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Improvement Wheat Germination by Using some Biostimulants Substances

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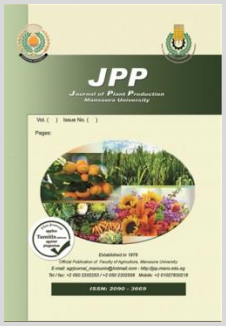

ABSTRACT

A laboratory experiment was carried out at Seed Testing Laboratory, Agronomy Department, Faculty of Agriculture, Mansoura University, Egypt, during November and December 2018 to study the effects of application methods and seeds treatments with some biostimulants on germination parameters of bread wheat Misr 2 cultivar. The experiment was conducted in factorial experiment in Completely Randomized Design (CRD) with 4 replications. The experiment included two factors. The first factor included two application methods with some biostimulants (soaking and priming). The second factor integrated with eleven seed treatments with biostimulant substances. The obtained results showed that the priming method surpassed soaking method in final germination percentage, germination index and co-efficient of germination. Nevertheless, soaking method surpassed priming method in abnormal seedlings %, speed germination index, mean germination time and germination energy %. Treating seeds with yeast extract surpassed the other studied treatments in speed germination index, mean germination time and germination energy percentage. Conversely, treating with mixture of ascorbic acid and salicylic acid surpassed other studied treatments in final germination percentage and germination index. However, treating with mixture of humic acid + amino acid + algea extract + yeast extract surpassed other studied treatments in abnormal seedlings percentage. It could be recommended that priming seeds of bread wheat Misr 2 cultivar with the mixture of ascorbic acid and salicylic acid at the rate of 200 mg/L of each or yeast extract at the rate of 100/L as an effective way for improving germination parameters.

Keywords: Wheat, soaking, priming, biostimulants, germination parameters.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the chief source is of food for more than a third of the world population. As all cereal crops, begins to lose seed quality when they are harvested, processed or stored. The losses of seed viability resultant destitution in plant stand which is the basis for appreciate production and expansion of this crop mainly in tropical and subtropical counties.

Seed germination is an important biological process in growth cycle of the plant species. Successful plant establishment in most cases ends up in acceptable and economical final yield (Zare *et al*., 2006). Poor plant establishment is a common cause of reduction in plant yields in arid and semi-arid areas (Harris and Hollington, 2001). The key to success in seed propagation is proper timing of germination. Where the period of germination is prolong, the emerging seedling is exposed to risk of attack by soil microbes or lack of sufficient moisture, light or oxygen. The idea of soaking seeds before sowing is aimed at shortening the lag phase in germination and to enhance seedling establishment thereby minimizing the risk in the early vegetative growth (Sabongari and Aliero, 2003). Abo-El-Kheer *et al*. (2019) revealed that there was a noticeable improvement in germination percentage as compared to control treatment due to seeds soaking technique. Patra (2019) stated that seed soaking with water in cereal crops especially wheat and rice has been found to be better in mitigating the detrimental effect of adverse climatic conditions. During priming, the seeds are usually exposed to an external water potential biochemical and physiological processes occur before germination within the seed, which is sufficient to prevent germination, but let biochemical and physiological processes occur before germination within the seed. Priming seeds allows some of the metabolic processes necessary for germination to occur without germination take place. Seed priming has been commonly used to reduce the time between seed sowing and seedling emergence and to synchronize emergence (Parera and Cantliffe, 1994 ; Khan *et al*., 2011 and Patra, 2019). Seed priming with various plant growth hormones, such as salicylic acid, ascorbic, amino acid or yeast extract is a common technique for increasing the speed and uniformity of germination and seedling emergence under stress (Ashraf and Foolad, 2005).) Catav *et al*. (2012) found that priming of seeds enhance germination speed and uniformity as well as stimulates different biochemical changes in seeds that are vital in breaking dormancy, enzyme activation, hydrolysis and mobilization of seed reserves and the emergence of embryonic tissues.

