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Response of field crop seeds to stimulators improve germination and growth

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ABSTRACT

Seeds are the foundation of agricultural production. Whatever other production elements are present, they will not compensate for the poor production that occurs as a result of the use of inferior seeds, which surely leads to a drop in quantity and quality production. To restart the metabolic processes in the seeds that have been prepared for planting, the seed must be hydrated in order to encourage it to germinate, and it will only do so when the right moisture is available. Stimulating seed germination in a short period of time, fighting with the bush that grows alongside the crop, and lowering the amount of pesticides required in control. Therefore, conserving the environment from pollution and lowering agricultural production costs through the use of available technology with outstanding results, particularly for leguminous crops that suffer from the presence of hard seeds. Soaking technology minimizes seeding rates, reduces work and time, and provides a homogeneous field in growth and its reflection on the harvest at one time, as well as facilitating the harvest process. In comparison to other ways, this is the safest for increasing the output and quality of field crops.

استجابة بذور المحاصيل الحقلية لمحفزات تحسين الانبات والنمو

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الخلاصة

تشكل البذور الركيزة الاساسية في الانتاج الزراعي, فمهما توفرت عوامل الانتاج الاخرى فان ذلك لن يعوض تدني الانتاج الذي يحصل بسبب استخدام بذور رديئة والذي بدون ادنى شك يؤدي الى انخفاض الانتاج كما ونوعا. لاستئناف العمليات الايضية في البذور المعدة للزراعة لابد من تمييؤ البذرة لحثها على الانبات ولأيتم ذلك الا عندما تتوفر الرطوبة الملائمة، ولذلك يلجأ المنتجون

الى ايجاد حلول من اجل تقليص الفترة اللازمة لإنبات البذور ولأيتم ذلك الا من خلال استخدام تقنية نقع وتنشيط بذور المحاصيل بالمحاليل المختلفة من اجل تحفيز البذور على الانبات بوقت قصير ومنافسة الادغال المرافقة للمحصول وخفض كميات المبيدات المستخدمة في المكافحة وبالتالي المحافظة على البيئة من التلوث وبالتالي التقليل من كلف الانتاج الزراعي باستخدام تقنية متوفرة وذات نتائج ممتازة وخاصة للمحاصيل البقولية التي تعاني من وجود البذور الصلبة. ان استخدام تقنية النقع تعمل على تقليل معدلات البذار وتقليل الجهد والوقت وإعطاء حقل متجانس في النمو وانعكاس ذلك على الحصاد بوقت واحد وتسهيل عملية الحصاد. وتعد هذه التقنية المصدر الأكثر أمانًا لتحسين حاصل ونوعية المحاصيل الحقلية بالمقارنة مع الطرق الاخرى.

الكلمات المفتاحية: المحاصيل ، تقنية، محلول، نقع.

INTRODUCTION

The decrease in the rate of field emergence and weak growth of seedlings in field crops in general is a significant factor that influences field crop productivity Murungu *et al*., (2004), because the speed and homogeneity of growth, the completion of field emergence, and the strength of seedlings ultimately lead to achieving the required plant density and complete coverage of the field in a short period of time, which helps greatly in the competition of the associated bush. As a result, a large seed production is obtained. Soaking and reviving field crop seeds before planting, as proposed by Genkel and Kolotova (1934), becomes one of the most important treatments for improving field crop productive, due to seed impregnation with the used soaking materials and secures an additional store for the embryo (Bharate and Vaidehi 1989). In addition to performing their other necessary roles during germination and growth, nutrients supplied to soaking solutions serve a significant role as a cofactor in the enzymatic system or may be involved in these reduction reactions. Seed priming is the process of soaking seeds in synthetic or natural solutions that increase the strength of the seeds to withstand stress as well as provide speed and a high and homogeneous germination rate (Mengel *et al*., 2001). Marschner (1995) highlighted the important role of nutrients in soaking seeds.

