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EFFECT OF MUNG BEAN SEED PRIMING METHODS AND DURATION ON SEED GERMINATION AND SEEDLING VIGOUR

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Abstract

The experiment was carried out in the laboratories of the Office of Examination and Certification of Seed - Qadisiyah Branch to study the effect of priming methods and durations on mung bean (*Vigna radiat*a L.) seed germination and seedlings vigour properties. The first factor contain three seed priming methods: Hydro- priming (with distilled water), Hormo- priming with salicylic acid (75 mg L^{-1}) and Nutrient-priming with P (at 0.6%) using KH_2PO_4 solution as a source of phosphorus, and the second factor contain three seed priming durations (4, 6 and 8 hrs), in addition to unprimed seed treatment (dry seeds as a control). A factorial experiment according to completely randomized design (CRD) was used in the first stage of statistical analysis (without control treatment) with three replicates. A completely randomized design (CRD) was used in the second stage of statistical analysis to compare means of treatments (methods and duration of seed priming combination + control treatment) with three replicates. The results showed that seed priming methods had no significant effect on all the studied characters except the germination percentage in the first count test, the Hormo-primed seed treatment gave the highest percentage of germination 86.7% without significant differences with nutrient- primed seed treatment 85.8%. Also, the seed priming durations had no significant effect on all the studied characters. The interaction between two factors had significant effect on all the studied characters, the nutrient primed seed for 8 hr treatment produced the highest values of the germination percentage in the first count 89.0%, standard germination percentage 94.0%, radical length 13.79 cm, shoot length 9.82 cm, seedling vigour index 2236 and seedling dry weight 26.73 mg without significant differences with hormo primed for 4 hr treatment of all the studied characters and with hydro primed for 6 hr treatment in the shoot length only. Further, the differences between treatments (methods and durations of seed priming combination + control treatment) had significant effect on the all the studied characters. The results showed that all the seed priming treatments gave the highest values in all the studied characters compared with unprimed seeds (control treatment). However the nutrient priming for 8 hr treatment gave the highest values in the germination percentage at the first count, standard germination percentage, radical length, shoot length, seedling vigour index and seedling dry weight without significant differences with hormo priming for 4 hr treatment of all studied characters and hydro priming for 6 hr treatment in the shoot length only. It can be concluded that mung bean primed seeds improved all the seedling vigour characters in laboratory experiment compared to unprimed seed, and mung bean seed priming treatment with P at 0.6% for 8 hrs was the best among others seed priming treatments.

Keywords: Mung bean, priming methods, germination, seeding vigour

Introduction

Mung bean (***Vigna radiata*** L.) is an important seed legume crop, which is used mainly as a food for humans and livestock due to high seed content of digestible protein (24-27%). The protein of mungbean seeds is high in lysine amino acid (Saini *et al.*, 2010, (Widjajaseputr *et al.*, 2019), which making it a good supplement for most cereal based diets which lack this essential amino acid (Baskaran *et al.*, 2009). In addition to its ability to bio-stabilize atmospheric nitrogen and improve soil fertility. Although of several benefits of mung bean but it's productivity remains low in Iraq at 1.535 ton ha^{-1} (Directorate of Agricultural Statistics, 2017), compare to other legumes, including peanut and soybean, which can produce up to 5 t/ha, although of the radiation and water use efficiencies of mungbean are similar to those of soybean and peanut, but the dry matter production potential and its partitioning into yield are relatively low (Chauhan *et al.*, 2010). Seed priming techniques by using hydro priming or hormo priming or nutrient priming proved effective in improving the rate, speed, uniform and percentage of seed germination and improve seedling vigour which leads to growth and yield better than un-primed seed (Ahmet *et al*., 2013; Sori, 2014, Ozdemir and Sade, 2015, Soliman, *et al*., 2016), while poor seed germination and seedling growth affecting subsequent crops growth and yield) Farooq *et al.*, 2011). This techniques reduce cell membrane damage of seed by slower and controlled water uptake during imbibition process (which it is the most critical period of germination) and that leads to maintain the largest possible amount of stored reserved foods from leaking out of the seed. Seed priming techniques increase seed tolerant to abiotic stress under field conditions (Ozdemir and Sade, 2015).

