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SEED PRIMING EFFECTS OF ASCORBIC ACID ON WHEAT (*Triticum aestivum* L.)

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The role of ascorbic acid as an important antioxidant has been well described. The present experiment was designed in order to study the important morphological and physiological effects of ascorbic acid as a pre sowing seed treatment on wheat (*Triticum aestivum* L.) to see whether it can enhance growth or not. Seeds of two different varieties of wheat i.e. (SH-95 and Chakwal-50) were soaked overnight in ascorbic acid (1mM). Seeds were also be soaked in distilled water for control. The experiment was conducted in the wire house of Old Botanical Garden, University of Agriculture, Faisalabad. Twelve pots were prepared with 9kg soil in each, six pots were treated seeds while six were of control. There were three replicates and a complete randomized design was used. The changes in different morphological and physiological parameters were observed and recorded. The yield of the crop was inspected by yield parameters at maturity of crop. Ascorbic acid had a significant effect on both varieties. The shoot length, root length, plant height, shoot fresh weight, root fresh weight, shoot dry weight and root dry weight of treated seeds was higher compared to the non-treated ones. Thus, the results showed that ascorbic acid priming significantly increase growth and production of wheat plants.
Keywords: Wheat (*Triticum aestivum* L.), ascorbic acid, seed priming.

INTRODUCTION

A very few species are grown on a great area as staple food and wheat (*Triticum aestivum* L.) is one of them. In Pakistan, wheat has the share in the value added in agriculture about 13.1% and in GDP 2.1% (Anonymous 2013-14). Pre-sowing seed treatment or priming is used as beneficial technique for better crop production of wheat especially in arid and semi-arid regions of world (Yasmeen *et al*., 2013). Seed priming is very easy and cheaper way for the improvement of seedling growth under the stress conditions. Seed priming not only provides uniformity in the seed sprouting (Khan *et al*., 2008; Khalil *et al*., 2010). It also regulates many natural changes into the seed, which are very essential for breaking dormancy, seed reserve's hydrolysis and activation of enzyme which are necessary for seed germination and the development of embryonic tissues (Asgedom and Becker, 2001; Catav *et al*., 2012). Different chemicals are used as seed priming agents i.e. ions, organic compounds (ascorbic acid, salicylic acid or vitamins) hormones and antioxidants (Ahmad *et al*., 2012). It provides essential nutrients to the seeds which they could not get under the stress conditions. Researchers have shown that it has been more beneficial for the plants in the seed germination, growth as well as crop yields. Moreover, seed priming also helps the plants to tolerate environmental stress conditions (Hameed *et al*., 2010). The beneficial effects of different priming chemicals used as seed priming agents have been studied in mustard (Srinivasan *et al*., 1999), chickpea (Kaur *et al*., 2002), sunflower (Kaya *etal*., 2006), maize (Nawaz and Ashraf, 2010), wheat (Iqbal and Ashraf, 2007; Perveen *et al*., 2010), cotton (Casenave and Toselli, 2007), sugarcane (Patade *et al*., 2009) and rice (Habib *et al*., 2010). Seed priming includes halo-priming, osmo-priming, hydro-priming (soaking seeds in water), osmoconditioning, hormo-priming, osmo-hardening, matri-priming, hardening and others (Ghassemi-Golezani *et al*., 2008). In view of previous work ascorbic acid (vitamin C) as a seed primer has a noteworthy effect on crop plants under normal and stress conditions as well and is one of the most significant antioxidants (Arrigoni and De Tullio, 2002). It can increase germination rate, plant growth, total leaf area, dry and fresh biomass, and transpiration rate (Amin *et al.*, 2009). Ascorbic acid also maintains H_2O_2 at the non-toxic level in wheat plants exposed to water deficit stress (Menconi *et al*., 2005). In canola (*Brassica napus* L.) effects of salinity are reduced by using ascorbic acid as seed priming agent (Dolatabadian *et al.*, 2008).

Keeping in view the present study was conducted to determine effect of seed priming with ascorbic acid on wheat (*Triticum aestivum* L.). The information derived may be helpful to device means for improving the germination and growth of plant to establish a good crop stand ensuring better yield.

MATERIAL AND METHODS

***Plant material*:** The seeds of two genotypes (SH-95 and Chakwal-50) of wheat (*Triticum aestivum* L.) were obtained from the Cereal Research Programme, Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan.