The act of soaking and priming the seeds of field crops

Some peer-reviewed studies in the Seed Science, Harris *et al*. (2001) and Goshi and Singh (2005), found that soaking seeds before planting for a short period of time hads a positive effect on the germination of these seeds and plants that grow from them. Soaking seeds is done here. Seeds are soaked for short periods of time (before germination) with water, osmotic solutions, or nutrient solutions, and then dried to their initial wetness before re-planting. Such as NaCl, KCl, and others, or the most commonly used osmopriming solutions, PEG and mannitol. Nutrient seed priming solutions are soaking solutions that contain minerals, vitamins, or antioxidants. Many researchers headed toward the use of more economical agricultural technologies that contribute to benefiting from the speed of seed germination even during the season of low water such as the technique of seed priming. It is one of the cost effective procedures that shortens the time between planting seeds and seedling emergence reduces efforts, and is characterized by Seed priming technology with its high efficiency in stimulating seeds (Sadeghi *et al*. 2011, Goudarz *et al*. 2012, Zidan *et al*. 2012).

Features of the technique of soaking with priming seed solutions and its significance on crop yield growth.

Priming seeds that have been stored for a long time helps to heal some of the cellular and cytoplasmic damage that may occur during storage, with some of these repairs occurring during seed impregnation with water during planting Goshi and Singh (2005). To maximize the degree of repair in the chromosomal aberration, soak the seeds before planting them using one of the previously described soaking procedures and drying them to their initial wetness before replanting. Soaking seeds is not a new concept, and it has long been practiced since ancient times by farmers who found that seeds soaked in water performed better in terms of germination, speed of emergence, and blooming. There are numerous hypotheses and theories that explain why seeds deteriorate and why seed priming is required. Among the most well-known of these hypotheses are:

1- Bioaccumulation: This occurs when seeds are stored at low moisture levels, causing respiration and enzyme activity to decrease.
2- Destruction of germination promoting hormones: The role of gibberellins and cytokinins in encouraging them to increase the enzymatic activity that leads to germination has been thoroughly investigated. The improved germination of aged seeds after exposure to growth hormones lends support to this notion.
3- Enzymatic decomposition or decrease in activity during storage: One of the indicators of seed aging is a decrease in enzymatic activity. Catalase and decarboxylase are two of these enzymes. The general drop in enzyme activity implies a decrease in respiratory capacity, limiting the availability of energy, ATP, and food to developing seeds.
4- Self-oxidation of fats: Although oxidation happens in all cells, water functions as a regulator for the occurrence of reactions and so controls the suppression of enzyme activity in completely imbibed cells.
5- Decomposition of cell activities:- Membrane degradation happens via two processes: hydrolysis or lipid oxidation, as well as mitochondrial deterioration and functional alterations.
6- Decomposition of genetic material: Due to the irregular cellular processes of living seed tissues, there is sometimes deterioration in the genetic material and partial decomposition of DNA, and the deterioration rises with the storage period.

Significant findings on increasing and improving the percentage of germination as a result of soaking and priming seeds and its impact on crop yield growth: Literature review

The developments that occur prior seed germination, leads to an improvement in seed physiology, and can be investigated by analyzing the impregnation curve (Lopes *et al*., 2000) by finding the regression points in the process of impregnation without harming the embryo, it is a basic rule in seed priming and could be sometimes Osmotic conditioning, which is based on enabling the occurrence of metabolic processes that precede germination, but without reaching radical to the emergence (Bradford, 1986). Bewley and Black (1978) characterized the seed soaking system as one in which the potential energy of seed water is maintained at adequate levels to enable the commencement of critical processes and activities in the second stage of germination process, but without germination. Soaking seeds in water increases their germination rate and homogeneity, as well as their ability to withstand unfavorable environmental circumstances (Nath *et al*., 1991), (Khan, 1992) and (Braccini *et al*., 1997).

