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Effect of seed priming on the germination behavior of wheat in salt affected soils in ecological zone of Rahim Yar |Khan

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Abstract

This study was conducted to evaluate the influence of seed priming in wheat (*Triticum aestivum* L.) in salt effected soils. Soil salinity affects a large arable land of world. Experiment was conducted using a completely randomized design of three replications. Following seed primer was used i.e (hydro priming, priming with KNO_3 (Potassium Nitrate) with 2% solution, priming with KCL (Potassium Chloride) with 2% solution, priming with $CaCl_2$ (Calcium Chloride) with 1% solution and one plot as control where no priming was done. Priming was done by soaking of required quantity of seeds of wheat variety in tap water and various chemicals' concentration for 12 hrs in ratio of 1:1 (Kg of seeds/volume of solution) by using wet gunny bags. Results indicate that priming seed significantly increased germination percentage of seed and other yield parameters of wheat variety. The maximum results were obtained when seed primed with KNO_3 (Potassium Nitrate) with 2% solution for 12hrs followed by KCL (Potassium Chloride) with 2%

solution for 12hrs. The minimum effect was seen when used $CaCl_2$ (Calcium Chloride) with 1% solution for 12hrs. The primed seed gave both faster germination and led to higher germination when under salt stress. We conclude that using priming techniques can effectively enhance the germination seed under saline condition.

Introduction

Wheat is an important cereal crop of the world. The major obstacles to high yield and production of crop plants is the lack of synchronized crop establishment due to poor weather and soil conditions (Mwale *et al*., 2003). Germination is a critical stage of the plant cycle and improved tolerance of high salinity could improve the stability of plant production. Salinity affects plant growth at all developmental stages; however, sensitivity varies from one growth stage to another. (Jajarmi, 2009). Salt concentration completely inhibits germination at higher levels or induces a state of dormancy at low levels, it also reduces imbibition of water because of lowered osmotic potentials of the medium and causes changes in metabolic activity (Rafiq, 2006). Seed priming can improve the tolerance of plants against abiotic stresses through enhanced and advanced germination, improved mechanisms of protection against oxidative stress and retained memory of previous stress (Chen and Arora 2013). Many such seed priming or invigoration treatments are being used to improve the rate and speed of germination under stressed conditions or with substandard seed lots and soils condition (Lee and J. H. Kim, 2000). On the other hand seeds are occasionally sown in seedbeds having unfavorable moisture because of the lack of rainfall at sowing time which results in poor seedling emergence (Angadi and Entz, 2002). The size of the seed plays a major role in germination and establishment of vigorous seedlings that is essential to achieving high yield. In drought prone environments, particularly, cereal germination tends to be irregular and can be extended over long periods (Bougne *et al*., 2000). Seed germination is negatively affected by drought (Damirkaya *et al*., 2006). A phenomenon called hydro priming. In recent years, seed osmo priming has been tested in over 1000 trials in India, Pakistan, Nepal,

Bangladesh and Zimbabwe on a range of crops including maize (*Zea mays*), sorghum (*Sorghum bicolor*), rice (*Oryza sativa*), wheat (*Triticum wwspp.*) and Chickpea (*Cicer arietinum*) (Harris *et al*., 2001). For priming, seeds are soaked in low water potential solutions. A variety of inorganic salts, plant growth regulators and organic solutes are used as priming agents (Farooq *et al*., 2006, Afzal *et al*., 2008). However, seed priming with calcium salts has been more effective and economical in improving stress tolerance in plants (Jafar *et al*., 2012; Tabassum *et al*., 2017). Priming had resulted in more germination speed especially in drought stress and low temperatures in sorghum, sunflower and wheat (Sivritepe *et al*., 2003). It allows some of the metabolic processes necessary for germination to occur without germination take place. In priming, seeds are soaked in different solutions with high osmotic potential. This prevents the seeds from absorbing enough water for radicle protrusion, thus suspending the seeds in the lag phase (Taylor *et al*., 1998). Seed priming is controlled hydration of seed carried out to a level where germination related metabolic activities begin but radical protrusion does not take place (Farooq et al. 2006). Priming of seeds with CaCl2, followed by priming with KCl and NaCl, were found to be effective in alleviating the adverse effects of salt stress on wheat plants through their effects on altering the levels of different plant phytohormones (Iqba, *et.al.,* at.2006). Seed priming has been commonly used to reduce the time between seed sowing and seedling emergence and to synchronize emergence (Parera and Cantliffe, 1994). Various seed priming techniques have been developed which include hydro-priming, halo priming, osmo-priming and hormonal priming. Seeds spend a great deal of time just absorbing water from the soil. If this time is minimized, seed germination and seedling emergence can be significantly speeded up. The easiest way to do this is to soak the seeds in water before sowing (Harris, 1999). Seed priming is a controlled hydration process followed by retrying that allows seeds to imbibe water and begin internal biological processes necessary for germination, but which does not allow the seed to actually germinate. A robust seedling establishment enhances competitiveness against