Umair *et al.* (2010) reported that the priming of mung bean seed with phosphorus at o.6% concentration for 5 hrs increased germination speed, radicle length, seedling vigour index and seedling dry weight compared with other treatment (distilled water, salicylic acid and dry seeds). Umair *et al.* (2013) noted that the soaking of mung bean seed at 10 and 20 mg L^{-1} of salicylic acid for 4 and 5 hr led to improve the seedling vigour as result to increase the radicle and shoot length, seedling dry weight and seedling vigour index. Further, the results of Laghari *et al.*, (2016) showed that the soaking of mung bean seed with distilled water for 4 hours gave a significant increase in germination ratio, radicle and shoot length, seedling dry weight and seedling vigour index compared with dry seeds treatment. The aims of research are study the effect of priming methods and durations on mung bean seed germination and seedling vigour properties.

Materials and Methods

The experiment was carried out in the laboratories of the Office of Examination and Certification of Seed - Qadisiyah Branch to study the effect of seed priming methods and durations on mung bean seed germination and seedlings vigour properties. The first factor contain three seed priming methods: hydro priming (with distilled water), hormo priming with salicylic acid (75 mg L^{-1}) and nutrient priming with P (at 0.6 %) using KH_2PO_4 solution as a source of phosphorus, and the second factor contain three seed priming durations (4, 6 and 8 hr), in addition to unprimed seed treatment (dry seeds as a control). A factorial experiment according to completely randomized design (CRD) was used in the first stage of statistical analysis (without control treatment) with three replicates. A completely randomized design (CRD) was used in the second stage of statistical analysis to compare means of treatments (methods and duration of seed priming combination +

control treatment) with three replicates. Using least significant difference (LSD) test at 0.05 level of probability to compare means of treatments (Steal and Torrie, 1984).

Studied characters :

1. Standard Germination Test (%)

100 seeds of each treatment with three replicates were tested for standard germination test, using paper towels in rolling methods. Samples were placed in the germinators at 25±5 ºC for 7th days , At the end of the test, the standard germination percentage for all the four replications of each treatment were calculated (ISTA, 2008) as the following equation*: Germination %=(Number of normal seedlings / Number of seeds sown*) / 100

2. The First Count in Standard Germination Test

After 4th days in standard germination test the normal seedlings percentage were calculated (ISTA, 2005) as the following equation :

Germination %= (Number of normal seedlings at the first count / Number of seeds sown)/100.

3. Seedling Shoot and Root Length Test (cm)

The seedlings shoot and root lengths were measured after the final count in standard germination test (after the7th days). Ten normal seedlings were selected randomly from each replicate. The shoot length was measured from point of the attachment of the cotyledon to the tip of the seedling. Similarly, the root length was measured from the point of attachment to the tip of the root. Average shoot or root length (cm) was computed by dividing the total shoot or root length by total number of normal seedlings measured. (AOSA, 1988).

4. Seedling Dry Weight Test (mg)

Seedling dry weight (mg) was measured after the final count in the standard germination test. Ten normal seedlings selected randomly from each replicate were cut free from their cotyledons and placed in envelopes and dried in an oven at 80±1 ºC for 24 hours. The mean of the seedling dry weight was calculated by dividing the weight of the total seedlings dry weight by their number (Hampton and Tekrony, 1995).

5. Seedling Vigor Index

Seedling vigor index : This was calculated by multiplying the standard germination percentage with the average sum of shoot length (cm) and root length (cm), (Islam *et al.*, 2009).

Statistical analysis

The data were analyzed statistically by using Gnestat program, and least significant difference (LSD) test at 0.05 probability level was used to compare the treatment means (Steel and Torrie, 1960).

