

Significance of Chemical Priming on Yield and Yield Components of Wheat under Drought Stress

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Abstract

Drought is the most important factor limiting plant production in the majority of agricultural crops of the world. Wheat is generally grown on arid-agricultural fields. An experiment was conducted at the Plant physiology research area, Agronomic Research Institute Faisalabad, during winter 2010-11 to evaluate the effect of drought on wheat variety Lasani 2008. The experiment was comprised of following treatments. T₁ Normal moisture (3 IR at CRS, Booting and grain filling), T₂ No irrigation (only rainfed) control, T₃ water spray (100 ppm), T₄ ascorbic acid (100 ppm), T₅ salicylic acid (100 ppm), T₆ calcium chloride (100 ppm), T₇ glycinebetain (100 ppm). According to the resulting data the treatment in which three irrigation were applied produced more no. of tillers (52%), spikelet per spike (41%), spike length (30%), grain per spike (58%), grain yield (54%), biological yield (35%) as compared to control. The treatment in which no irrigation was applied produced less no. of tillers, spikelet per spike, spike length, grain per spike, grain yield, biological yield. Thousand grain weight and harvest index were non significant among all treatments.

Keywords

Wheat, Hormonal Priming, Drought, Ascorbic Acid, Salicylic Acid, Calcium Chloride, Glycinebetain

1. Introduction

Drought stress is characterized by reduction of water content, diminished leaf

water potential, turgor loss, closure of stomata, decrease in cell enlargement and growth [1]. Severe water stress may result in the arrest of photosynthesis, disturbance of metabolism and finally the death of plants [2]. Plant growth is accomplished through cell division, cell enlargement and differentiation, which involve genetic, physiological, ecological and morphological events; sensitive to drought [3]. Water stress reduces plant growth and manifests several morphological, physiological and biochemical alterations leading to massive loss in yield [4]. Water shortage at critical growth stages such as crown root initiation, tillering, booting, anthesis and grain filling has deleterious effects on plant growth, development and economic yield of wheat [5] [6]. Wheat grain yield and yield components such as productive tillers, grains per spike, kernel weight, biological yield and harvest index are the attributes, which are adversely affected by soil moisture stress [4] [7] [8] [9]. Water deficit hampers photosynthesis due to reduced synthesis of chlorophyll pigments resulting in declined light harvesting reaction [10]. The other causes of reduction in photosynthetic rate are decrease in leaf expansion, impaired photosynthetic machinery, reduced influx of CO₂ due to low stomatal conductance and premature leaf senescence. Water stress lowers water potential, osmotic potential and pressure potential of wheat leaves [7]. Water stress mostly reduces leaf growth and in turn leaf area in many plant species [8].

Many strategies are being practised in the world to cope with water scarcity; exogenous application of compatible solutes is the one that is getting considerable attention in present-day agricultural research [11] [12]. However, seed priming is cheapest approach to cope with adverse effect of abiotic stresses at different developmental stages of crop [9] [13] [14]. There are different priming techniques such as hormonal priming hydropriming and osmopriming [14] [15] [16] [17].

Plant growth regulators, hormones and hormones like substances for example ascorbic acid, salicylic acid, glycylbetain used as seed priming to reduce the adverse effect of abiotic stresses in different crops [14] [15]. The relative effectiveness of different priming agents varies with different stresses and different crop species is unclear. Moreover biochemical and physiological roles of ascorbic acid, salicylic acid, calcium chloride and glycylbetain on drought tolerance of wheat as pre seed treatment is limited. The objective of this paper was to check ameliorating effects of pre sowing treatments on wheat yield.

2. Material and Methods

2.1. Experimental Site

A field experiment was conducted at the Agronomic Research Institute, Plant Physiology Section, Ayub Agricultural Research Institute (AARI), Faisalabad during Rabi 2010-11.

2.2. Experimental Material

The soil of this experimental area was loam to sandy loam. Variety was Lasani

2008. The experiment was laid out in randomized complete block design (RCBD) with three replications and seven treatments. Sowing with hand drill. Before final land preparation nitrogen and phosphorus were applied at the rate of 24-60 kg per hectare and the source of fertilizers were Urea and DAP. The seed was 50 kg per hectare and row spacing was 30 cm. Main plot size was 12 m × 7.2 m and sub plot size was 4 m × 2.4 m (Table 1).

Table 1. Physico-chemical soil analysis of crop area.

Characteristics	Soil sample depth			
	10 cm	15cm	20 cm	Mean
Soil Ph	7.7	7.9	8	7.8
Organic matter (%)	1.33	1.35	1.02	1.23
Total nitrogen (%)	0.066	0.048	0.058	0.057
Available P (mg.kg ⁻¹)	4.2	7.3	9.8	7.1
Available k (mg.kg ⁻¹)	186	161	142	163
Texture	Loam to sandy loam	Loam to sandy loam	Loam to sandy loam	

2.3. Seed Chemical Priming Treatments

The seeds were surface sterilized with 1.0% solution of sodium hypochlorite for three minutes and residual chlorine was washed with disttle water. The sterilized seed were soaked in the priming solutions for a period of 12 hours at room temperature. The experiment was comprised of following treatments. T₁ Normal moisture (3 IR at CRS, Booting and grain filling), T₂ No irrigation (only rainfed) control, T₃ water spray (100 ppm), T₄ seed priming with ascorbic acid (100 ppm), T₅ seed priming with salicylic acid (100 ppm), T₆ seed priming with calcium chloride (100 ppm), T₇ seed priming with glycinbetain (100 ppm).