Ascorbic acid (vitamin-C) is one of the key products of D-glucose metabolism which synthesized in higher plants. It has been shown to play multiple roles in plant growth and development such as; cell division, cell wall expansion, the electron transport system and other developmental processes (El-Kobisy *et al*., 2005). Tabatabaei and Naghibaighora (2013) revealed that priming seed with ascorbic acid at concentration of 50 ppm

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recorded the highest percentages of germination, germination index as compared with the control. Shah *et al*. (2019) concluded that ascorbic acid (AsA) priming enhances stand establishment and antioxidant enzyme activities in wheat leaves.

Salicylic acid (SA) is deemed as a hormone substance, which acting a substantial role in regulating a number of physiological operations in the plants like; stomata closure, ion absorption and transport, bio ethylene inhibition, transpiration, membrane permeability, photosynthesis and growth, nitrate metabolism, flowering and endure stress (Ashraf *et al*., 2010). Salicylic acid play a role in improving the growth and development of the crops (Krantev *et al*., 2008). Movaghatian and Khorsandi (2013) found that the highest percentages of germination was obtained from wheat seeds priming with 0.00001 mM salicylic acid. Sharafizad *et al*. (2013) concluded that salicylic acid priming at low level significantly produced the greatest reducing mean germination time. The highest percentage of seed germination percentage was recorded from seed soaking with salicylic acid at level of 0.7 mM. Mohamed *et al*. (2019) indicated that all priming wheat seeds in salicylic acid (SA) at 100 ppm significantly increased germination %.

Humic acid is chelators and a principal component of humic substances. Humic substances combine minerals to make them into organic compounds that can be ingested by plants more easily. Their activity in promoting plant growth is not completely known, but several explanations have been proposed by some researchers such as; increasing cell membrane permeability, important for the transport and availability of micro-nutrients as well stimulates nutrient uptake, seed germination and viability, oxygen uptake, respiration (especially in roots) and photosynthesis, phosphate and nutrient uptake and root cell elongation (Chen *et al*., 1994). Mersal *et al*. (2015) showed that the best values of germination percentage and mean germination time were recorded when wheat seeds soaked in humic acid, followed by priming in humic acid solution. Kandil *et al*. (2017) showed that soaking seed in humic acid 1 % for 24 h exceeded percentage of germination, germination rate, germination index, energy of germination and chlorophyll content by 5.2, 7.7, 17.1, 65.8 and 17.8 %, respectively.

Amino acids also help with many symbiotic processes that improve many aspects of plants, soil and microbiology. In the soil, they are amazing chelators. The importance of amino acids came from their widely use for the biosynthesis of a large variety of non proteinic nitrogenous materials, *i.e*. pigments, vitamins, coenzymes, purine and pyrimidine bases. Studies have proved that amino acids can directly or indirectly influence the physiological activities in plant growth (Mohamed, 2006). El-Nabarawy (2001) mentioned the importance and role of amino acids in synthesizing processes enzymes. Ghalichechi and Azar (2013) showed the mean germination time (MGT) inversely correlated to soaking in the amino acid. Soaking in 200 mg amino acid/L for 12 h produced the maximum level of germination index.

Yeast extract is a natural source of many growth substances (thiamine, riboflavin, niacin, pyridoxine and vitamins B_1, B_2, B_3 and B_{12}), cytokinins and many of the nutrient elements as well as organic compounds *i.e*. protein, carbohydrates, nucleic acid and lipids (Barnett *et al*., 1990 and Nagodawithana, 1991). Yeast extract is used as a plant fertilizer and also to stimulate microbial activity in soil, promote rapid proliferation of beneficial microorganism to improve soil enzyme activity, enhance plant resistance (especially the resistance to saline-alkali), stimulate enzyme activity of seed and accelerate seed germination. Amer (2004) showed that yeast extract is consider as natural source of cytokines and has catalytic effects on plant growth.