Results and Discussion

The first count in standard Germination percentage

The results at the Table 1 indicate that there are significant differences among priming methods treatments (hydro priming with distilled water, hormo priming at 75 mg SA L^{-1} and nutrient priming with KH_2PO_4 solution 0.6% P) on the germination percentage at the first count, the hormo priming treatment recorded the highest mean 86.7% without significant difference with nutrient priming treatment 85.8%, while the hydro priming treatment recorded the lowest mean 84.7%. The superiority could be due to the role of Salicylic acid in increasing the metabolic activity required for seed germination and reducing the time of radicle emergence (Khamseh *et al.*, 2013). These results are in agreement with Umair *et al.* (2013). The results at the Table 1 show that the seed priming durations (4, 6 and 8 hr) had no significant effect on the germination percentage at the first count. The interaction between two factors without dry seeds (control treatment) had significant effect on the germination percentage at first count, the nutrient priming for 8 hr treatment gave the highest value 89% without significant differences with hormo priming for 4 hr treatment 88.3%, while the nutrient priming for 4 hr treatment gave the lowest value 82.3% without significant differences with hydro priming for 8 hr treatment 83% (Table 1). The superiority of soaking seeds with KH2PO4 could be due to increased phosphorus seed content which led to faster growth (Umair *et al.*, 2010). Further, phosphorus activation also increases the activity of enzymes such as amylase, protease and sometimes lipase which will lead to early development and of the embryo and accelerate germination (Nawaz *et al.*, 2013). Also, the results at the Table 1 indicate that there are significant effects of treatment (methods and duration of seed priming combination + unprimed seed) on the germination percentage at first count. All the priming treatment gave the highest value compared with unprimed seeds (control treatment), the nutrient priming for 8 hr treatment recorded the highest value 89% without significant differences with hormo priming for 4 hr treatment 88.3%, while the control treatment recorded the lowest value 80.0% without significant differences with the nutrient for 4 hr treatment 82.3%.

Table 1 : Effect of priming methods and durations on the germination percentage at the first count (%) of mung bean seeds.

Priming methods	Priming durations (hr)			Mean
	4	6	8	
Hydro priming with H_2O	85.0	86.0	83.0	84.7
Nutrient priming with KH_0PO_4 (P 0.6%)	82.3	86.0	89.0	85.8
Hormo priming with 75 mg SA L^{-1}	88.3	86.3	85.3	86.7
LSD 0.05	2.4			1.4
Mean	85.2	86.1	85.8	
LSD 0.05	N.S			
Control treatment (Dry seeds)	80.0			
LSD 0.05	2.5			

Standard germination percentage

The results at the Table 2 show that the seed priming methods and seed priming durations had no significant effect on the standard germination percentage. The interaction between two factors without dry seeds (control treatment) had significant effect on the standard germination percentage, the nutrient priming for 8 hr treatment gave the highest value 94.0% without significant differences with hormo priming for 4 hr treatment 93.0%, while the nutrient priming for 4 hr treatment gave the lowest value 84.0% without significant differences with hydro priming for 8 hr treatment 86.0% (Table 2). The results show that activation of phosphorus is more effective than activation with salicylic acid when the activation priming period is increased, which means that the two phases of the seeds water uptake activation are not completed when treated with phosphorus solution at the short periods . The first phase include rapid water uptake (imbibition) , and the second phase include enzymes activation and it is the most important active phase in which the metabolic processes occurs to prepare seeds for germination and elongation of embryonic axes, where the enzymes of amylase, ribonuclease and phosphatase are synthesized by the influence of gibberelic acid, also increase the effectiveness of hydrolytic enzymes such as ATPase, protease, lipase and peroxidase, in addition to transfer of nutrients from storage tissues (endosperm and cotyledons) to the growth sites of the seed and stimulation the chemical reactions to synthetic new substances (Copeland and McDonald, 2001). On the other hand, the ability of ions from inorganic solutions such as KH_2PO_4 to penetrate the seed coat and accumulation inside them during activation process (Parera and Cantiffe, 2010). These results are in agreement with Umair *et al.* (2010). Also, the results at the Table 2 indicate that there are significant effects of treatment (methods and duration of seed priming combination+ unprimed treatment) on the standard germination percentage . All the seed priming treatment gave the highest values of the standard germination percentage compared with control treatment, the nutrient priming for 8 hr treatment recorded the highest value 94.0% without significant differences with hormo priming for 4 hr treatment .93%, while the control treatment recorded the lowest value 83.0% without significant difference with the nutrient priming for 4 hr treatment 84.0%.