***Priming techniques*:** Seeds were soaked in 1m M solution of ascorbic acid overnight as for pre-sowing treatment. The solution was prepared by dissolving 176.12mg of ascorbic acid in 1L of distilled water.

***Experiment layout*:** The experiment was conducted in the wire house of the Old Botanical Garden, Department of Botany, University of Agriculture, Faisalabad. Twelve pots were prepared on November 25, 2012 with 9kg soil in each, six pots were used to grow treated seeds while six were used as control. Ten seeds of each genotype per replication per treatment were grown in pots. Hoagland's solution was prepared in 20L of water and applied to all pots at constant intervals of one week, after germination. The experiment was laid out in a completely randomized design (CRD) with three replications. The temperature and rainfall data during experiment period are presented in Fig.1 and Fig.2, respectively.

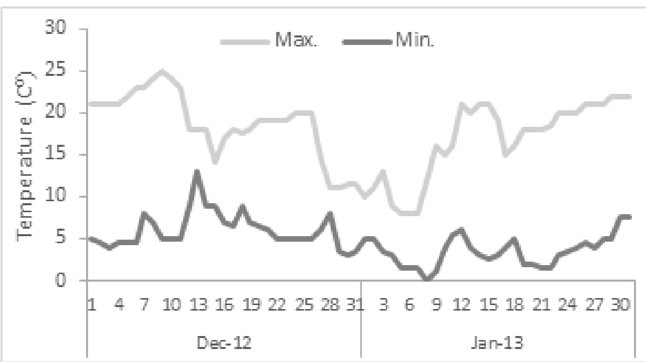

Figure 1: Temperature variation throughout the experiment period.

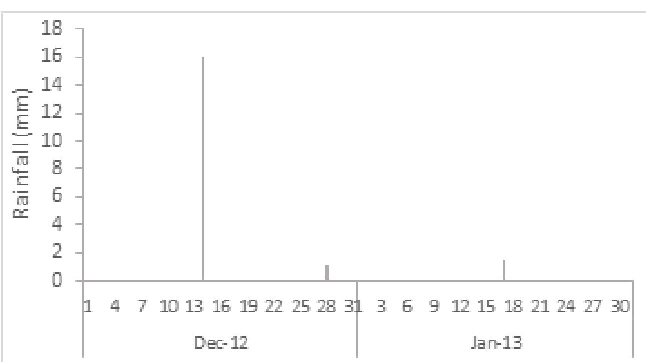

Figure 2: Total rainfall during the experiment period.

***Data recording*:** Five plants from each replication of each genotype were used to record the data on seedling stage and five for maturity traits. Shoot length (cm), root length (cm), plant height (cm), shoot fresh weight (g), root fresh weight (g), shoot dry weight (g), root dry weight (g) and chlorophyll contents were recorded at six week seedlings. At maturity, the number of tillers per plant, number of spikes per plant, number of spikelet per plant, weight of 100 grains, grain length and grain diameter were recorded.

***Statistical analysis*:** The data were analyzed statistically for using analysis of variance (ANOVA) following Steel *et al*. (1997).

RESULTS

Comparison of mean performance of wheat varieties (V1=SH-95 and V2=Chakwal-50) for various traits studied is presented in Fig 3-9. Mean values of data showed that the shoot length, root length,plant height, fresh biomass, dry biomass, tillers per plant, spikes per plant, spikelet per plant, grain length, grain diameter, weight of 100 grains, chlorophyll a, b and carotenoid contents were increased under ascorbic acid treatment (Fig.3-8).

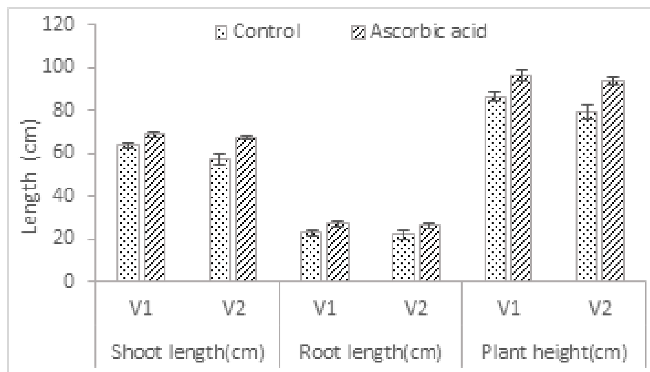

Figure 3: Effects of ascorbic acid on shoot length, root length and plant height.