The duration of sorghum seeds was (96.83) days in the comparator treatment after 12 hours of activation with water (Singh and Murthy, 1987). (Jones and Wahbi, 1992) discovered that zinc shortage inhibits seedling growth, a proper and adequate preparation of elemental zinc reduces the likelihood of seedling failure. According to Wv and Xiao (1992), using $ZnSO_4$ at a concentration of (0.3 ppm) boosted plant height and the number of branches of soybean plants. Gulati *et al*. (1997) discovered that the amount of water absorbed reduces in stored Kabuli chickpea seeds and increases in desi chickpea seeds. Ghazi and Al-Karaki (1998) discovered that low concentrations of PEG-8000 solution increased the percentage of germination of wheat and barley and decreased the period of completion of germination by nearly half, with wheat responding more than barley. According to Klamczynska *et al*. (2001), Chickpea seeds reached its maximum weight after 8 hours of soaking, and the size of seeds increases by 90%. Sabapathy (2005) discovered that soaking chickpea seeds of varieties, Kabuli and desi, for 16 hours improveds their meaning, but it peakeds quickly in the first four hours and then began to slow down. Ghana and William (2003) found that winter wheat seed soaking treatments had no discernible influence on germination.

In terms of field growth, they found that only one of the two employed cultivars increased in its percentage of germination and the speed of emergence of seedlings under laboratory and greenhouse conditions. Aziza *et al*. (2004) and Abida *et al*. (2008) found that soaking barley seeds in water or other soaking solutions increased germination in their two tests. Kant *et al*. (2006) concluded that soaking wheat seeds in 10% PEG boosteds the percentage of germination as well as growth speed and uniformity even under non-optimal field circumstances. Sharifzadeh *et al*. (2006) found no positive effect of osmotic soaking solutions on the germination characteristics of bread wheat seeds, but the researcher attributed this to the possibility of a high osmotic potential of the solutions used (-12 to -17 bar) or an increase in soaking times (24 to 96 hours). Hossain (2007) discovered that there was a significant effect of the treatment (250 ppm) on the characteristics of germination rate in a study was conducted to find out the effect of three concentrations of boron (zero, 250, 500, and ppm) and for soaking period of (6 hours) and for three varieties of mungbean. It was discovered that (250 ppm) treatment had a significant effect on the parameters of germination rate, leaf area index, maturity date, crop growth rate, number of seeds/pod, seed yield, weight of (1000) seeds, and protein yield.

According to Muhammad *et al*. (2007), soaking the seeds produces biochemical changes in the seeds such as hydrolysis of the seed food supplies, activation of enzymes, inhibitor metabolism, and breaking the dormancy of the seeds, which leads to rapid germination. According to Janmohammadi *et al*. (2008), soaking maize seeds in PEG-6000 solution, saline solutions, or water boosts germination % and seedling vigor index in both saline and non-saline soil conditions. Kumpawat and Manohar (2009) conducted an experiment in which three boron concentrations (150, 250, and 350 parts per million) were used for a period of (2, 4 and 6 hours) for each concentration resulted in significant differences between them, as the factorial treatment with Concentration (250 ppm) for a period of (6 hours) of seed yield, biological yield, crop growth rate, net photosynthetic rate, and protein yield. When Mahdi and Muhammad (2009) studied the effect of treatments for maize seeds without soaking, soaking with water, soaking in acidic solution, and soaking in brine, the treatment of soaking seeds with water significantly outperformed in increasing the biological yield of the plant and increasing the amount of proline and chlorophyll in plant leaves, while it was the treatment of soaking in brine that performed poorly.