Table 2 : Effect of priming methods and durations on the standard germination (%) of mung bean seeds

Priming methods	Priming durations (hr)			Mean
	4	6	8	
Hydro priming with H_2O	87.0	90.0	86.0	87.7
Nutrient priming with KH_2PO_4 (P 0.6%)	84.0	89.0	94.0	89.0
Hormo priming with 75 mg SA L^{-1}	93.0	88.0	86.7	89.2
LSD 0.05		2.8		N.S
Mean	88.0	89.0	88.9	
LSD 0.05		N.S		
Control treatment (Dry seeds)		83.0		
LSD 0.05		2.7		

Radicle length

The results at the Table 3 show that the priming methods treatments and priming durations had no significant effects on the radicle length. The interaction between two factors without control treatment had significant effect on the radicle length, the nutrient priming for 8 hr treatment gave the highest value 13.97cm without significant differences with hormo priming for 4 hr treatment 13.32 cm, whereas the nutrient priming for 4 hr treatment gave the lowest value 12.02 cm without significant differences with hydro priming for 8 hr treatment 12.22 cm (Table 3). The superiority of the phosphorus activation treatment for 8 hours could be due to the role of phosphorus in increasing the enzymatic activity and superiority in germination speed (Table 1) and in the standard germination percentage (Table 2), which were reflected in the increase of root length. These results are in agreement with Umair *et al.* (2010). Also, there are significant effect of treatment (methods and duration of seed priming combinations + unprimed seed) on the radicle length . All the seed priming treatments gave the highest values of the radicle length compared with control treatment, the nutrient priming for 8 hr treatment recorded the highest value 13.97 cm without significant differences with hormo priming for 4 hr treatment 13.32 cm, while the control treatment recorded the lowest value 10.19 cm (Table 3).

Table 3 : Effect of priming methods and durations on the radicle length (cm) of mung bean seedlings

Priming methods	Priming durations (hr)			Mean
	4	6	8	
Hydro priming with H_2O	12.52	13.17	12.22	12.63
Nutrient priming with KH_2PO_4 (P 0.6%)	12.02	12.61	13.97	12.87
Hormo priming with 75 mg SA L^{-1}	13.32	12.98	12.33	12.88
LSD 0.05		0.78		N.S
Mean	12.62	12.92	12.84	
LSD 0.05		N.S		
Control treatment (Dry seeds)		10.19		
LSD 0.05		0.74		

Shoot Length

According to the Table 4, the priming methods and priming durations had no significant effect on the shoot length, whereas the interaction between two factors without control treatment was significantly effect on the shoot length, the nutrient priming for 8 hr treatment produced the highest value 9.82 cm without significant differences with hormo priming for 4 hr treatment 9.73 cm and hydro priming for 6 hr 9.57 cm, while the nutrient priming for 4 hr treatment produced the lowest value 8.50 cm without significant differences with hydro priming for 8 hr treatment 9.1 cm. The superiority could be due to the role of phosphorus activation for 8 hours in increasing the effectiveness of the enzymes responsible for seed germination and embryo growth and development and then increasing the shoot length (Nawaz *et al.*, 2013). These results are in agreement with Umair *et al.* (2010). There are significant effect of treatment (methods and duration of seed priming combination + unprimed seed) on the shoot length compared with control treatment, the nutrient priming for 8 hr treatment recorded the highest value 9.82 cm without significant differences with hormo priming for 4 hr treatment 9.73 cm and hydro priming for 6 hr 9.57 cm, while the control treatment recorded the lowest value 7.77 cm (Table 4)

Table 4 : Effect of priming methods and durations on the shoot length (cm) of mung bean seedlings