2.4. Parameters Studied

At maturity, no. of tillers, spikelet per spike, spike length, grain per spike, thousand grain weight, grain yield, biological yield and harvest index were computed.

2.5. Statistical Analysis

The data was statistically analyzed using Analysis of Variance (ANOVA) technique and least significance Difference (LSD) test (P < 0.05) using MSTATC software.

3. Results and Discussion

3.1. No. of Tillers

Tillering is an important yield component. In general more no. of tillers ensure better crop stand and ultimately the yield. Response of total no. of tillers of wheat with irrigations is significant. The results are illustrated in Table 2. Maximum no. of tillers (378.9) was recorded where 3 irrigations are applied. Seed

Table 2. Chemical priming effect on wheat yield under drought stress.

Treatments	No. of tillers	No. of Spikelets per spike	Spike length	Grain per spike	1000 grain weight	Biological yield kg/ha	Grain yield Kg/ha	HI
3 irg	378.9 a	17.93 a	12.13 a	57.90 a	43.2	12740 a	4907 a	37.15
No irg (control)	248.3 e	12.70 d	9.33 b	36.50 e	36.27	9420 d	3181 e	33.77
Water (100 ppm)	294.9 c	13.73 cd	9.633 b	40.93 d	38.34	10110 cd	3648 c	36.07
Ascorbic acid (100 ppm)	287.5 cd	14.07 c	9.833 b	42.77 cd	39.60	10590 c	3595 cd	37.2
Salicylic acid (100 ppm)	270.7 de	14.90 c	9.633 b	44.83 c	39.63	10260 c	3346 de	38.1
Calcium chloride (100 ppm)	273.5 cd	14.80 c	10.20 b	40.00 d	39.07	10570 c	3603 cd	34.07
Glycinbetain (100 ppm)	323.6 b	16.53 b	10.33 b	49.80 b	44.3	11620 b	4318 b	38.2
LSD VALUE	23.88	1.399	1.372	3.383	1.793	836.2	299.0	2.061

priming with glycinbetain also produced large no of tillers. Minimum no. of tillers (248.3) were produced in treatments where no irrigation was applied. These results are similar with (Jaffar *et al.*, 2012).

3.2. No. of Spikelets per Spike

The data tabulated in **Table 2** regarding the no. of spikelet per spike. No. of spikelet per spike were effected markedly by application of irrigations in different levels. Minimum no. of Spikelets (12.70) were produced where no irrigation was applied and maximum no. of spikelets per spike (17.93) were produced where 3 irrigations were applied. Priming with glycinbatin produced (16.53) spikelets per spike.

3.3. Spike Length

Ear size is considered as a key factor which contributes much towards final grain yield. Larger the length of ear more would be the grain produced per ear and ultimately the yield would be more. The results are illustrated in **Table 2**. Response of spike length of wheat to irrigation was significant. Maximum Spike length (17.93) produced where 3 irrigations were applied and minimum spike length (12.13) was recorded where no irrigation was applied. These results were similar with (Razzaq *et al.*, 2013).

3.4. Grain per Spike

Grain per spike are significantly affected by irrigation system. The results are illustrated in **Table 2**. The treatment in which three irrigation were applied produced maximum (57.90) grain per spike and in treatment in which no irrigation was applied produced minimum (36.50) grain per spike. Priming with glycinbe-

tain produced more no of grain per spike. These results were similar with (Razaq *et al.*, 2013).

3.5. 1000 Grain Weight

1000 grain weight is very important parameter to determine grain yield. The results are illustrated in **Table 2**. According to this table results were non significant. It means there is no difference among treatments.

3.6. Biological Yield

The effect of different irrigation level on biological yield of wheat was significant. The results are illustrated in **Table 2**. Minimum (9420 kg/ha) biological yield was produced where no irrigation applied and biological yield increased with increase in irrigation level and it was maximum (12740 kg/ha) where three irrigations were applied. Priming with glycinebetain produced (11620 kg/ha) yield.

3.7. Grain Yield

Grain yield is an important parameter used for evaluation of effectiveness of any treatment because grain production is ultimate objective of cereals used for feeding of human being in world. According to **Table 2** the effect of different level of irrigation on wheat was significant. Maximum yield (4907 kg/ha) was recorded where 3 irrigations were applied. Minimum grain yield (3181 kg/ha) was recorded where no irrigation was applied. These results were similar with (Hassanein *et al.*, 2012).

3.8. Harvest Index

The harvest index is a essential parameter indicating photosynthetic efficiency of crop and transformation of photosynthate into its economic yield. The results are illustrated in **Table 2**. According to this table results were non significant. It means there is no significant difference among treatments.

4. Conclusion

In conclusion, the present piece of work showed that the treatment where three irrigation were applied produced more no. of tillers, spikelet per spike, spike length, grain per spike, grain yield, biological yield as compared to control. Moreover priming with Glycinebetain also produced more no. of tillers, spikelet per spike, spike length, grain per spike, grain yield, biological yield as compared to other treatments.

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