatments greatly increased the growth characteristics of the seedlings.

With respect to the handling of paclobutrazol, it should be observed that the seeds are soaked at varying amounts of paclobutrazol level decreased seedling absolute growth rate compared with the control during both seasons of study.

**Table 3.** Effect of seed soaking treatments with benzyl adenine, paclobutrazol, algae extract, some elements (Ca, Mg and Fe in chelated form) and lithovit on absolute growth rate of roots and stems (g day<sup>-1</sup>) of *Moringa oleifera* seedlings grown under laboratory conditions during seasons of 2016 and 2017.

Characteristics	Treatments	Absolute growth rate of root				Absolute growth rate of stem			
		Seasons							
		2016		2017		2016		2017	
		Days after soaking							
		10	13	10	13	10	13	10	13
Control	0.0	0.24	0.38	0.43	0.40	0.28	0.32	0.37	0.47
	25 mg l <sup>-1</sup>	0.29	0.43	0.46	0.43	0.37	0.40	0.43	0.53
Benzyl adenine	50 mg l <sup>-1</sup>	0.33	0.46	0.52	0.50	0.43	0.47	0.51	0.60
	100 mg l <sup>-1</sup>	0.51	0.63	0.62	0.60	0.67	0.70	0.68	0.77
Paclobutrazol	5 mg l <sup>-1</sup>	0.10	0.36	0.33	0.32	0.17	0.20	0.27	0.37
	10 mg l <sup>-1</sup>	0.06	0.34	0.27	0.27	0.16	0.18	0.23	0.33
	20 mg l <sup>-1</sup>	0.04	0.32	0.23	0.25	0.14	0.17	0.18	0.23
Algae extract	5 ml l <sup>-1</sup>	0.26	0.44	0.44	0.42	0.30	0.33	0.40	0.50
	10 ml l <sup>-1</sup>	0.29	0.46	0.48	0.47	0.39	0.42	0.47	0.57
	20 ml l <sup>-1</sup>	0.46	0.60	0.55	0.53	0.57	0.60	0.53	0.63
Elements	500 mg l <sup>-1</sup>	0.31	0.45	0.50	0.48	0.42	0.45	0.48	0.58
Lithovit	500 mg l <sup>-1</sup>	0.49	0.62	0.58	0.57	0.62	0.63	0.62	0.70
L.S.D. at	0.05	0.05	0.06	0.08	0.05	0.09	0.09	0.05	0.10

### Discussion

Such enhancing effect of using BA, algae extract, mineral nutrients and lithovit on germination of seed and seedling growth parameters may be qualified to the main role of such growth enhancement substances on the regulation of meristematic cell division, cell enlargement, differentiation activity and organogenesis in the evolving plants, which in turn may stimulate plant growth rate.

The promotive effects of BA on accelerating and increasing seeds germination %, rate and seedling growth traits of *Moringa oleifera* in the current study attributed to the significant role of cytokinins in the formation of hydrolytic enzymes activates for the mobilization of reserve in germination seeds. Also, benzyl adenine has important role on synthesis of enzyme protein by messenger RNA and DNA synthesis. Hence, reflected on germination processes

and in the subsequent development of the seedling. Plant hormones have cytokinins, are biochemical substances regulatory many physiological and biochemical processes in the plant (Werner *et al.*, 2001). Cytokinins are regulating a range of plant activities including seed germination (Graeber *et al.*, 2012). They are active in all periods of germination (Chiwocha *et al.*, 2005), (Nikolic *et al.*, 2006), (Riefler *et al.*, 2006). Different actions of cytokinins, such as their properties on seed germination, have been attributed to the several functions of cytokinins in different plant cell types. They can also affect the activities of meristemic cells in roots and shoots.

Cytokinins also, has a regulatory role in the translation of genetic code into new protein (Purohit 2007). Several researches showed that cytokinins have a very active metabolism roles in all phases of germination from imbibition to radical emergence and the start of seedling establishment (Stirk *et al.*, 2005)

and (Nikolic *et al.*, 2006). In this respect, (Patil *et al.*, 2012) found that all used types and concentration of BA and auxins were able to accelerate the germination rate and increases seed germination % and seedlings growth of *Digitalis puerperal*.

These results of BA are in harmony with those reported by (Du and Tuong 2002), (Harris *et al.*, 2002), (Ismail 2004), (Afzal *et al.*, 2008), (Chiwocha *et al.*, 2005 ), (Farooq *et al.*, 2005 ), (Nikolic *et al.*, 2006), (El-Desoky 2013) and (Ahmed *et al.*, 2014).

The simulative favorable effect of algae extract in present investigation on personally seeds germination rate and %, in addition, seedlings growth parameters may be due to its content of the plant growth promoting constituents such as cytokinins, auxins, gibberellins, amino acids, vitamins and enzymes which reflected on enhancing of seeds germination % and rate as well as seedlings growth by effecting on activities of many enzymes and with cell division and cell expansion.

Many studies have evaluated the helpful effects of different algael extracts on improving seeds germination and seedling growth by (Thirumaran *et al.*, 2009) and (Cherian *et al.*, 2011) they showed that the seaweed extract promoted seeds germination % and rate as well as seedling growth (shoot length and root length) of rice seeds.

