

## DIFFERENTIAL WATER IMBIBITION IN WHEAT VARIETIES RELATED TO GERMINATION

SHAHBAZ AHMAD AND RASHID IBRAR

*Department of Agronomy,  
University of Arid Agriculture, Rawalpindi, Pakistan.*

### Abstract

Ten different wheat varieties viz., Rohtas-90, Pirsabak-90, Mehran-89, Chakwal-86, Inqalab-91, Sutlaj-86, Sariab-92, LU-26, Rawal-87 and Yecora-70 were compared for water imbibition for 0,2,4,6,8,10 and 12 hours and germination. Chakwal-86 showed maximum water imbibition during first two hours of soaking with Sutlaj-86 the least. Drying the seeds after soaking improved the germination potential. Germination Rate Index in Yecora-70 was maximum both in soaked and conditioned seeds. Soaking time did not affect the GRI but after conditioning, six hours soaking proved the best treatment for better germination.

### Introduction

In Pakistan about 20% of wheat crop is grown under rainfed conditions. Soil moisture for planting wheat is often marginal under rainfed conditions which makes the stand establishment uncertain. For the germination of seeds, they have to attain a specific moisture content where seeds germinate in a shorter time at high soil moisture content (Doneen & McGillworay, 1943). Wheat seeds germinate when their moisture content is approximately 50% on dry weight basis (Ashraf & Abu Shakra, 1978). Heavy and medium weight fractions of seed show better germination and seed vigour as compared to light weight fraction (Patil & Sarode, 1988). However, growth and development of wheat seeds is not necessarily limited by an initial low rate of water uptake (Klein & Sachis, 1992).

Soaking the seed before sowing helps improve stand establishment when seeding conditions are dry. The rate of emergence was 16.58% and 42.34% higher in 12 hours pre-soaked seed compared to control when planted at 8 cm and 5 cm seeding depth, respectively (Ahmad *et al.*, 1989). Aschermann-Koch *et al.*, (1992) reported that pre-soaking wheat seeds for 12 h and then drying, improved germination rate and root dry weight in higher quality seeds and also improved all vigour parameters, including final germination percentage in lower quality seeds. Soaking wheat seed for 12 h before seeding showed an increase in seedling emergence and grain yield by 15 and 10% respectively (Ahmad & Sandhu, 1989).

Experiments were carried out to study the differential behaviour of 10 different wheat varieties to water imbibition over time and its impact on seed germinability since these parameters contribute towards stand establishment especially under rainfed conditions.

**Table 1. Seed characteristics and water imbibition in different varieties of wheat seed at different pre-soaking periods.**

Varieties	1000-grain weight (g)	Initial (unsoaked) seed moisture %	Seed Density (g/ml)	Seed moisture % after soaking
Rohtas-90	36.07	14.26 NS	1.25 NS	37.66
Pirsabak-91	41.10	13.63	1.25	37.32
Mehran-89	42.70	13.70	1.25	37.13
Chakwal-86	39.79	14.24	1.25	41.94
Inqalab-91	40.03	14.05	1.35	39.26
Sutlaj-86	38.15	13.92	1.25	35.84
Sariab-92	39.74	14.53	1.25	41.07
Lu-26	43.62	14.55	1.25	38.98
Rawal-87	41.99	14.58	1.25	40.94
Yecora-70	36.96	14.25	1.35	40.34
LSD=0.05	0.34	1.16	0.13	1.08
<b>Soaking</b>				
0 hours				14.17
2 hours				32.33
4 hours				36.56
6 hours				42.61
8 hours				45.85
10 hours				50.03
12 hours				51.78
LSD=0.05				0.091

\* Pooled figures over soaking time

## Materials and Methods

Seeds of 10 different varieties of wheat (*Triticum aestivum* L.) viz., Rohtas-90, Pirsabak-91, Mehran-89, Chakwal-86, Inqalab-91, Sutlaj-86, Sariab-92, LU-26, Rawal-87 and Yecora-70 were grown during 1993-94 in the same field with recommended agronomic practices. Seed lots were divided into four sub-lots and 1000-grain weight was determined for all the seed samples. Seed volume was determined by using constant weight of seed of each variety and measuring the water displacement in a graduated cylinder. Each observation was repeated four times. Seed density was determined for each variety by dividing seed weight by volume. Moisture content of unsoaked seed of all the varieties was also determined by drying 10 g of seed in an oven at 137°C for 4 h.

Ten g seed samples were soaked in water for 0,2,4,6,8,10 and 12 h at room temperature followed by rolling separately on a blotting paper to remove excess water present on the surface of seeds and weighed to calculate the water imbibed by the seeds. Half of the seeds from each sample were sun dried to let them attain their

Table 2. Water imbibition (g) per ten grams by different varieties of wheat seed pre-soaked for different periods.