Algae extract being organic and bio-degradable in nature is considered as an important source of nutrition for sustainable agriculture especially in the newly reclaimed soil. Chemical analysis of algae extract have revealed the presence of a wide variety of plant growth regulators such as; auxins and cytokinins in varying amounts (Zhang and Ervin, 2004), which is known to stimulate establishment and elongation rate of root hairs as well as increase their number and gibberellins promote lateral growth. Kumar and Sahoo (2011) showed that the application of seaweed liquid extract at 20% increased wheat seed germination percentage as compared to control. Mohy El-Din (2015) found that seed germinating percentages were 98 and 97% by use of 20% SLF of *Sargassum vulgare* and *Codium tomentosum*, respectively.

Thus, the objective of this study was to study the effect of application methods and seeds treatments with some biostimulants to improve germination parameters of bread wheat Misr 2 cultivar.

MATERIALS AND METHODS

A laboratory experiment was carried out at Seed Testing Laboratory, Agronomy Department, Faculty of Agriculture, Mansoura University, Egypt, during November and December 2018 . The objective of this investigation was to study the effect of application methods and seed treatments with some biostimulant on germination of bread wheat Misr 2cultivar.

The experiment was conducted in factorial experiment in Completely Randomized Design (CRD) with four replications. The experiment included two factors. The first factor included two methods of application with some biostimulant substances (soaking and priming grains). In soaking application method, wheat seeds were soaked for 12 hours in the studied biostimulant substances and then directly sowing. While, in priming application method, wheat seeds were soaked for 12 hours in the studied biostimulant substances and then air-dried before sowing.

The second factor integrated with eleven wheat seed treatments with biostimulant substances as follows:

1- Without treatment (control treatment).
2- Distilled water.
3- Ascorbic acid (AsA) at the rate of 200 mg/L.
4- Salicylic acid (SA) at the rate of 200 mg/L.
5- Humic acid (HA) at the rate 5 ml/L.
6- Amino acids (AA) at the rate of 50 ml/L.
7- Yeast extract (YE) at the rate of 100/L.
8- Algas extract (AE) at the rate of 2000 mg/L.
9- The mixture of ascorbic acid (AsA) and salicylic acid (SA) at the same rates.

10- The mixture of amino acids (AA),yeast extract (YE) and algas extract (AE) at the same rates.
11- The mixture of all studied biostimulant substances at the same rates.

Standard germination test:

Random sample of 400 seeds per each treatment were allowed to germinate during November and December, 2018, as the rules of International Seed Testing Association (ISTA, 2013) on top filter paper in sterilized Petri-dishes (14 cm diameter). Each Petri-dish contains 25 seeds, and 4 Petri-dishes kept close together and valued as though they were one 100-seed replication under the environmental conditions of Seed Testing Laboratory of Agronomy Department, Faculty of Agriculture, Mansoura University, Egypt.

The seeds were calculated and the first number of germinated seeds were determined on the fourth day. After that, every 24 hours the number of germinated seeds were count until end of germination test (8 days), as described ISTA (1996).

DATA RECORDED:

1. **Final germination percentage (FGP%).** It was counted after 8 days from planting according to the following equation as described by Ellis and Roberts (1981):

$$FGP = \frac{\text{Number of germination seeds}}{\text{Total Number of tested seeds}} \times 100$$

2. **Abnormal seedlings percentage (AS %).** It was calculated and expressed as a percentage of rotten grains at the end of the germination test according to ISTA (1996).
3. **Speed germination index (SGI).** Counted by the following equation (ISTA, 1996):

$$SGI = \frac{\text{No. of germinated seeds}}{\text{Days to first count}} + \frac{\text{.....}}{\text{.....}} + \frac{\text{No. of germinated seeds}}{\text{Days to final count}}$$

4. **Germination index (GI %).** It was calculated as stated in the following formula Karim et al. (1992) as the following equation:

$$GI = \frac{\text{Germination percentage in each treatment}}{\text{Germination percentage in the control}} \times 100$$

5. **Co-efficient of germination (CG).** It was counted using the following equation according to Copeland (1976):

$$CG = \frac{100\,(A_1 + A_2 + \ldots\ldots + A_n)}{A_1 T_1 + A_2 T_2 + \ldots\ldots A_n T_n}$$

Where;
A = Number of germinated seeds.
T = Time (days) matching with A.
n = number. of days to final count.

