

## Effect of Seed Soaking Time on Germination of Maize (*Zea mays* L.)

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### Abstract

Higher germination percentage is the key factor in higher crop production. Thus, strategies were made to increase the germination percentage of the seeds. One of the best strategies to enhance the germination percentage was soaking seeds in water before sowing. This experiment evaluated the best soaking duration (in hours) to enhance the germination and seedling of maize cultivars. Pot experiment was conducted under Latin Square Design (LSD design) with two factors. Factor one was genotypic variety of Maize while other factor was duration of soaking seeds in water. Soaking duration was maintained at 12 hours, 24 hours and 36 hours along with the control treatment (0 hour or without soaking), each with three replications. Other factor was high yielding cultivars Pearl, MMRI-Yellow and Sahiwal-2002. Results showed that maximum germination percentage (99%) was found in MMRI-yellow cultivar of Maize soaked at 24 hours of duration followed by 94% germination soaked at 36 hours, 87% germination at 12 hours soaking time and 69% germination rate at 0 hour soaking, respectively. Results clearly revealed that optimum soaking duration was 24 hours instead of 36 hours although 36 hours soaking showed second best result on MMRI-yellow variety. Results also showed that optimum soaking time (24 hours) was the best soaking time among 36 hours, 12 hours and showed significantly better results.

**Keywords:** Germination, germination percentage, maize, soaking, water soaking, germination rate, soaking time.

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## INTRODUCTION

Pakistan is a largest grower of Maize crop. Country's agriculture is facing many challenges including lack of latest agro-based research. Scientists are investigating the latest technology focusing for the higher productivity of agronomic crops including Maize. In Pakistan, maize is cultivated two times in a year (Khatoon *et al.*, 2012). Maize seeds are mono-cotyledon and thus take some more time to germinate as compared to di-cotyledon crops (Heard *et al.*, 2003). Germination is a direct indicator for higher crop production. For higher productivity of maize, the main focus is to enhance the germination of the maize. Prolong germination duration can cause emerging seedlings to direct interact of soil born pathogenic bacteria (Maron *et al.*, 2013). Seedlings are less immutable against the pathogenesis caused by these kinds of harmful bacteria. Some adverse reasons can occur like lack of water or moisture content in soil (soil water) due to evaporation (Fischer *et al.*, 2007), amount of light and amount of oxygen supplied by the soil and other edaphic factors. Most of the farmers believe that seed soaking in water before sowing promote the germination (Esmaeilpour and Van Damme, 2016). Soaking of seeds in water is aimed to minimize the lag-phase in seedling germination in which seedling may adversely affect and thus noticeable reduction

in crop productivity can occur. Seed soaking before sowing decreased adverse effect of high temperature and enhanced seed germination (Finch-Savage *et al.*, 2004). Moreover, to provide sufficient amount of water or moisture content to the seed may increase germination rate. Objective of this experiment was to investigate the most favorable duration of soaking to seed and its effect on germination percentage and growth of seedling of Maize.

## MATERIALS AND METHODS

Experiment was plotted on three locally-available maize cultivars. These high yielding cultivars were Pearl, MMRI-Yellow and Sahiwal-2002. Pearl is a white grain while MMRI-Yellow and Sahiwal-2002 are yellow grain full season varieties of maize in Pakistan. Experiment was laid down under Latin Square Design (LSD design) with two factors and three replications of each treatment. Factor one was genotypic variety of Maize while other factor was duration of soaking seeds in water. Soaking duration was maintained at 12 hours, 24 hours and 36 hours along with the control treatment (0 hour or without soaking). Viability analysis of seeds was carried out following previous method (Leakey, 1993). Before sowing of seeds, soil physical and chemical

properties were measured (Table 1). Ten numbers of seeds were sown per pot having normal fertile soil. Germination percentage was counted on daily basis. Appropriate moisture was applied on each replication (within all treatments) including control (zero hours soaking duration). Ten numbers of seeds were also weighed, and then soaked in water for the duration of 12 hours, 24 hours and 36 hours, respectively to determine the water quantity imbibed by each

variety. The seeds were again weighed accordingly to obtain their weight after soaking at the end of each period. Data regarding germination percentage was recorded for 10 days from the time of sowing. Radical emergence from soil was considered as germination of seed. Parameters regarding seedling growth were plant height (cm), number of leaves, diameter of stem (millimeter) and dry matter (in grams).