Soaking Period (hours)	Wheat Varieties											Mean
	Robtas-90	Pirsabak-91	Mehran-89	Chakwal-86	Inqalab-91	Suttaj-86	Samiab-92	Lu-26	Rawal-87	Yecora-70	Mean	
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.50	1.63	1.45	1.69	1.74	1.39	1.63	1.55	1.68	1.65	1.59	1.59
4	1.75	1.80	1.81	2.11	2.06	1.71	2.14	1.99	2.18	2.05	1.96	1.96
6	2.31	2.39	2.45	2.83	2.49	2.21	2.64	2.36	2.59	2.65	2.49	2.49
8	2.62	2.69	2.61	3.08	2.82	2.51	3.03	2.69	2.86	2.84	2.78	2.78
10	3.06	3.07	3.06	3.51	3.06	2.61	3.32	3.07	3.37	3.33	3.15	3.15
12	3.14	3.02	3.03	3.74	3.30	3.04	3.47	3.25	3.44	3.49	3.30	3.30
Mean	2.02	2.09	2.06	2.42	2.21	1.93	2.32	2.13	2.30	2.29	2.29	2.29

LSD<sub>0.05</sub> Value: Varieties = 0.085, Soaking periods = 0.071, V x S = 0.2248

**Table 3. Germination of wheat seed as influenced by pre-soaking for different periods.**

Varieties	Germination Potential % Soaked	Germination Potential % Soaked & dried	Germination Rate Index (Soaked)	Germination Rate Index Soaked & dried
Rohtas-90	91.79	93.57	99.07	89.75
Pirsabak-91	89.29	91.43	94.68	83.43
Mehran-89	88.57	92.50	93.54	88.61
Chakwal-86	92.14	94.29	99.11	93.71
Inqalab-91	88.57	90.71	91.96	85.11
Sutlaj-86	93.93	93.21	96.25	81.36
Sariab-92	93.21	95.00	100.10	91.71
LU-26	92.50	94.29	99.29	92.11
Rawal-87	86.07	87.86	88.86	80.61
Yecora-70	91.79	93.93	101.60	93.82
LSD=0.05	3.49	3.77	4.67	4.15
<b>Soaking</b>				
0 hours	92.00 N.S.	93.00 N.S.	95.00 N.S.	84.00
2 hours	92.00	93.00	98.00	85.93
4 hours	93.00	92.00	98.00	87.25
6 hours	90.00	94.00	97.00	91.10
8 hours	91.00	91.00	98.00	89.50
10 hours	90.00	93.00	95.00	88.57
12 hours	90.00	92.00	95.00	89.80
LSD=0.05	3.53	3.76	4.23	3.48

original weight whereas 25 seeds from the other half were used for germination test at room temperature. The seed was considered germinated when the plumule and radical had appeared. Number of seeds germinated at 12 h interval were counted for 7 days and Germination Rate Index (GRI) calculated following the method described by Maguire (1962). The sun dried samples were also tested for germination.

### Results and Discussion

Wheat varieties showed differences for 1000-grain weight which ranged from 36.0 g in Rohtas-90 to 43.6 g in LU-26 (Table 1). Wheat varieties did not show differences in seed density (Table 1). The number of seeds per unit weight were therefore, different among the varieties. The variation in the seed surface area might have benefited the varieties having lower 1000-seed weight for water imbibition in free water soaking. Initial seed moisture percentage of the varieties varied from 13.6% (Pirsabak-91) to 14.5% (Rawal-87) on dry weight basis and these differences were statistically non significant at 5% level of probability (Table 1).

Wheat varieties differed from one another in germination percentage which ranged from 86.0% to 93.9%. Sutlaj-86 followed by Sariab-92, LU-26, Chakwal-86, Yecora-70 and Rohtas-90 showed greater germination while poor germination was found in Rawal-87, Inqalab-91, Mehran-89 and Pirsabak-91. Drying the seed after soaking improved the germination in all the varieties. It is likely that the hydrolytic processes begin during pre-soaking and the resulting simple sugars that are released were utilized for synthesis immediately upon germination. Such similar observations have been made by Aschermann-Koch *et al.*, (1992) where germination % and rate improved in seeds dried after 12 h soaking.

Wheat varieties when soaked showed variable behaviour for water imbibition over period of time which was statistically significant (Table 2). During the first 2 h, Inqalab-91 imbibed maximum water whereas Rawal-87, Chakwal-86, Inqalab-91, Sariab-92 and Yecora-70 showed maximum water imbibition after 4 h soaking. Sutlaj-86 showed less water imbibition at all the soaking periods. Pooled analysis over soaking periods showed that Chakwal-86 imbibed maximum water and was significantly better than all the others whereas Sutlaj-86 was the lowest in water imbibition. Water imbibition by wheat seed was maximum during the first 2 h of soaking (Table 1). Thereafter, water imbibition continued over time but the rate per unit time was less than the first 2 h of soaking. It would suggest that wheat seeds could imbibe more water if they have been soaked for 12 h. Twelve hours soaking period could be used by the farmers to soak the seed in the evening and plant it the next morning. Besides, at 12 h maximum soaking, wheat seed also attains 50% moisture content. Ashraf & Abu-Shakra (1978) found that germination process in wheat starts when the seeds attain approximately 50% moisture content on dry weight basis.

Germination Rate Index for the varieties was statistically significant (Table 3). Yecora-70, LU-26, Sariab-92, Chakwal-86 and Rohtas-90 showed maximum GRI with lowest GRI in Rawal-87 and Inqalab-91. The soaking periods did not differ from one another for GRI. Yecora-70 had the maximum GRI (93.8) for conditioned seed and it was statistically at par with LU-26, Sariab-92, Chakwal-86 and Rohtas-90 whereas Rawal-87 had the lowest GRI (80.6) which was at par with Sutlaj-86 and Pirsabak-91. The differences among the soaking periods were also statistically significant. The GRI improved with the increase in soaking time and 6 h soaking gave better results beyond which it decreased but this decrease was statistically non-significant. Ahmad *et al.*, (1989) also reported increased emergence rate for 12 h soaked seed.

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