6. **Mean germination time (day).** It measured due to due to the resulting equation as showed by Ellis and Roberts (1981):

$$MGT = \frac{\Sigma\, Dn}{\Sigma n}$$

Where (n) is the number of seeds, which germinated per day, D is the number of days calculated from the beginning of germination

7. **Germination energy percentage (GE %).** It determined by the percentage of the seeds germinated in the first count (4 days after sowing) relative to the total number of seeds tested as shown by Ruan *et al.* (2002).

$$EG = \frac{\text{Number of germinated seeds after four days}}{\text{Number of seeds tested}} \times 100$$

Rendering to the system of analysis of variance (ANOVA) was used for the factorial experiment in Completely Randomized Design (CRD) as published by Gomez and Gomez (1984) of the subjected data was statistically analyzed. Means of the treatments were compared using Duncan's multiple range tests at 5 % level of probability as described by Duncan (1955).

RESULTS AND DISCUSSION

A. Effect of application methods:

The obtained results of this study in Tables 1 and 3 show that methods of application with some biostimulant substances (soaking and priming grains) significantly affected germination parameters (final germination %, abnormal seedlings %, speed germination index, germination index, co-efficient of germination, mean germination time and germination energy %).

It could be noticed that priming method of seeds wheat with biostimulant substances surpassed soaking method in final germination percentage, germination index, and co-efficient of germination (Tables 1 and 3). Nevertheless, soaking method with biostimulant substances surpassed priming method in abnormal seedlings, speed germination index, mean germination time and germination energy percentage.

These results may be ascribed to soaking seeds in water before sowing gives the germinating seeds a head start and speeds up seed establishment with a corresponding increase in survival rates (DFID, 2014).

Also, priming seeds stimulates different biochemical changes in seeds that are vital in breaking dormancy, enzyme activation, hydrolysis and mobilization of seed reserves and the emergence of embryonic tissues (Catav *et al.*, 2012). These results are in good agreement with those informed by Khan *et al.* (2011) and Patra (2019).

B. Effect of seed treatments with biostimulants:

Seed treatments with some biostimulant substances (ascorbic acid, salicylic acid, humic acid, amino acid, yeast extract and alga extract and some mixture of them) significantly affected germination parameters (final germination %, abnormal seedlings %, speed germination index, germination index, co-efficient of germination, mean germination time and germination energy %) as shown in Tables 1 and 3.

From obtained results, it could be observed that treating wheat seeds with yeast extract treatment surpasses the other studied seeds treatments with biostimulants in speed germination index, mean germination time and germination energy percentage (Tables 1 and 3). On the other hand, it could be noticed that treating wheat seeds with the of mixture of ascorbic acid and salicylic acid treatment surpasses other studied seeds treatments with biostimulants in final germination percentage and germination index. However, treating wheat seeds with the mixture of humic acid + amino acid + algea extract + yeast extract surpasses other studied seeds treatments with biostimulants in abnormal seedlings percentage.

Also, treating wheat seeds with amino acid was the best one in germination index. As we can see treating wheat seeds with with algas extract was the best value in Co-efficient of germination.

