

Original Research Article

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## Effect of Seed Hardening and Irrigation on Growth and Yield of Wheat (*Triticum aestivum* L.)

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### ABSTRACT

#### Keywords

Wheat, PEG, GA<sub>3</sub>, Irrigation

#### Article Info

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The experiment was conducted at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS) Prayagraj (U.P.) located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and at an altitude of 98 m above mean sea level during the *rabi* season 2019-2020 to evaluate the performance of various seed hardening chemicals *viz.* Distilled water, KNO<sub>3</sub> at 1000mg/l, PEG at 15% and GA<sub>3</sub> at 450 mg/lin late sown variety of wheat (*Triticumaestivum* L.).The plant height was highest in GA<sub>3</sub> at 450 mg/l + Three Irrigations at crown root initiation, jointing and anthesis (81.27 cm), the maximum dry weight was noted in PEG at 15%+Three Irrigations at crown root initiation, jointing and anthesis stage (24.00 g). The no. of total effective tillers/m<sup>2</sup> (402), straw yield (45.15t), grain yield (3.52t) and harvest index (5.82) was observed in the treatment PEG at 15%+Three Irrigations at crown root initiation, jointing and anthesis stage.

### Introduction

In India wheat crop is cultivated in *rabi* season. It is normally sown during November and harvested between March and April. The cultivated area under wheat at national level has shown increasing trend, from 29.04 million hectare to 30.54 million hectare with a magnitude of 1.5 million hectare (5%) net gain in terms of area. Uttar Pradesh has largest share in area with 9.75 million hectare (32%).

The production of wheat has also showed an increasing trend, from 87.39 to 94.57 million

tons from 2012–2013 to 2017–2018 with a magnitude of 7.18 million tonnes (8.22%). However, in the past decade a general slowdown in increase in the productivity of wheat has been noticed (Nagarajan, 2005).

In rice–wheat systems, late sowing of wheat is also one of the major reason of low yield. This yield reduction is principally due to lower and erratic germination, and poor crop establishment because of low temperature prevailing. Good crop establishment is one of the major challenges to crop production and its importance is recognized by farmers as well as researchers (Chivasa *et al.*, 1998).

Seed hardening has been found a doable technology to enhance rapid and uniform emergence, high vigor, and better yields in field crops (Dearman *et al.*, 1987). Seed priming has been commonly employed to reduce the time between seed sowing and seedling emergence and the synchronization of emergence (Parera and Cantliffe, 1994).

Priming of wheat seed in water has been observed to improve the germination and emergence (Ashraf and Abu-Shakra, 1978) and promote vigorous root growth (Carceller and Soriano, 1972) under low soil water potential compared with untreated seeds. The rationale is that sowing soaked seed decreases the time needed for germination and may allow the seedling to escape deteriorating soil physical conditions. It had resulted in more germination speed especially in drought stress and low temperatures in various crops (Sivritepe *et al.*, 2003). Seed priming allows some of the metabolic processes necessary for germination to occur without germination taking place. Treating the seed with chemicals or growth hormones like GA<sub>3</sub> treatment, enhanced the vegetative growth by enhancing the deposition of Na<sup>+</sup> and Cl<sup>-</sup> in both root and shoots. And also cause a significant increase in photosynthetic activity at the vegetative stage of the crops.

The hardening of the seeds or seed treatment with KNO<sub>3</sub> solution increases yield, fruit size and improves quality in field and vegetables crops. Priming with KNO<sub>3</sub> also results in enhancement of seed germination, mineral composition, proline, β-amylase and protein.

It has been observed that germination and seedling establishment of some cereals under drought, cold stress, and high salinity were improved following seed Osmo - priming with PEG. A seed hardened with PEG treatment indicated a relationship between the pattern of water absorption, the reactivation of

mitotic activity and the start and synchronization of germination. Thus, enhancing a better germination compared to the untreated seeds.

Therefore, the present experiment was carried out by keeping this in view, experiment was laid to evaluate “the effect of Seed Hardening and Irrigation on Economics of Wheat (*Triticum aestivum* L.).”

## Materials and Methods

The experiment was conducted at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and at an altitude of 98 m above mean sea level. The experiment was conducted during the *Rabi* season 2019-2020. The experimental soil was sandy loam, with pH 7.2, Organic C (%) 0.49, low in available N (109.01 kg/ha) and medium in available P (21.80 kg/ha) and K (270.02 kg/ha).