weeds, improves tolerance to environmental stresses and maximizes biological and grain yields (Hosseein *et al.,* 2011). Potassium hydro phosphates (KH2PO4), have been introduced as the osmoticum which have shown good potential to enhance germination, emergence, growth, and grain yield of wheat (Misra and Dwibedi, 1980). Ajirloo *et al.* (2013) said Potassium nitrate (KNO3) is the most common known chemical for promoting seed germination. It may interact with temperature and influencing the seed physiology finally, germination and vigour are improved.

When the seeds treated properly they are able to germinate and emerge better as the inorganic salts improve germination and growth parameters of the treated seed; KNO_3 increases the protein and starch content in grains and KCL increases yield, fruit size and improves vegetative growth. The present study is therefore, planned to see the effect of seed priming on the germination behavior of wheat in salt affected soils in ecological zone of Rahim Yar Khan.

Materials and methods:

The experiment was conducted at Adaptive Research Farm Rahim Yar Khan during Rabi season 2020-21 and 2021-22 to to see the effect of seed priming on the germination behavior of wheat in salt affected soils in ecological zone of Rahim Yar Khan. The soils of this region mostly saline sodic. Salts concentration too much high which effects the germination of most of the crops. To overcome the poor germination of seed four seed primer were used i.e (hydro priming, priming with KNO_3 (Potassium Nitrate) with 2% solution, priming with KCL (Potassium Chloride) with 2% solution, priming with $CaCl_2$ (Calcium Chloride) with 1% solution and one plot as control where no priming was done. Pre sowing seed treatment or priming was done by soaking of required quantity of seeds of wheat variety in tap water and various chemicals' concentration for 12 hrs in ratio of 1:1 (Kg of seeds/volume of solution) by using wet gunny bag. Then the treated or primed seeds were dried in shade to maintain the seed moisture content approximately 12 or 13%. The crop was raised by using all required agronomical practices. Mature crop was

harvested in the last week of April. Data collected on different parameters were analyzed statistically by using M STAT-C Programme (Anonymous,1986) for analysis of variance and means were separated using Fisher's protected least significant difference (LSD) test at 5% probability level (steel *et a*l., 1997).