These results may be ascribed to the role of salicylic acid in regeneration of physiological processes in plants (Sakhabutinova *et al*., 2003). So, salicylic acid is an effective priming factor and increases some of the germination parameters (Krantev *et al*., 2008). Also, ascorbic acid serves as a major redox buffer and regulates various physiological processes controlling growth, development and stress tolerance. Furthermore, Studies have proved that amino acids can directly; or indirectly influence the physiological activities of the plant. These results are in good accordance with those testified these result by Ghalichechi and Azar (2013), Sharafizad *et al*. (2013), Tabatabaei and Naghibaighora (2013) and Shah *et al*. (2019).

C. Effect of the interaction between application methods and seeds treatments with bio-stimulants:

The achieved results of this study in Tables 2 and 4 show that the interaction between application methods and seeds treatments with some biostimulant substances significantly affected germination parameters (final germination %, abnormal seedlings %, speed germination index, germination index, co-efficient of germination, mean germination time and germination energy %).

It could be noticed that soaking wheat seeds in yeast extract surpasses other studied treatments and resulted in the highest values of speed germination index, mean germination time and germination energy percentage (Tables 2 and 4). Priming wheat seeds with amino acid was the best treatment for final germination percentage, germination index and germination energy percentage, which resulted in the highest values of these traits. However, priming wheat seeds with the mixture of humic acid + amino acid + algas extract + yeast extract surpasses other studied treatments in abnormal seedlings percentage. As we can see, soaking wheat seeds in ascorbic acid gave the highest values of mean germination time. However, soaking wheat seeds in humic acid registered the highest co-efficient of germination. Moreover, soaking or priming wheat seeds in algas extract was the best in co-efficient of germination.

Table 1. Final germination and abnormal seedlings percentages, speed germination index (SGI) and germination index (GI) of wheat as affected by methods of application and seeds treatments with biostimulants as well as their interaction.

Characters / Treatments	Final germination percentage (FG %)		Abnormal seedlings percentage (%)		Speed germination index (SGI)		Germination index (GI)	
Soaking	87.95		4.95		11.89		0.99	
Priming	91.81		4.31		11.18		1.02	
F. test	*		*		*		*	
B- Seeds treatments with biostimulants:								
Without	89.0	Bc	6.19	D	1.00	ab	4.75	bc
Distilled water	92.0	abc	12.32	A	1.03	a	2.50	c
Ascorbic acid	79.7	E	10.59	C	0.89	c	5.00	bc
Salicylic acid	91.2	abc	12.25	A	1.02	a	5.00	bc
Humic acid	92.7	abc	12.25	A	1.04	a	1.25	c
Amino acids	94.2	Ab	12.34	A	1.06	a	3.00	c
Yeast extract	91.5	abc	12.43	A	1.03	a	4.00	bc
Algas extract	92.2	abc	12.32	A	1.03	a	4.50	bc
Ascorbic & Salicylic	94.5	A	12.29	A	1.06	a	1.50	c
Humic & Amino & Yeast & Algas	84.0	De	12.11	ab	0.94	bc	11.50	a
Ascorbic & Salicylic & Humic & Amino & Yeast & Algas	87.5	Cd	11.78	B	0.98	ab	8.00	ab
F. test	*		*		*		*	
C- Interaction (F. test):								
A × B	*		*		*		*	

Table 2. Final germination and abnormal seedlings percentages, speed germination index (SGI) and germination index (GI) of wheat as affected by the interaction between methods of application and seeds treatments with biostimulants.

