A Study on Seed Hydro-Priming Effects on Morphological Traits, and Qualitative and Quantitative Yield in Soybeans under Farm Conditions (Iran)

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Abstract: To study the Seed Hydro-Priming effects on soybeans morphologic, and qualitative and quantitative traits, a research was carried out in Ardebil Islamic Azad University research farm, in 2008. This research was conducted in factorial based on complete block randomized design. One of the Seed Hydro-Priming factors was 8, 12, 16 and 20 hours which were soaked in tap water and dried to 30percent moisture. A seed sample was also considered as an observation sample (without pretreatment). The second cultivar factor was Williams and LV $_{(17)}$. Results indicated that there is a significant difference at 1percent level between hydro-priming durations on plant height, grain yield, oil content, weight of sub-stems, number of sub-stem and germination percentage. In most traits other than sub-stems weight and number of sub-stems, 8-hour Hydro-Priming provided the best yield. Moreover, cultivar interaction effects on plant height trait in Hydro-Priming were significant at 1percent. The results to the average comparison table indicated that Williams cultivar had the most height with 8-hour Hydro-Priming. Also, there was a significant difference among cultivars on number of sub-stem, weight of sub-stems and plant height at 1percent and in most traits LV $_{(17)}$ had a better yields comparing to the Williams cultivar. Considering the results, see Hydro-Priming due to the short growth period and to increase the yield and better green in farm seems to be of significance. Also, 8-hour Seed Hydro-Priming is suggested for soybeans.

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Introduction

Deploying seedling is a critical step in the plant production process. Seeds uniformity and germination percentage in direct cultivation could have a great impact on production quality and performance. In recent years, a lot of efforts have been made to improve the germination condition, seed and seedling growth strength in special environments. (Ellis, 1989;Srinivasanet al, 1999; Drewet al, 1997) Priming is among the main methods in increasing seeds germination strength. Priming includes various seed improving methods in which seeds are controllably discharged. (Faruq et al, 2006b) The main objective in seed priming is partial water discharge so that seeds pass the germination in the first stage (physical water absorption) and second stage (biochemical processes initiation and sugars hydrolysis) and halt in the germination third stage (sugar consumption by the embryo and radicle growth). (Bradford, 1995) Seed priming is of various types according to the priming solution. The main and common point for all solutions is related to the optimal concentration and proper preservation period. Also, the seed should not be immersed in the prime solution during priming. Putting the seed with 50% of the height for a better exchange of oxygen is recommended. (Van Vactor, 2000; Hardegree et al., 2002) One of the main priming methods is to prime by water. Priming by water is very simple and cheap, and the water absorption amount is controllable through the calculating the time which the seeds are in contact with water. (Jusi and Sharifzade, 2006; Ashraf and Fulad, 2005; Faruq et al, 2006b)

Using increasing seed strength treatments could lead into rapid germination, consistent emergence and

plant strong deployment. (Afzal et al, 2002; Ashraf and Fulad, 2005; Faruq et al, 2006a) Priming by water affects DNA and RNA synthesis, alpha-amylase activities and better embryo growth. By improving the germination rate, growth consistency, seedling vigor and deployment, plant growth improves. (Basra et al., 2005; Ruan et al., 2002; Harris et al., 1999) It is reported that hydro-priming improves the cottonseed germination under tension and non-tension conditions. (Casenave and Toselli, 2007) Raaj and Mehra (2002) have also reported growth improvement and seedling deployment in canola under tension condition. Kaya et al (2006) have reported more germination and seedling growth in hydro-primed sunflower seeds under drought and salinity tensions. Additionally, Ghassemi- Golezani et al (2008) reached more seed yield in pea seeds under 16-hour hydro-priming treatment. Ghassemi-Golezani et al (2008) showed that hydro-priming results in seedlings growth rate, percentage, yield and yield components. They also reported that hydro-priming has a better effect on lentil seedling growth rate and percentage comparing to osmo-priming. Berg et al (1989) reported increase in production in subsequent to soybean seeds pretreatment. During their research on wheat seeds, Bosra et al (2005) came to this conclusion that, aqueous pretreatment for 24hours has a high effect on germination rate. Aqueous pretreatment in sunflower seedling weight is more tangible comparing to osmotic treatment in osmotic tension condition. (Demir Kaya, 2006) Pill (1986) reported that, parsley pre-germinating decreases the growth duration and increases shoot dry weight.