The experiment was laid out in a randomized block design, having 13 treatment combinations in 3 replicates. The treatments comprised of T<sub>1</sub> -Distilled water + One Irrigation at crown root initiation stage, T<sub>2</sub> - Distilled water + Two Irrigations at crown root initiation and jointing stage, T<sub>3</sub> -Distilled water + Three Irrigations at crown root initiation, jointing and anthesis stage, T<sub>4</sub> - KNO<sub>3</sub> at 1000 mg/l+ One Irrigation at crown root initiation stage, T<sub>5</sub> -KNO<sub>3</sub> at 1000 mg/l+ Two Irrigations at crown root initiation and jointing stage, T<sub>6</sub> -KNO<sub>3</sub> at 1000 mg/l+ Three Irrigations at crown root initiation, jointing and anthesis stage, T<sub>7</sub> -PEG at 15% + One Irrigation at crown root initiation stage, T<sub>8</sub> - PEG at 15% + Two Irrigations at crown root initiation and jointing stage, T<sub>9</sub> -PEG at 15%

+ Three Irrigations at crown root initiation, jointing and anthesis stage, T<sub>10</sub> -GA<sub>3</sub> at 450 mg/l+ One Irrigation at crown root initiation stage, T<sub>11</sub> -GA<sub>3</sub> at 450 mg/l + Two Irrigations at crown root initiation and jointing stage, T<sub>12</sub> -GA<sub>3</sub> at 450 mg/l+ Three Irrigations at crown root initiation, jointing and anthesis stage, T<sub>13</sub> –Control (no seed treatment).

The seeds were soaked in different seed hardening chemicals for 12-14 hours and then dried using tissue papers to remove the excess moisture outside the seed coat. The sizes of each experimental plot were 4 m × 3 m. The wheat variety used in the experiment was Halna (K-7903).

The seeds were sown by line sowing method with spacing of 22.5cm manually with the seed rate of 125 kg/ha. N, P and K were applied at the rate of 120, 60 and 60 kg per ha, respectively. N was applied in split application, 50% at basal and 50% as top dressing, whereas P and K were applied as basal dose.

## Results and Discussion

### Growth and yield attributes

The Maximum plant height(81.67cm) was recorded in treatment T<sub>12</sub> (GA<sub>3</sub> at 450 mg/l + Three irrigations). Whereas, T<sub>1</sub>(Distilled water + One Irrigation), T<sub>2</sub> (Distilled water + Two irrigations), T<sub>3</sub> (Distilled water + Three irrigations), T<sub>6</sub> (KNO<sub>3</sub> at 1000 mg/l + Three irrigations), T<sub>8</sub> (PEG at 15% + Two irrigations), T<sub>9</sub> (PEG at 15% + Three Irrigations), T<sub>11</sub> (GA<sub>3</sub> at 450 mg/l + Two Irrigations), T<sub>13</sub> (Control) were at par with T<sub>12</sub> (GA<sub>3</sub> at 450 mg/l + Three irrigations). The hardening could not affect the plant height much because the standing crops were not given any additional treatments but considering GA<sub>3</sub> is a plant growth hormone; its effect on promoting growth is slight. Positive effects of GA<sub>3</sub> treatment effects reported include breaking seed dormancy, promoting germination, increasing inter-node length, increasing plant height and encouraging cell division (Ghodrat and Roustaa, 2012).