Characters / Treatments	Final germination percentage (FG %)				Abnormal seedlings percentage (%)				Speed germination index (SGI)				Germination index (GI)			
	Soaking		Priming		Soaking		Priming		Soaking		Priming		Soaking		Priming	
Without	88.0	bcd	11.69	c	0.705	E	1.000	ab	1.000	ab	90.0	abcd	4.00	bcde	5.50	bcde
Distilled water	89.5	abcd	12.37	abc	12.28	abc	1.020	a	1.053	a	94.5	abc	4.50	bcde	0.50	de
Ascorbic acid	65.0	F	8.86	d	12.31	abc	0.740	d	1.053	a	94.5	abc	7.50	bc	2.50	cde
Salicylic acid	86.5	cd	12.24	abc	12.27	abc	0.980	ab	1.067	a	96.0	abc	9.00	B	1.00	de
Humic acid	88.0	bcd	12.25	abc	12.25	abc	0.997	ab	1.082	a	97.5	ab	2.50	cde	0.00	e
Amino acids	90.0	abcd	12.25	abc	12.42	A	1.025	a	1.097	a	98.5	a	6.00	bcde	0.00	e
Yeast extract	90.5	abc	12.46	a	12.40	Ab	1.030	a	1.030	a	92.5	abc	6.00	bcde	2.00	cde
Algas extract	91.5	abc	12.31	abc	12.34	abc	1.040	a	1.038	a	93.0	abc	6.50	bcd	2.50	cde
Ascorbic & Salicylic	93.0	abc	12.23	abc	12.35	abc	1.055	a	1.067	a	96.0	abc	2.00	cde	1.00	de
Humic & Amino & Yeast & Algas	91.5	abc	12.31	abc	11.90	abc	1.038	a	0.850	c	76.5	e	5.00	bcde	18.00	a
Ascorbic & Salicylic & Humic & mino & Yeast & Algas	94.0	abc	11.85	abc	11.71	Bc	1.067	a	0.905	bc	81.0	de	1.50	cde	14.50	a
F. test	*				*				*				*			

Table 3. Co-efficient of germination (CG), mean germination time (MGT) and germination energy percentage (GE %) of wheat as affected by methods of application and seeds treatments with biostimulants as well as their interaction.

Characters Treatments	Co-efficient of germination (CG)		Mean germination time (MGT day)		Germination energy percentage (GE %)	
A- Methods of application:						
Soaking	24.60		48.00		93.95	
Priming	23.76		45.13		88.13	
F. test	*		*		*	
B- Seeds treatments with biostimulants:						
Without	18.71	D	26.37	d	46.00	d
Distilled water	24.82	Ab	49.50	ab	98.00	a
Ascorbic acid	24.22	C	43.13	c	81.75	c
Salicylic acid	24.81	ab	49.25	ab	97.25	a
Humic acid	24.89	ab	49.13	ab	97.75	a
Amino acids	24.69	abc	49.75	a	97.25	a
Yeast extract	24.89	ab	49.88	a	98.75	a
Algas extract	24.95	A	49.38	ab	98.25	a
Ascorbic & Salicylic	24.86	ab	49.38	ab	97.50	a
Humic & Amino & Yeast & Algas	24.83	ab	48.63	ab	96.50	a
Ascorbic & Salicylic & Humic & Amino & Yeast & Algas	24.31	bc	47.88	b	92.50	b
F. test	*		*		*	
C- Interaction (F. test):						
A × B	*		*		*	

Table 4. Co-efficient of germination (CG), mean germination time (MGT) and germination energy percentage (GE %) of wheat as affected by the interaction between methods of application and seeds treatments with biostimulants.

Characters Treatments	Co-efficient of germination (CG)				Mean germination time (MGT day)				Germination energy percentage (GE %)			
	Soaking		Priming		Soaking		Priming		Soaking		Priming	
Without	24.00	bc	13.42	D	47.75	a	5.00	c	91.5	b	0.50	d
Distilled water	24.78	abc	24.87	Ab	49.75	a	49.25	a	98.0	ab	98.0	ab
Ascorbic acid	23.99	c	24.45	abc	36.25	b	50.00	a	68.5	c	95.0	ab
Salicylic acid	24.75	abc	24.87	Ab	49.25	a	49.25	a	97.0	ab	97.5	ab
Humic acid	24.78	abc	25.00	A	49.25	a	49.00	a	97.5	ab	98.0	ab
Amino acids	24.42	abc	24.97	A	49.75	a	49.75	a	95.5	ab	99.0	a
Yeast extract	24.87	ab	24.90	A	50.00	a	49.75	a	99.0	a	98.5	a
Algas extract	25.00	a	24.90	a	49.25	a	49.50	a	98.5	a	98.0	ab
Ascorbic & Salicylic	24.78	abc	24.93	a	49.25	a	49.50	a	96.5	ab	98.5	a
Humic & Amino & Yeast & Algas	24.78	abc	24.87	ab	49.50	a	47.75	a	98.0	ab	95.0	ab
Ascorbic & Salicylic & Humic & Amino & Yeast & Algas	24.43	abc	24.20	abc	48.00	a	47.75	a	93.5	ab	91.5	b
F. test	*				*				*			