Since there is not enough comprehensive data on hydro-priming application and effects on soybean cultivars primary growth and yield, the following research tries to study hydro-priming treatments effects on morphologic traits and qualitative and quantitative yield under farm condition.

Materials and Methods

The soybean seeds (Williams and LV $_{(17)}$) which were provided by Moqan Agricultural Research Center were divided into five equal portions and a sample with 10percent moisture was collected in a plastic bag in refrigerator in 3to 5°C as the control sample. The other four samples were soaked in an incubator with 17.3 °C in distilled water for 8, 12, 16 and 20hours. Pretreated seeds were scattered on a table in laboratory environment between 20to 22°C to reach 30percent moisture. To determine the seeds moisture, 2 5-gram replicates of each treatment were separately beaten within porcelain to turn into granule. Beaten samples were weighed again and put in an oven with the temperature of 130°C for an hour. Consequently, samples were brought out of the oven and weighed. Seeds moisture percent were calculated through the following equation:

Equation 1: MC= Sample Wet Weight – Sample Dry Weight / Sample Wet Weight × 100

This research was conducted in in Ardebil Islamic Azad University research farm, in 2008. The region climate was semi-arid and cold with an altitude of 1350m above sea-level. The research was carried out as a factorial based on complete block randomized design in 3replicates. Each test unit included five implant lines with five meters length. On row from sides and half a meter from the row beginning and end were omitted as margin and sampling was done on the three medial rows. Soybean seeds were planted with 20seeds in a square meter on May 25, 2008. Immediately after observing the first seedlings, counting the grown seedlings in each test unit began and continued daily for 10days. The growing percentage was determined, considering implanting density and total grown seedlings, by the period ending. During crop ripening, 10plants were randomly harvested from each test unit and plant height, sub-stem weight and number of sub-stems was measured. Final harvest for each test unit was done when seed moisture reached to 17percent. In this stage, plants in 1 square meter in each plot were harvested. Subsequently, seeds were separated from pods and seed yield per unit area were separately weighed and recorded for each treat and replication. Also, oil and protein percentage in laboratory were calculated by Soxhlet apparatus. Data variance analysis was done as factorial in complete block randomized design for all studied traits. All statistical analyses and average comparisons were carried out by SPSS software. The diagrams were drawn by Microsoft Excel.

Results and Discussion

Plant Height: According to the data analysis and Table 1, there is a significant effect between plant height and replication, cultivar, treatment and cultivar with treatment interaction at 1percent level. According to the average comparison table, Williams cultivar has a higher plants comparing to LV $_{(17)}$ and among the treatments, 8-hour aqueous pretreatment has the most high. Control treatment and then other treatments are prioritized, respectively. Cultivar with treatment interaction has a significant relation with the plant height. According to the variance analysis and trait average

comparison between cultivars'' traits, there is a significant difference between the cultivars based on germination percentage. Since Williams cultivar has the most germination during 8-hour pretreatment, hence, it has the most plant height. Caur et al (2002) reported that, re-exposed to the water, pretreated seeds grow faster and germinate more comparing to the control seeds and finally result in plant better deployment under drought tension. They also showed that pea seeds pretreatment by 4% mannitol, increases the plant height to 17percent within 130days after planting, comparing to the control seeds seedlings.

Germination Percentage: According to the average comparison table and variance analysis (Figure 5 and Table 1) there is a significant difference between cultivars and treatments in this trait at 1percent level. Among the cultivars, Williams cultivar and among the treatments, aqueous 8-hour treatment had the highest germination percent. This trait shows that 8-hour aqueous pretreatment is the best seed aqueous pretreatment for germination, growing speed and yield in Ardebil condition. Also, the 20-hour aqueous pretreatment had the lowest effect in the farm. During their research on wheat seeds, Bosra et al (2005) came to this conclusion that, aqueous pretreatment for 24hours has a high effect on germination rate. Also, Casiro et al (2004) came to this conclusion that aqueous pretreatment is the most effective method for improving onion seeds germination. The aqueous and matric pretreatment had a higher effect on wheat germination rate and percentage comparing to osmotic pretreatment with NaCl. (Bosra et al, 2005)Ghassemi- Golezaniet all (2008) showed that hydro-priming results in increase in growth rate and percentage along with the increase in yield and yield components. They also reported that hydro-priming had a better effect on lentil seedling growth percentage and rate. Biyoli and Black (1978) and Khan (1992) have reported that the growth duration in farm could be decreased to 50% by priming. Seed priming could help the seedling extraction before soil forms crust and result in damage.