Soaking seeds in a calcium chloride brine solution before planting increased the proportion of protein in the plant leaves, while the treatment of soaking seeds in the acid solution before planting exceeded growth in plant leaf area. Soaking soybean seeds with (KNO_3) produced the greatest values for all examined parameters when compared to unsoaked seeds, with germination rate, seedling growth, and seedling dry weight increasing by 28.3, 129.4, and 58.1 percent, respectively, as compared to unsoaked seeds (Mohammadi, 2009). Soaking bean seeds in water for varying lengths of time (no soaking, 12, and 24 hours) had a substantial influence on germination, seedling dry weight, and seed strength. The treatment of soaking seeds in water for 24 hours recorded the highest mean comparing the other treatments in all evaluated parameters, with a mean seed germination of 96 percent, the dry weight of the seedling increased to 1.52 g, and the seedling strength increased to 145.92 (Maroufi *et al*., 2011). According to Liela *et al*. (2011), the increased activity of the enzymes amylase, protease, and lipase, which have a significant influence in deconstructing the stored big molecules that the embryo requires for growth and development, may explain the faster emergence in the soaked seeds.

The researcher used four different soaking solutions on two distinct types of bread wheat, and the responses of the varieties vary. According to the findings of (Seyedi *et al*., 2011), soaking chickpea seeds in zinc sulfate for 8 hours at a temperature of 25 °C enhanced the percentage of germination as well as the fresh and dry weight of the seedlings when compared to unsoaked seeds. Furthermore, (Eskandari and Kazemi, 2011) discovered that soaking pea seeds in (KNO3) at a concentration of 1.5 percent for three soaking periods (8, 12, 16 hours) considerably improved germination percentage, seed strength factor, and seedling dry weight. It should be noted that soaking chickpea seeds in water for 10 hours at a temperature of 20 °C resulted in a considerable increase in plant height, number of branches per plant, number of seeds per pod, weight of 100 seeds, seed yield, and biological yield (Abbasdokht *et al*., 2012). In their investigation, Ahmadvand *et al*. (2012) employed two treatments for the seeds of two soybean cultivars (without soaking and soaking in KNO_3 solution at a concentration of 6 g/L). Soaking the seeds in KNO3 considerably increased the percentage of laboratory germination, field emergence, root length, shoots, seedling dry weight, plant height, leaf area, and plant dry weight. When wheat seeds were immersed in magnetic water, the germination rate of the seeds increased, as did the dry weight of the plant, according to Babar *et al*. (2012). Syed *et al*. (2012) demonstrated that soaking maize seeds in various doses and durations of soaking had a favorable influence on the rate and speed of germination, although the researcher saw stronger effects when the seeds were soaked with gibberellin. When studying the effect of different levels of boron seed soaking treatments (0, 150, 200, and 250 ppm) on two mung cultivars, Subedi and Deo (2013) found that boron seed soaking treatment at a concentration of (250 ppm) was superior to the control treatment in flowering time, maturity date, and pod length. In both cultivars, the number of pods/plant, the number of seeds/pod, the weight of (1000) seeds, and the seed yield. In their study, Kadam and Khanvilkar (2015) mentioned the effect of two levels of boron (250 and 350 parts per million) for a period of six hours on the growth of two cultivars of green marrow to the superiority of seeds treated with boron compared to non-treated in plant height and number of branches / plant. Both cultivars had the same number of pods per plant, vital yield, harvest index, and protein content. According to Najm (2016), priming sorghum seeds with gibberellic acid resulted in the highest average germination speed in the first count (65.2 percent) and the standard laboratory germination rate (83.0 percent) when compared to the treatment of dry seeds, which resulted in the lowest average germination speed of (40.7 percent). The average laboratory germination rate was (57.8 percent). Ali (2016) discovered the effect of soaking seeds in two amounts of boron (0 and 250 ppm) for six hours on the growth and yield of two black and green marrow cultivars. Plant, blooming and maturity dates, number of branches per plant, pod length, number of pods per plant, vital yield, harvest index, and protein content were all measured in both cultivars. According to Daoud and Abboud (2017), priming sorghum seeds with gibberellic acid at a concentration of 500 ppm was superior to a plant height of 157.67 cm over all treatments (750 and 1000) ppm. AL-Rawi and Habeeb (2017) discovered that the sunflower seeds of the cultivar Amar were significantly distinguished by the studied and activated traits with potassium chloride solution, with the highest values for the characteristics of the percentage of laboratory germination at the first count being 58.05 percent, the standard laboratory germination being 80.65 percent, the root length 15.49 cm, the stalk length 9.89 cm, and the seedling strength index 2091, the fresh weight of the feather is 1.430 g, and the dry weight of the feather is 0.064 g. The concentration of 20 mg L^{-1} potassium chloride solution was significantly superior and recorded the highest significant mean of germination speed 79.92 percent, standard laboratory germination 89.92 percent, root length 18.90 cm, stalk length 12.11 cm, seedling strength index 2792, fresh weight of the stalk 1.68 g, and dry weight of the feather 0.075 g. Al-Hadi experiment (2019) showed that activating sorghum seeds with gibberellic acid at a dose of 60 mg L^{-1} was preferable significantly outperformed the inactivation (no soaking) treatment by having the highest averages for germination speed (74.50 percent), percentage of standard laboratory germination (73.67 percent), root length (6.55) cm and chlorophyll content (15.39) SPAD index and dry weight of the seedling (11.40) mg, and the strength of the seedling in the first count (1108) and the strength of the seedling in the second count (1103),compared to the inactivation (no soaking) treatment, which produced the lowest averages for these features (57.17 percent and 50.67 percent), (2.52 cm), (12.48) SPAD (7.95 mg), (338) and (303). In addition, the priming treatment with gibberellic acid outperformed the inactivation treatment by producing the highest average feather length of (8.13) cm compared to the inactivation treatment, which produced the lowest average of (3.13) cm.