**Table 1. Physical and chemical analysis of experimental soil**

Physical Analysis		Chemical Analysis	
Parameter	Value	Parameter	Value
Sand	63.8%	pH	7.85
Silt	17.5%	EC	2.41 dS m <sup>-1</sup>
Clay		Available phosphorus	4.00 mg kg <sup>-1</sup>
USDA Textural Class	Silty clay loam	Organic matter	0.58%
		SAR	8.80 (mmol L <sup>-1</sup> ) <sup>1/2</sup>
		CaCO <sub>3</sub>	6.63%

## RESULTS

Soaking of seeds in water for 24 hours resulted significant germination as compared to non-soaked seeds at 50% of germination of Sahiwal-2002 cultivar (Figure 1).

Results revealed that maximum water intake (100%) was found in variety sahiwal-2002 having 36 hours of soaking (Table 2). While same variety showed second best result (99% water intake) at 24 hours soaking time followed by pearl variety showed 95% at 36 hours soaking, sahiwal-2002 variety showed 94% at 12 hours soaking, MMRI-yellow variety showed 91% at 36 hours soaking, MMRI-yellow variety showed 90% at 24 hours soaking, pearl variety showed 82% at 24 hours soaking, pearl variety showed 80% at 12 hours soaking and MMRI-yellow variety showed 76% at 12 hours soaking, respectively.



**Fig. 1. Effect of soaking seeds in water on germination of Sahiwal-2002 cultivar after 18 hours sowing. Left) 0 hour soaking showed no germination, Right) 24 hours soaking showed 50% germination**

**Table 2. Water intake (% ± S.E.) of genotypic varieties of Maize**

Genotypic Variety	Duration of seed soaking in water		
	12 (hours)	24 (hours)	36 (hours)
Pearl	80.00±0.39	82.90±0.41	95.00±0.47
MMRI-Yellow	76.20±0.37	90.10±0.44	91.00±0.45
Sahiwal-2002	94.40±0.46	99.60±0.49	100.00±0.50

Values: mean of three replications

In case of 1<sup>st</sup> genotypic variety (pearl), results showed that maximum germination percentage (97%) was found in pearl cultivar of Maize soaked at 24 hours of duration followed by 91% germination soaked at 36 hours, 85% germination at 12 hours soaking time and 67% germination rate at 0 hour soaking, respectively (Table 3). Results clearly revealed that optimum soaking duration was 24 hours

instead of 36 hours although 36 hours soaking showed second best result on pearl variety of maize.

Similar results were found in genotypic variety number 2. In case of 2<sup>nd</sup> genotypic variety (MMRI-yellow), results showed that maximum germination percentage (99%) was found in MMRI-yellow cultivar of Maize soaked at 24 hours of duration followed by 94% germination soaked at 36 hours,

87% germination at 12 hours soaking time and 69% germination rate at 0 hour soaking, respectively (Table 4). Results clearly revealed that optimum soaking duration was 24 hours instead of 36 hours although 36 hours soaking showed second best result on MMRI-yellow variety.

Genotypic variety number 3 also showed similar results in respond to soaking duration on germination percentage. In case of 3rd genotypic variety (sahiwal-2002), results showed that maximum germination percentage (98%) was found in sahiwal-2002 cultivar of Maize soaked at 24 hours of duration followed by 93% germination soaked at 36 hours,

88% germination at 12 hours soaking time and 70% germination rate at 0 hour soaking, respectively. Results clearly showed that optimum soaking duration was 24 hours instead of 36 hours although 36 hours soaking showed second best result on sahiwal-2002 variety of maize (Table 5). MMRI-yellow variety respond maximum to germination percentage at 24 hours soaking duration followed by sahiwal-2002 and peal, respectively among other treatments.