Number of Sub-Stems: There was no significant relation found between replication effects and treatment interaction on cultivar on number of sub-stems. However, considering the variance analysis table (Table1) cultivar and treatment effects on this trait were significant. Among the cultivars, LV $_{(17)}$ cultivar had the most number of sub-stems and among the treatments, the 20-hour seed aqueous pretreatment had the most number of sub-stems. It should be mentioned that control treatments had no significant difference in 8 and 12-hour treatments. The reason to this result could be the plant strength in control treatments of 8 and 12-hour aqueous pretreatment and low plant density in area unit in 20-hour pretreatment. Kaur et al (2002) have reported increase in amylase enzymes and sucrose synthase in shoot and root of treated seedlings. They claimed that priming leads to the increase in amylase enzymes activity and converting the savings substances into transitional substances and as a result increase in plant growth.

Weight of Sub-Stems: There was no significant relation found between replication effects and treatment interaction on cultivar on weight of sub-stems (Table 1). Since this trait is dependent on weight and number of stems, they have more correlation so their results are similar to number of sub-stems. Data mean comparison shows that among the cultivars, LV $_{(17)}$ has the highest weight of sub-stems and among the treatments, the highest weight is related to 16 and 20-hour aqueous pretreatment. Hydro-priming affects DNA and RNA synthesis, ATP availability, alpha-amylase activity and embryo's better growth. Hence, germination better rate, growth consistency, seeding vigor and deployment leads to better plant growth. (Basra et al., 2005; Ruan et al., 2002; Harris et al., 1999)

Grain Yield: According to the variance analysis table (Table 1) there is a significant difference between economic yield in replications, cultivars and treatments. The interaction between cultivar and treatment is not significant in this trait. Average comparison results show that among the cultivars, LV $_{(17)}$ has the highest economic yield and among the treatments, 8-hour aqueous pretreatment has the highest yield. It should be mentioned that there was no significant difference found between 8-hour and 12-hour treatments. 20-hour aqueous treatment had the lowest economic yield. Pod number, plant height and grain dry weight are among the factors which could affect the yield. In aforementioned traits also, 8-hour aqueous pretreatment had the highest yield. Rashed et al (2006) reported that barley seed pretreatment could increase the yield up to 53percent. Increase in seed yield has been observed in corn and rice seeds due to the seed pretreatment. Faruq et al (2006) and Harris et al (1999) believe that the rice seed yield due to the pretreatment is a result of growth percentage improvement and yield execution such as seed weight. Ghassemi- Golezani et al (2008) showed that hydro-priming could lead into seedling growth rate and percentage and also yield and yield components. Kahlon et al (1992) Hussain et al (2006) reported higher seed yield in

hydro-primed seeds of sunflower and wheat, respectively. Moreover, Ghassemi- Golezani et al (2008) obtained a higher pea seed yield in 16-hour hydro-priming.
Harris et al (1999) reported that hydro-priming results in corn, pea and Upland rice better seedling deployment and vigor which increases the growth, flowering maturity and yield.

Oil and Protein Percentage: The data variance analysis related to the oil percentage (Table 1) indicates that all effects except the treatments effects are not significant. Data mean comparison show that among treatments, 8-hour aqueous pretreatment, control treatment and 12-hours aqueous pretreatment had the highest oil percentage and 20-hour aqueous pretreatment had the lowest oil percentage. According to the variance table (Table 1) the protein percentage in replication, cultivar, treatment and cultivar treatment interaction was not significant. This shows that treatments are not effective in protein yield. Ashrafi and Razmju (2009) in a study on safflower claimed that 6 hours of hydro-priming could improve the hydro-primed seeds physiologic and biochemical characteristics and this leads to increase in oil and protein in seeds. Hydro-priming results in better growth a plant system protection against tension and increase in oil and protein amount. Seeds priming affects DNA and RNA synthesis and also improves the embryo's growth. (McDonald, 2000) Results from this research show conformity with previous studies in oil percentage while the protein percentage was not in accordance with previous studies.