Similarly, (Arun *et al.*, 2014) showed that rate and % of seeds germination and seedlings growth of tomato and okra seeds were increased by low concentration of seaweed extract, but it reduces at higher level. The applying of seaweed extract improves seeds and seedling development and stimulates rooting (Zhang and Errin 2008).

The aforementioned results of algae extract are in conformity with those obtained by (Pascale *et al.*, 1993), (Sunarpi *et al.*, 2007), (Zhang and Errin 2008) and (Arun *et al.*, 2014). Such enhancing effects of lithovit and mineral nutrients (Ca, Mg and Fe chelated) on seeds germination process and seedlings growth due to the functions of these mineral nutrients in cell metabolism and effects as a metal component of some enzymes and during seeds germination (Marschner 1995).

Such results of lithovit have been earlier recommended by (Lu *et al.*, 2002), (Prasad *et al.*, 2012), (Yugandhar and Savithamma 2013), (Hojjat 2015) and (Abdel ghafar *et al.*, 2016). They found that treatment of nanoscales promoted both seed germination and seedling vigour and proved effective on increasing stem and root growths.

In this respect, (Abdel ghafar *et al.*, 2016) presented that lithovit application with 0.5 g/L significantly affected on seed germination % of onion plants. (Yugandhar and Savithamma 2013) showed that the biosynthesized calcium carbonate nanoparticles accelerate the seed germination and seedling growth of *Vigna mango* and the highest percentage of seed germination, seedling vigor index,

root and shoot length were recorded from synthesized CCNPS treatment.

On the other side, such reduction and delayed seeds germination rate and percentage as well as seedlings growth aspects in the abovementioned results with paclobutrazol treatments may be attributed to that paclobutrazol in a common is anti-gibberellin and inhibits gibberellin biosynthesis, later reducing cell elongation and retarding plant growth (Rademcher 2000).

Since, the stimulating effects of gibberellin on germination process due to fact that GA<sub>3</sub> affects on activities of many enzymes and control production of hydrolyzing enzymes involved in germination process GA<sub>3</sub> also induces substrate mobilization. In addition, one of the effects of GA<sub>3</sub> is to promote the onset of DNA synthesis in cells which are arrested a G<sub>1</sub> phase of cell cycle.

GA<sub>3</sub> can promote the growth of plant by affecting either cell expansion and or cell division or both (Purohit 2007).

On the contrary, paclobutrazol completely reversed these effects of gibberellin. Hence, it decreased seeds germination % and rate as well as seedling vigour growth of moringa plants these results are in agreement with those obtained by (Marshall *et al.*, 2000), (Rademacher 2000), (Ismail 2004), (Mijajlović *et al.*, 2005), (Müller 2007) and (Abd El-Gwad 2006) they reported that treatment of seeds with paclobutrazol delayed germination and decreased root and shoot extension.

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## تأثير نقع البذور بالبنزيل أدنين و الباكلوبترازول و مستخلص الطحالب و بعض العناصر الغذائية والليثوفيت على إنبات بذور ونمو بادرات نبات المورينجا.

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أجريت تجربتين معمليتين بقسم النبات الزراعى - كلية الزراعة - جامعة بنها - محافظة القليوبية - مصر خلال موسمى 2016 ، 2017 لدراسة تأثير نقع البذور بمنظم النمو البنزيل أدنين بتركيز 25، 50، 100 ملجم/لتر والباكلوبترازول بتركيز 5 و 10 و 20 ملجم/لتر ومستخلص الطحالب بتركيز 5 و 10 و 20 مل/لتر وبعض العناصر الغذائية ( كالسيوم وماغنسيوم وحديد مخلبى ) بتركيز 500 ملجم/لتر والليثوفيت بتركيز 500 ملجم/ لتر مقارنة بالكنترول (ماء الصنبور) على نسبة إنبات البذور ونمو البادرات لنبات المورينجا. أظهرت النتائج المتحصل عليها أن معاملات نقع البذور بالبنزيل أدنين بالتركيزات المختلفة المستخدمة قد حسنت كل الصفات المدروسة متمثلة فى نسبة إنبات البذور ونمو البادرات خلال موسمى الدراسة . أعطت معاملة نقع البذور بالبنزيل أدنين بتركيز 100ملجم/لتر أعلى القيم لنسبة ومعدل إنبات البذور وقياسات نمو البادرات متمثلة فى ( متوسط طول الجذير والريشة عند عمر 7 و 10 و 13 يوم من نقع البذور ومعدل النمو المطلق للجذر والساق عند عمر 10 و 13 يوم ) ثم معاملات الليثوفيت بتركيز 500 ملجم/لتر و مستخلص الطحالب بتركيز 20 مل/ لتر والبنزيل أدنين بتركيز 50 ملجم/لتر والعناصر الغذائية ( كالسيوم وماغنسيوم وحديد مخلبى ) بتركيز 500 ملجم/لتر والبنزيل أدنين بتركيز 25ملجم/ لتر مرتبة تنازلياً. وعلى العكس من ذلك أدت معاملة الباكلوبترازول إلى نقص معنوى فى نسبة ومعدل إنبات البذور وقياسات نمو البادرات مقارنة بالكنترول خلال موسمى الدراسة.