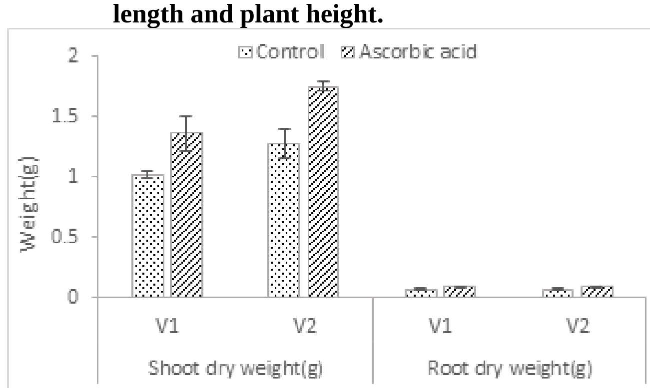

Figure 5: Effects of ascorbic acid on shoot dry weight and root dry weight.

Table 1: Mean square values from analysis of variance of various traits of wheat varieties with seed priming.

Sources of variations	D.F	Shoot length (cm)	Root length (cm)	Plant height (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)	Chlo-rophyll a	Chlo-rophyll b	Carotenoids	No. of tillers per plant	No. of spikes per plant	No. of spikelet per plant	Weight of 100 grains (g)	Grain length (cm)	Grain diameter (cm)
Treat.	1	50.02^{*}	1.47	69.12	15.46^{**}	0.033	0.313^{*}	0.000005	0.020	0.0033	0.0075	0.083	0.75	4.083	0.0033	0.000075	0.00041
Variety	1	186.44^{**}	56.3^{*}	446.5^{**}	8.602^{*}	0.653^{*}	0.504**	0.0026^{***}	1.540^{***}	0.963^{***}	8.167^{***}	2.083^{*}	4.083^{**}	52.1^{***}	0.857^{***}	0.0184^{***}	0.02708^{***}
Interaction	1	20.02	0.03	18.253	0.313	0.000	0.013	0.000012	0.00083	0.0133	0.3675^{**}	0.083	0.75	2.083	0.0247	0.000075	0.00041
Error	3	8.96	6.805	21.618	1.266	0.076	0.030	0.000062	0.0083	0.0083	0.0175	0.333	0.333	1.583	0.0132	0.00024	0.00015

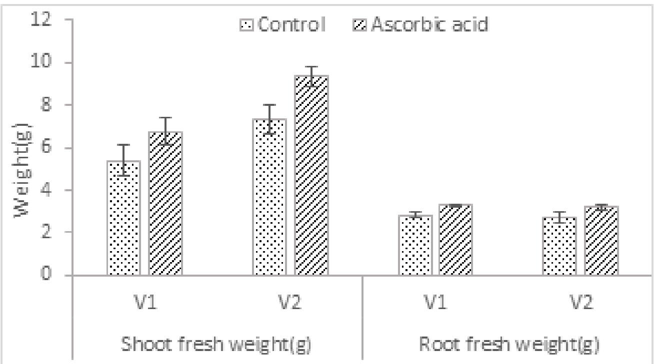

Figure 4: Effects of ascorbic acid on shoot fresh weight and root fresh weight.

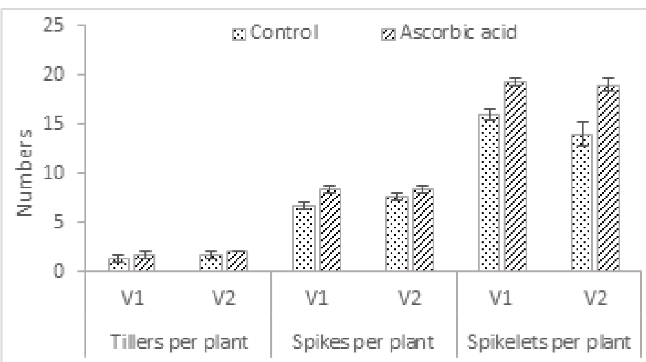

Figure 6: Effects of ascorbic acid on tillers per plant, spikes per plant and spikelets per plant.