RESULTS AND DISCUSSION

Significant effect of various pre-sowing seed priming treatments control, hydro priming, priming with KNO_3 (Potassium Nitrate) with 2% solution, priming with KCL (Potassium Chloride) with 2% solution, priming with $CaCl_2$ (Calcium Chloride) with 1% solution were found on seed quality in terms of 1000 seed weight, germination, seedling length, seedling dry weight, seed vigour, seed, electrical conductivity and protein content of wheat when crop was raised under field conditions (Table 1). Similar findings are given by Farooq *et al.* (2006), Tian *et al*., (2014) and Toklu *et al*., (2015). Seed priming treatment of KNO3 gave significantly highest percent improvement over control for 1000 seed weight, germination, seedling length, seedling dry weight, seed vigour, electrical conductivity and protein content with values of 41g, 91 %, 15.3cm, 0.265g, 1756.3cm,, 1.29dSm-1 and 15.6 % respectively (Ajirloo *et al*. 2013.). Next pre-sowing seed priming treatment was KCL, which showed significantly similar performance & at par to KNO3 for improving the 1000 seed weight, germination, seedling length, seedling dry weight, seed vigour, electrical conductivity and protein content and showed % improvement with values of 39g, 85 %, 13.2cm, 0.253g, 1632.8cm, 1.32dSm-1 and 14.2% respectively over unprimed seeds. Seed priming with tap water also showed significant improvement for 1000 seed weight, germination% seedling length (cm), seedling dry weight (g), seed vigour and protein content and ranked 3rd with values 38g, 82%, 12.3cm, 0.247g, 1546.3, 1.34& 13.1% These findings were strongly supported by Lemrasky *et al.* (2012), Hamidi *et al.* (2013) and Toklu *et al.* (2015) respectively followed by CaCl2 that scored nearly similar values and were at par to control 35g, 80%, 11.6, 0.245, 1478.6, 1.37 & 11.7 % for 1000 seed weight (g), germination (%),

seedling length (cm), seedling dry weight (g), seed vigour, electrical conductivity dSm-1 and protein content (%) respectively. It was very much clear for the findings of experiment that untreated or unprimed (control) seeds exhibited significantly inferior performance than KNO3 and KCL. These results are in accordance with the finding of Khan *et al*., (2009), Ghobadi *et al.* (2012), Ghassemi-Golezani *et al*. (2013), Tian *et al*. (2014). It was very much clear from the findings of experiment that untreated or unprimed (control) seeds exhibited significantly inferior performance regarding 1000 seed weight, germination, seedling length, seedling dry weight, seed vigour, electrical conductivity and protein content. Priming treatments KNO3 and KCL showed best performance among all the treatments and were at par with each other.

In table 2 means of climate data for both years showed that in November temperature favorable for the germination of wheat. Seed priming with water and other solutions gave good results and no disease and other heat losses effects the germination.

Table 1: Mean table (2 years) for the effect of seed priming on the quality parameters under Ecological Zone of Rahim Yar Khan.

Treatments	**1000 Seed weight (g)**	**Germination (%)**	**Seedling length (cm)**	**Seedling Dry weight (g)**	**Seed Vigour**	**E.C. value**	**Protein Content (%)**
Control	32	76	10.1	0.221	1276.8	1.42	9.3
Hydro priming	38	82	12.3	0.247	1546.3	1.34	13.1
KNO_3 (2%)	41	91	15.3	0.265	1756.3	1.29	15.6
KCL (2%)	39	85	13.2	0.253	1632.8	1.32	14.2
$CaCl_2$ (1%)	35	80	11.6	0.245	1478.6	1.37	11.7
S.E.D	1.62	1-02	0.50	0.011	50.4	0.006	0.23
C.D	4.05	2.55	1.25	0.031	122.8	0.021	0.52

MONTHS	**Av. Max temp C^o**	**Av. Mini temp C^o**	**Humidity%**	**Rainfall mm**

November	30.40	15.55	79.90	-
December	25.28	7.60	81.03	-
January	22.78	4.43	82.86	2.2
February	26.85	5.81	82.11	-
March	28.28	11.30	82.16	-
April	37.91	20.29	82.80	5.4

Table 2: Mean table (2 years) climate data under Ecological Zone of Rahim Yar Khan.

Conclusions

It was concluded from the present study that the seed priming with KNO3 @ 2% on wheat variety has significantly improved the seed quality with an increase of 1000 seed weight (41g), germination (91 %), seedling length (15.3cm), seedling dry weight (0.265g), seed vigour (1756.3cm), electrical conductivity 1.29dSm-1 and protein content with a value of 15.6 % respectively. Among all the treatments, KNO3 was found to be the best which was at par with KCL and $CaCl_2$.

Different field views

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