Results: Priming in improving seed germination and seedling deployment is accepted in arid and semi-arid regions due to its positive effects. Considering Iran's location which is situated in arid and semi-arid region and two crises of moisture and temperature which are considered to be of significant factors in seed germination and seedling deployment stage, especially rain fed conditions, rapid deployment could be of a great help in better water resources use. In such situation, using seed priming technique to reach a scientific result from laboratory to farm is of importance. One of the main existing concerns is conducting laboratory research in this field without evaluating their results in greenhouse and farm conditions. Hence, if there is a possibility to use this technique well, we could benefit from each condition of water cultivation in more rapid deployment with lower irrigation and success in delayed plants in rain fed condition with temperature and moisture fluctuations. According to the results in this research, due to the growth short period and using seed aqueous pretreatment in increasing the yield and improvement in growth, the activities before seed aqueous pretreatment seem to be of essence and the 8-hour aqueous pretreatment is recommended for soybeans.

Table 1. Analysis of variance for the evaluated traits at different Hydro-Priming levels in Williams and Lv_{17} cultivars in 2008

Source of Variations	df	Mean Square						
		Plant height	Number of Sub-Stems	Weight of Sub-Stems	Oil percentage	Protein percentage	Grain yield	Germination percentage
Replication	2	148.146^{**}	1.213^{ns}	0.245^{ns}	0.196^{ns}	2.359^{ns}	49409.085^{**}	36.273^{ns}
Cultivar	1	329.425^{**}	5.208^{**}	7.792^{**}	0.768^{ns}	0.481^{ns}	17079.941^{**}	188.351^{**}
Hydro-Priming	4	161.822^{**}	3.737^{**}	2.917^{**}	3.644^{**}	6.686^{ns}	19956.800^{**}	431.148^{**}
C * H-p	4	341.735^{**}	0.047^{ns}	0.161^{ns}	0.197^{ns}	3.354^{ns}	1456.316^{ns}	2.230^{ns}
Error	18	0.447	0.368	0.429	0.357	76.022	2975.028	18.723
CV (%)		0.93	13.84	10.11	3.99	4.70	16.66	10.69

* and ** Significantly at $p < 0.05$ and < 0.01, respectively

Table 2. Comparison of Means of traits at different Hydro-Priming levels in Williams and Lv_{17} cultivarsr

Hydro-Priming levels	Characters				
	Number of Sub-Stems	Weight of Sub-Stems (gr)	Grain yield(gr/m2)	Oil percentage	Germination percentage
Without pretreatment	3.86 BC	5.88 C	326.7 ABC	15.48 AB	41.85 B
8 hours	3.56 C	5.88 C	409.6 A	15.83 A	54.01 A
12 hours	4.15 BC	6.24 BC	348.3 AB	15.08 AB	37.72 BC
16 hours	4.83 AB	7.10 AB	297.3 BC	14.53 BC	37.56 BC
20 hours	5.52 A	7.33 A	255.3 C	13.87 C	31.19 C

Differences between averages of each column which have common characters are not significant at probability level of 5%.

Table 3. Comparison of Means of traits at Characters

Cultivars	Characters		
	Number of Sub-Stems	Grain yield(gr/m2)	Germination percentage
Williams	3.97 B	303.56 B	42.97 A
LV17	4.80 A	351.28 A	37.96 B

Table 4. Comparison of Means of cultivar interaction effects with trait

Hydro-Priming levels	Cultivars	Character
		Plant height(cm)
Without pretreatment	**Williams**	77.20 B
	LV17	70.38 DE
8 hours	**Williams**	86.81 A
	LV17	72.33 CD
12 hours	**Williams**	73.06 C
	LV17	66.86 F
16 hours	**Williams**	70.47 DE
	LV17	68.60 EF
20 hours	**Williams**	67.76 F
	LV17	64.00 G

Differences between averages of each column which have common characters are not significant at probability level of 5%.

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