Priming methods	Priming durations (hr)			Mean
	4	6	8	
Hydro priming with H_2O	9.17	9.57	8.57	9.10
Nutrient priming with KH_2PO_4 (P 0.6%)	8.50	9.13	9.82	9.15
Hormo priming with 75 mg SA L^{-1}	9.73	9.23	8.72	9.23
LSD 0.05	0.56			N.S
Mean	9.13	9.31	9.03	
LSD 0.05	N.S			
Control treatment (Dry seeds)	7.77			
LSD 0.05	0.54			

Seedling vigour index :

The results at the Table 5 indicate that the seed priming methods and seed priming durations had no significant effect on the seedling vigour index, while the interaction between two factors without dry seeds (control treatment) had significant effect on the seedling vigour index, the nutrient priming for 8 hr treatment gave the highest value2236 without significant differences with hormo priming for 4 hr treatment 2144, while the nutrient priming for 4 hr treatment gave the lowest value 1724 without significant differences with hydro priming for 8 hr treatment 1786. The superiority of nutrient priming for 8 hr could be due to superior in the standard germination percentage (Table 2), radicle length (Table 3) and shoot length (Table 4). The results at the Table 5 show significant effect between treatments (methods and duration of seed priming combination + unprimed seed) on the seedling vigour index compared with control treatment, the nutrient priming for 8 hr treatment recorded the highest value 2236 without significant differences with hormo priming for 4 hr treatment 2144, whereas the control treatment recorded the lowest value 1473. These results are in agreement with Umair *et al.* (2010) who noted that the unprimed mung bean seeds recorded the lowest values of speed germination, radicle length and shoot length which that reflected negatively on the seedling vigour index (Table 5).

Table 5 : Effect of priming methods and durations on the seedling vigour index of mung bean

Priming methods	Priming durations (hr)			Mean
	4	6	8	
Hydro priming with H_2O	1887	2046	1786	1907
Nutrient priming with KH_2PO_4 (P 0.6%)	1724	1935	2236	1965
Hormo priming with 75 mg SA L^{-1}	2144	1953	1825	1974
LSD 0.05	108			N.S
Mean	1918	1978	1949	
LSD 0.05	N.S			
Control treatment (Dry seeds)	1473			
LSD 0.05	104			

Seedling dry weight

The results at the Table 6 show that the seed priming methods and seed priming durations had no significant effect on the seedling dry weight, whereas the interaction between two factors without dry seeds (control treatment) had significant effect on the seedling dry weight, the nutrient priming for 8 hr treatment gave the highest value 26.73 mg without significant differences with hormo priming for 4 hr treatment 26.10 mg, while the nutrient priming for 4 hr treatment gave the lowest value 24.71 mg without significant differences with hydro priming for 8 hr treatment 25.25 mg. The superiority of nutrient priming for 8 hr could be due to superior in the radicle length (Table 3) shoot length (Table 4) and seedling vigour index (Table 5). Table 6,There are significant effect between treatments (methods and duration of seed priming combination + unprimed seed) on the seedling dry weight, the nutrient priming for 8 hr treatment recorded the highest value 26.73 mg without significant differences with hormo priming for 4 hr treatment 26.10, whereas the control treatment recorded the lowest value 23.94 mg without significant differences with the nutrient priming for4 hr . These results are in agreement with Umair *et al.*, (2010) who noted that the priming of mung bean seeds with phosphorus increased seedling dry weight.

Table 6 : Effect of priming methods and durations on the seedling dry weight (mg) of mung bean seedlings

Priming Methods	Priming durations (hr)			Mean
	4	6	8	
Hydro priming with H_2O	25.71	25.82	25.25	25.59
Nutrient priming with KH_2PO_4 (P 0.6%)	24.71	25.54	26.73	25.66
Hormo priming with 75 mg SA L^{-1}	26.10	25.83	25.60	25.85
LSD 0.05	0.68			N.S
Mean	25.51	25.73	25.86	
LSD 0.05	N.S			
Control treatment (Dry seeds)	23.94			
LSD 0.05	0.65			

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