CONCLUSION

From the obtained results of this study, it could be recommended that priming seeds of bread wheat Misr 2 cultivar with the mixture of ascorbic acid and salicylic acid at the rate of 200 mg/L of each or yeast extract at the rate of 100/L as an effective way for improving germination parameters.

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تحسين إنبات القمح باستخدام بعض المواد المنشطة الحيوية

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أجريت تجربة معملية بمعمل اختبار البذور بقسم المحاصيل بكلية الزراعة - جامعة المنصورة خلال شهري نوفمبر وديسمبر عام ٢٠١٨. وكان الهدف دراسة تأثير كل من طرق ومعاملات تقاوى القمح باستخدام بعض المواد المنشطة الحيوية على إنبات قمح الخبز صنف مصر ٢. وقد أجريت الدراسة فى تجربة عاملية في تصميم تام العشوائية في أربع مكررات. وشملت التجربة عاملين، الأول؛ طريقتين للتطبيق ببعض المواد المنشطات الحيوية (نقع التقاوى وتهيئتها). العامل الثاني؛ ويشمل أحدى عشر معاملة لتقاوى القمح فى المواد المنشطة الحيوية. وقد أظهرت النتائج التي تم الحصول عليها أن طريقة تهيئة تقاوى القمح بالمواد المنشطة الحيوية، تفوق طريقة النقع في كل من نسبة الإنبات النهائية ومؤشر الإنبات ومعامل للإنبات. ومع ذلك، فقد أظهرت طريقة النقع تفوقاً على طريقة التهيئة في النسبة المئوية للبادرات الغير الطبيعية، ودليل سرعة الإنبات، ومتوسط زمن الإنبات ونسبة طاقة الإنبات. كما نجد أن معاملة تقوى القمح بمستخلص الخميرة قد تفوقت على غيرها من معاملات التقاوى في دليل سرعة الإنبات، متوسط زمن الإنبات، ونسبة طاقة الإنبات. ومن ناحية أخرى، فإن معاملة تقاوى القمح بخليط من حمض الأسكوربيك وحمض الساليسيليك قد تفوقت عن غيرها من معاملات التقاوى المدروسة في نسبة الإنبات النهائية ودليل الإنبات. ومع ذلك، فإن معاملة تقاوى القمح بخليط من حمض الهيومك، والأحماض الأمينية، ومستخلص الطحالب، ومستخلص الخميرة قد تتفوقت على غيرها من معاملات التقاوى المدروسة في نسبة البادرات الغير الطبيعية. وأيضا، كان لمعاملة تقاوى القمح بالأحماض الأمينية أفضل تأثير على مؤشر الإنبات. بالإضافة إلى أن معاملة تقاوى القمح بمستخلص الطحالب كان الأفضل من حيث معامل الإنبات. من النتائج التي تم الحصول عليها من هذه الدراسة، يمكن التوصية بتهيئة تقاوى قمح الخبز صنف مصر ٢ بخليط من حمض الأسكوربيك وحمض الساليسيليك بمعدل ٢٠٠ ملجم / لتر لكل منهم أو مستخلص الخميرة بمعدل ١٠٠ / لتر كإحدى الوسائل الهامة لتحسين صفات الإنبات.