**Table.1** Effect of seed hardening and irrigation on growth and yield attributes of wheat

|                   | Treatments                                  | Plant height (cm) | Dry weight (g) | No. of Total effective tillers/m <sup>2</sup> |
|-------------------|---|-------------------|----------------|---|
| T <sub>1</sub> :  | Distilled water + 1 irrigation              | 78.88             | 18.40          | 247.00  |
| T <sub>2</sub> :  | Distilled water + 2 irrigation              | 79.10             | 17.86          | 247.66  |
| T <sub>3</sub> :  | Distilled water + 3 irrigation              | 81.46             | 19.80          | 330.33  |
| T <sub>4</sub> :  | KNO <sub>3</sub> at 1000mg/l + 1 irrigation | 75.72             | 18.80          | 284.33  |
| T <sub>5</sub> :  | KNO <sub>3</sub> at 1000mg/l + 2 irrigation | 76.02             | 19.53          | 285.00  |
| T <sub>6</sub> :  | KNO <sub>3</sub> at 1000mg/l + 3 irrigation | 80.76             | 22.06          | 292.00  |
| T <sub>7</sub> :  | PEG at 15%+ 1 irrigation                    | 79.46             | 18.66          | 302.00  |
| T <sub>8</sub> :  | PEG at 15%+ 2 irrigation                    | 79.80             | 22.20          | 342.00  |
| T <sub>9</sub> :  | PEG at 15%+ 3 irrigation                    | 80.26             | 24.00          | 402.00  |
| T <sub>10</sub> : | GA <sub>3</sub> at 450 mg/l + 1 irrigation  | 77.93             | 18.00          | 281.66  |
| T <sub>11</sub> : | GA <sub>3</sub> at 450 mg/l + 2 irrigation  | 80.13             | 19.80          | 306.00  |
| T <sub>12</sub> : | GA <sub>3</sub> at 450 mg/l + 3 irrigation  | 81.67             | 23.80          | 373.00  |
| T <sub>13</sub> : | Control (no seed treatment)                 | 79.56             | 19.46          | 293.00  |
|                   | F- Test                                     | S                 | S              | S   |
|                   | Sem   | 1.09              | 0.54           | 27.89   |
|                   | C.D(0.05)                                   | 3.20              | 1.58           | 81.82   |

Note: 1 irrigation at CRI stage

2 irrigationsat CRI and jointing stage

3 irrigations at CRI stage, jointing stage, anthesis stage

**Table.2** Effect of Seed Hardening and Irrigation on Yield attributing characters of wheat

|                   | Treatments                                  | Grain Yield(t/ha) | Straw Yield(t/ha) | Harvest Index(%) |
|-------------------|---|-------------------|-------------------|------------------|
| T <sub>1</sub> :  | Distilled water + 1 irrigation              | 1.76              | 36.04             | 4.74             |
| T <sub>2</sub> :  | Distilled water + 2 irrigation              | 2.41              | 41.50             | 5.50             |
| T <sub>3</sub> :  | Distilled water + 3 irrigation              | 3.04              | 42.19             | 6.74             |
| T <sub>4</sub> :  | KNO <sub>3</sub> at 1000mg/l + 1 irrigation | 2.05              | 37.75             | 5.17             |
| T <sub>5</sub> :  | KNO <sub>3</sub> at 1000mg/l + 2 irrigation | 3.18              | 43.04             | 6.88             |
| T <sub>6</sub> :  | KNO <sub>3</sub> at 1000mg/l + 3 irrigation | 3.26              | 43.49             | 6.98             |
| T <sub>7</sub> :  | PEG at 15%+ 1 irrigation                    | 2.03              | 42.86             | 4.52             |
| T <sub>8</sub> :  | PEG at 15%+ 2 irrigation                    | 3.10              | 42.94             | 6.73             |
| T <sub>9</sub> :  | PEG at 15%+ 3 irrigation                    | 3.52              | 45.15             | 7.27             |
| T <sub>10</sub> : | GA <sub>3</sub> at 450 mg/l + 1 irrigation  | 1.92              | 41.17             | 4.49             |
| T <sub>11</sub> : | GA <sub>3</sub> at 450 mg/l + 2 irrigation  | 2.16              | 43.64             | 4.73             |
| T <sub>12</sub> : | GA <sub>3</sub> at 450 mg/l + 3 irrigation  | 2.16              | 43.8              | 4.72             |
| T <sub>13</sub> : | Control (no seed treatment)                 | 2.23              | 43.69             | 4.85             |
|                   | F- Test                                     | S                 | S                 | S                |
|                   | Sem   | 0.25              | 1.20              | 0.59             |
|                   | C.D(0.05)                                   | 0.74              | 3.53              | 1.74             |

Note: \*1 irrigation at CRI stage

\*2 irrigations at CRI and jointing stage

\*3 irrigations at CRI stage, jointing stage, anthesis stage

### Dry matter accumulation

A linear increase in Dry matter accumulation was observed from tillering to harvest. The dry matter accumulation (24.00g) was significantly superior in treatment T<sub>9</sub> (PEG at 15% + Three irrigations) and treatment T<sub>12</sub> (GA<sub>3</sub> at 450 mg/l + Three irrigations) was found to be statistically at par with the highest. Priming presumably permitted some repairs to damaged membrane caused by deterioration and exerted better germination pattern and higher vigor level than non-primed (Ruan *et al.*, 2004). The cause of rapid increase of Dry matter accumulation at crop harvest was possibly due to emergence of number of new tillers/plant and more fertile spikes/plant (Alam, 2013).