**Table 3. Germination percentage (%) of Pearl cultivar of Maize**

Days after sowing	Duration of seed soaking			
	0 (hours)	12(hours)	24 (hours)	36 (hours)
0	-	-	-	-
1	-	-	44.25±1.4	37.75±1.0
2	-	33.00±1.6	37.25±1.3	35.75±1.3
3	10.50±0.5	30.25±1.8	16.00±0.4	14.25±0.6
4	19.50±1.1	12.50±0.4	4.50±0.4	4.75±0.4
5	17.00±1.0	8.75±0.3	-	-
6	11.75±0.8	-	-	-
7	7.50±0.5	-	-	-
8	3.75±0.5	-	-	-
9	3.50±0.3	-	-	-
10	-	-	-	-
<b>Total</b>	67.00±1.5	85.25±0.8	97.00±0.9	91.50±1.1

Values: mean of three replications

**Table 4. Germination percentage (%) of MMRI-Yellow cultivar of Maize**

Days after sowing	Duration of seed soaking			
	0 hours	12 hours	24 hours	36 hours
0	-	-	-	-
1	-	-	46.25±1.4	39.75±1.0
2	-	35.00±1.6	37.25±1.3	35.75±1.3
3	12.50±0.5	30.25±1.8	16.00±0.4	14.25±0.6
4	19.50±1.1	12.50±0.4	4.50±0.4	4.75±0.4
5	17.00±1.0	8.75±0.3	-	-
6	11.75±0.8	-	-	-
7	7.50±0.5	-	-	-
8	3.75±0.5	-	-	-
9	3.50±0.3	-	-	-
10	-	-	-	-
<b>Total</b>	69.00±1.5	87.25±0.8	99.00±0.9	94.50±1.1

Values: mean of three replications

**Table 5. Germination percentage (%) of Sahiwal-2002 cultivar of Maize**

Days after sowing	Duration of seed soaking			
	0 hours	12 hours	24 hours	36 hours
0	-	-	-	-
1	-	-	45.25±1.4	38.75±1.0
2	-	34.00±1.6	37.25±1.3	35.75±1.3
3	11.50±0.5	30.25±1.8	16.00±0.4	14.25±0.6
4	18.50±1.1	12.50±0.4	4.50±0.4	4.75±0.4
5	17.00±1.0	8.75±0.3	-	-
6	11.75±0.8	-	-	-
7	7.50±0.5	-	-	-
8	3.75±0.5	-	-	-
9	3.50±0.3	-	-	-
10	-	-	-	-
<b>Total</b>	70.00±1.5	88.25±0.8	98.00±0.9	93.50±1.1

Values: mean of three replications

## DISCUSSION

Our results showed that optimum soaking time (24 hours) was the best among 36 hours, 12 hours and showed significantly better results (even better than 36 hours soaking time). It was reported that most of the seeds soaked in water before sowing caused rapid germination (Wang *et al.*, 2002). Adequate moisture is necessary for rapid seed germination (Patane *et al.*, 2016). It was also reported that higher germination percentage is an important parameter to determine the number and viability of seeds (Nikishina *et al.*, 2001). Prolonged soaking caused poor growth and germination due to excessive water (Vieira *et al.*, 2004). High water level caused poor aeration, low oxygen availability which decreased plant germination (Ali *et al.*, 2011). A previous study demonstrated that too early or late watering reduced the yield and yield parameters of Rhodes grass (Arshad *et al.*, 2016).

Moreover, high water availability caused leach down of the essential soluble food reserves in the seeds, exosmosis of enzymes and hormones reduced protein synthesis and respiration rate were reasons behind this mechanism (Khaleel *et al.*, 2013). Higher germination percentage is achieved by hydrolysis of complex sugars into simple sugars that are easily utilized during auxins and proteins synthesis. Production of more auxins facilitates to soften cell wall to enhance growth and the proteins utilization in the production of new tissues.

## CONCLUSION

In this experiment it is concluded that, soaked maize seeds as compared to non-soaked or control showed a significant increase in germination percentage. Germination percentage is a precursor for higher crop production.

Soaking maize seeds in water for 24 hours before sowing can increase crop production with no cost. Such type of phenomenon is required to adopt to enhance crop productivity at no cost. These technologies can serve better to farmers for increasing production of crops. More research on this topic is suggested at various agronomic crops as it showed significantly best results on maize varieties.

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## CONFLICT OF INTEREST

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Conflict of interest: none.

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