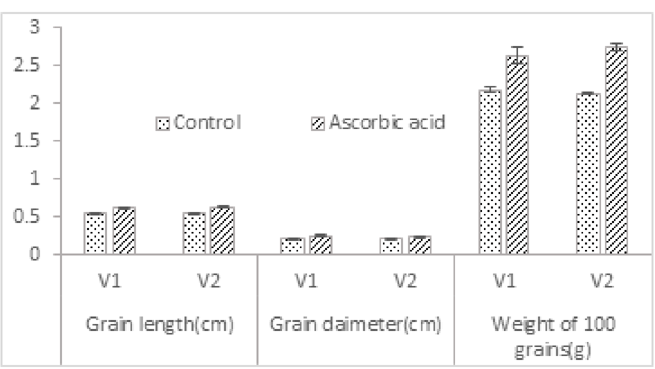

Figure 7: Effects of ascorbic acid on grain length, grain diameter and weight of 100 grains.

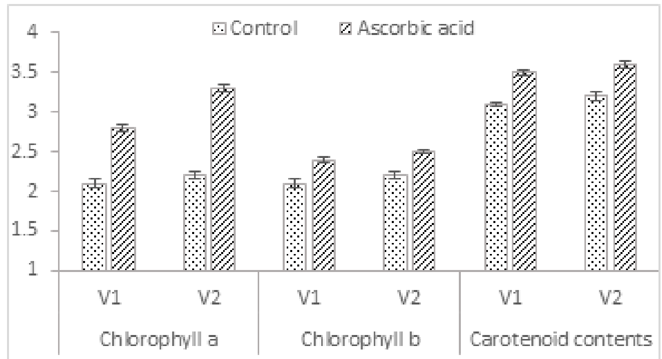

Figure 8: Effects of ascorbic acid on chlorophyll a, b and carotenoid contents.

Percent increase in plant height, fresh weight, dry weight and yield was more significant in V2 as compare to V1 treated with ascorbic acid relative to control (Fig.9). The analysis of variance of different traits of the both genotypes showed in Table 1. Treatments had shown significant differences for shoot fresh weight and shoot dry weight and varieties had shown significant differences for all studied traits. Their interaction had only significant difference for carotenoids.

DISCUSSION

Ascorbic acid act as an antioxidant molecule, it neutralizes and detoxifies the singlet oxygen and superoxide radicals in the cyclic pathway (Razaji *et al*., 2012). It involves in cell wall expansion and cell division thereby regulating growth and development of plants (Pignococchi and Foyer, 2003). By using ascorbic acid in a proper concentration during the plant development it can act as an immune-modulator (Khan *et al*., 2011). In the present study the shoot length, root length, fresh biomass, dry biomass and yield of two genotypes of wheat increased when ascorbic acid was applied as seed priming agent. A positive response from exogenous application of ascorbic acid was recorded for shoot length, root length, fresh biomass, dry biomass and grain yield per plant as well as its diameter by Khan *et al*. (2006), Ejaz *et al*. (2012), Behairy *et al*. (2012) and Bakry *et al*. (2013). Ascorbic acid acts as coenzyme in various reactions. It increases all growth parameters and chemical constituents in plants as studied by Mazher *et al*. (2011) in *Codiaeum variegatum* L. plants.

Ascorbic acid involves in cell division and cell wall expansion thereby regulating growth and development of plants. Chloroplast pigments such as chlorophylls “a” and “b” have the vital role in photochemical reactions of photosynthesis and determine the photosynthetic efficiency (Taiz and Zieger, 2006). In this study chlorophyll a and b increased in all varieties of wheat when ascorbic acid was applied. In another study, chlorophyll a contents were decreased significantly under salinity stress of the seedlings of wheat lines, this reduction was treated by applying ascorbic acid as seed priming agent (Khan *et al*., 2006). Chlorophyll contents were increased by the application of ascorbic acid as compared to non-treated plants of *Hibiscus rosasinesis* L. El-Quesni *et al.* (2009). According to Malik and Ashraf (2012), exogenous application of ascorbic acid helped plants maintain the chlorophyll pigments and hence mitigated the adverse effects of drought stress. Thus, it maybe concluded that ascorbic acid being a potential antioxidant helps wheat plants increase their chlorophyll contents, RWC, growth and yield under stress conditions. Hence, ascorbic acid may be suggested to farmers to be used as a growth hormone to increase the production and yield of wheat.

Conclusion: Based on present findings, it was concluded that seed priming with ascorbic acid can significantly enhance wheat performance in terms of morphological parameters and yield attributes both under stress and normal conditions. Higher yield was recorded in Pakistani wheat varieties while higher yield may be due to the rapid emergence and more vigorous seedling.

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