### Effective tillers per m<sup>2</sup>

Maximum no. of total effective tillers per m<sup>2</sup>(402) were found with application of T<sub>9</sub>

(PEG at 15% + 3 irrigations), whereas, T<sub>3</sub> (Distilled water + Three Irrigations), T<sub>7</sub> (PEG at 15% + One Irrigations), T<sub>12</sub> (GA<sub>3</sub> at 450 mg/l + Three irrigation) were found statistically at par with the highest treatment. These results were in conformity with the results of Rohool *et al.*, (2016) who also observed that the Seed hardening for 24 hours with PEG-8000 significantly increases various growth characters *viz.*, plant height, number of effective tillers and yield attributes in Wheat.

### Yield (kg/ha)

Maximum grain yield (3.52t) was recorded in the treatment T<sub>9</sub>(PEG at 15% + Three irrigations), whereas T<sub>3</sub> (Distilled water + Three Irrigations), T<sub>5</sub> (KNO<sub>3</sub> at 1000 mg/l + Two Irrigations), T<sub>6</sub> (KNO<sub>3</sub> at 1000 mg/l + Three Irrigations) and T<sub>8</sub> (PEG at 15%+Two Irrigations) were found to be statistically at par with the highest. The increase in the yield by

seed hardening with PEG and KNO<sub>3</sub> may be due to improvement in yield components mainly seed yield/plant and harvest index. These results are in agreement with Manjunath and Dhanoji, (2011) who stated that treating wheat seeds with PEG and KNO<sub>3</sub> increased the grain yield compare to control. Haris *et al.*, (1999) observed 15% increase in grain yield by seed hardening and stated that success of hardening techniques depends on type of cultivar, osmotic potential solution, temperature, seed vigor, rate of seed re-drying and conditions during seed storage.

### Straw yield

Maximum Straw yield (45.15t) were was found to be significantly higher with the treatment T<sub>9</sub>(PEG at 15% + Three irrigations), whereas T<sub>3</sub> (Distilled water+ Three irrigations), T<sub>5</sub> (KNO<sub>3</sub> at 1000 mg/l +Two irrigations), T<sub>6</sub> (KNO<sub>3</sub> at 1000 mg/l +Three irrigations), T<sub>7</sub>(PEG at 15%+ one irrigation at CRI stage), T<sub>8</sub> (PEG at 15%+ Two irrigations), T<sub>11</sub> (GA<sub>3</sub> at 450 mg/l+ Two irrigations), T<sub>12</sub> (GA<sub>3</sub> at 450 mg/l), T<sub>13</sub> (Control) were found to be statistically at par with the highest.

The increase in straw yield with pre sowing treatment was due to the expansion of leaves, which resulted in higher photosynthesis, assimilation and ultimately higher production of total dry matter. Misra and Dwibedi, (1980) reported 37 % increase in yield of wheat due to pre-sowing techniques.

### Harvest index

Highest percentage of harvest index (7.27) was observed in the treatment T<sub>9</sub>(PEG at 15% + Three irrigations), whereas T<sub>3</sub> (Distilled water+ Three irrigations), T<sub>5</sub> (KNO<sub>3</sub> at 1000 mg/l +Two irrigations), T<sub>6</sub> (KNO<sub>3</sub> at 1000 mg/l +Three irrigations) and T<sub>8</sub> (PEG at 15%+Two irrigations) were found to be statistically at par with the highest. The

improvement in harvest index due to priming could be attributed to better emergence and crop yields caused by seed priming (Minhas *et al.*, 1995).

It can be concluded that PEG at 15% + three irrigations (T<sub>9</sub>), which recorded significantly higher growth and yield parameters performed better than the remaining treatments. Hence, it can be recommended to the farmers.

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