Table (1) Increase percentage in seed yield of some field crops at different applied treatments.

Treatments	treatments method	Rate of application	Field crops	Increase in seed yield	Reference
Zinc sulphate	Seed priming	0.1% Zn	Wheat	34.87 (%)	Ashraf, and Iram, (2002)
ZnO	Seed coating	2.0% (w/w)	Rice	27.59 (%)	Srivastava and Bose, (2012)
Zinc sulphate	Seed priming	1% Zn, 16 h	Maize	27. 10 (%)	Murungu, *et al*. (2004)
Water and scratching	Seed priming	1% 12 h	Broad Bean	29.30 (%)	Assi *et al*. (2019)
Zinc sulphate	Seed priming	0.05% Zn 12 h	soybean.	36 (%)	Arif *et al*. (2008)
Zinc sulphate	Seed coating	0.05% Zn 14 h	Cowpea	32.10 (%)	Singh, *et al*. (2014)
Zinc sulphate	Seed priming	0.004 M, 12 h	cotton	23.64 (%)	Murungu, *et al*. (2013)

CONCLUSION

Based on the preceding, we may conclude that seed priming method resulted in a substantial increase in all evaluated features when compared to the control treatment (dry seeds), which resulted in the lowest values. When compared to dry seeds, the features of vegetative and reproductive development resulted in an increase in seed productivity. It appears that the effect of seed soaking treatments was seen at various stages of crop growth. Some features demonstrated superiority when seeds were treated with soaking solutions, particularly those tested in the early phases of plant growth. The soaking technique promotes seed germination with less time and moisture than non-soaked seeds, particularly in leguminous crop seeds. This strategy increases the quality and productivity of field crops by allowing crops treated with seed activation technology to compete with the adjacent weed, reducing the amount of pesticides needed in control and therefore reducing environmental pollution. Seed treatment alleviated the negative effects on plants and improved all of the indicators described in earlier research, resulting in an improvement in the plants' ability to tolerate hard circumstances.

CONFLICT OF INTEREST

The authors declare no conflicts of interest associated with this manuscript.

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