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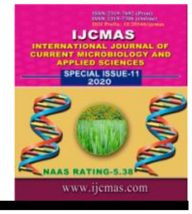

Original Research Article

Effect of Brassinolide on Seed Germination and Related Parameters of Wheat under Salinity

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A B S T R A C T

The experiment was conducted in the laboratory at the Department of Plant Physiology, S.K.N. College of Agriculture Jobner during the 2015-2016 rabi season under laboratory experiments. Two wheat cultivars, Raj-1482 and Raj-3077, were grown in petri dishes under salinity conditions (0, 4 and 8 dSm-1). Various concentrations of brassinolide (0.0, 0.5, 1.0 and 1.5 ppm) have also been applied to the saline collection of petri dishes. Control plants were supplied with regular water whenever needed. Various seedling growth parameters were reported 8 days after treatment in the laboratory. Examination of the data showed that the percentage of germination, root volume, shoot length, fresh weight and dry weight of root and shoot steadily decreased with an increase in salinity levels and increased with an increase in brassinolide levels, with a maximum increase of 1.5 ppm under non-stress and salt stress conditions in the laboratory experiment. Germination percentage decreased with a particular amount of saline irrigation water, at least at EC 8 dSm-1 at both levels of the investigation of both wheat genotypes. On the basis of the above observations, Raj-3077 was found to be superior to Raj 1482 in relation to the maximum parameters studied under laboratory conditions. It may be seen both the genotype that among Raj-3077 observed salinity tolerant and the tolerance was mediated by germination characteristics. The experiment again reflects the significant role of brassinolide in increasing productivity of wheat by improving germination and seedling growth under non stress and salt stress conditions.

Keywords

Brassinolide, Salinity, Raj-3077, Raj 1482, Germination

Introduction

In laboratory studies with petri-dishes, Sastry and Sharma (2000) tested various wheat varieties for germination and early seedling growth at EC 2.8, 8.5, 11.4 and 20.8 dSm-1 and observed a substantial decrease in germination percentage and early seedling growth at different EC levels compared to control. In addition to control, Singh *et al.,* (2000) grew seeds of 20 wheat genotypes under salinity stress. The salinity levels used were regulated and the equivalent EC values of 0.5 per cent were 20.8 dSm-1, respectively. Under salinity stress, the germination percentage and seedling growth decreased. With regard to seed germination and seedling vigor, the genotypes Raj-3077 and Kharchia-65 were more tolerant to salinity, while under salinity, Raj-4530 and

Raj-3934 were the most susceptible genotypes. Salt stress affects seed germination, growth, water deficit, ion imbalance and causes many biochemical lesions in different plants (Promila and Kumar, 2000) (Dash and Panda, 2001). In Rajasthan, salt issues affect around 1,183 million hectares of land (Sen, 2003). Salt stress influences the abnormal physiological processes (Dadarwal *et al.*, 2018) (Bhangare and Dadarwal, 2019). of plants, limiting wheat yields (Dadrwal *et al.,* 2018a, Dadarwal *et al.,* 2018b). Brassinolide has emerged as a new pleiotropic-effect phytohormone (Sasse, 1997) that affects various physiological processes such as germination, development, flowering, senescence, physio-biochemical and gives plant resistance to various abiotic stresses. Brassinosteroids are a new category of plant hormones with action that promotes growth. The ability of some pollen extracts to stimulate production of plants contributed to the discovery of this category of substances. As the first steroidal plant growth regulator was isolated from the rape pollens (Brassica napus), this new group of phytohormones has been assigned the common name "Brassinosteroids”.

Application of brassinosteroids is hydrolysed under different abiotic stresses polysaccharides, resulting in improved resilience of soluble sugars to environmental stresses in crop plants such as vegetables, fruits, cereals, wheat (Lal *et al.*, 2019) and oil seeds and also increases crop productivity (Rao *et al.,* 2002). A laboratory experiment was performed by Chetana *et al.*, (2014) to research the impact of salinity on wheat seeds and to see the level of efficacy of brassinolide (BS), to improve the deleterious effects of salinity on the metabolism of seedlings. The incremental rise in NaCl concentrations from 25 mM to 200 mM showed a drastic decline in growth parameters, i.e., Compared with the control, the root and shoot lengths, the fresh and dry weights of wheat (Soad and Shaimaa, 2014).

Materials and Methods

A pot experiment was carried out in the cage house located in the Department of Plant Physiology, S.K.N. College of Agriculture, Jobner during *Rabi* season 2015-16.The atmosphere and meteorological conditions; The climate of this area is usually semi-arid, distinguished in summer and winter by aridity and intense temperature variations. Maximum temperatures range from 36-45^0 C during the summer. It can drop to as low as -3^0 C in winter. The locality's annual rainfall is approximately 500 mm, the bulk of which is recorded between July and September during the rainy season. Soil: The field's loamy sand soil was used to fill the experimental pots. Pot Filling: Seventy-two cemented pots were filled in each pot with around 10 kg of well-mixed FYM soil. To allow free drainage, a broken piece of stone was put over the hole located on the bottom before filling. Salinity treatment: Sodium sulphate (NaSO4), sodium chloride (NaCl), calcium chloride (CaCl2) and magnesium chloride (MgCl2) were used in a 3:1 mixture of chloride and sulphate to prepare salty irrigation water with EC 0 (Tap water), 4 and 8 dS m-1.S_0= Control (Tap water), S_1 = 4.0dS m^{-1}, S_2 = 8.0dS m^{-1}

Experimental information: Season: Rabi, Crop: Wheat (*Triticum aestivum* L.), Cultivars/Genotypes: V1= Raj-3077 (salinity tolerant) V2= Raj-1482 (salinity susceptible), Observations: 52 and 82 days after sowing, observations were made. Under both saline and non-saline conditions, certain varieties were grown. The two wheat varieties, namely Raj-1482 and Raj-3077, were picked on the basis of their characters (salinity tolerant). Scheduling of irrigation. The crop will be irrigated with saline water as per treatment up to maturity. Treatments: Brassinolides (BR) of following concentration was used for different treatment. (i) control(ii) 0.5 ppm(iii) 1.0 ppm(iv) 1.5 ppm, Time of sprays: The different concentrations of brassinolide were sprayed at tillering stage (45 DAS) and anthesis stage (75 DAS).The following observations were recorded at 52 and 82 DAS (7 days after spray of brassinolides). Laboratory experiment parametersin the laboratory the effect of brassinolide in alleviating the adverse effect of salinity on germination percentage, seedling length, fresh and dry weight of seedling, physiological aspect, growth and yield of wheat cv Raj-3077 and Raj – 1482 screened out.

Germination percentage

Seeds of wheat cultivars namely Raj-3077 and Raj-1482 were evaluated for germination and early seedling growth in petri-dishes in laboratory. Each petri-dish was layered inside with filter paper. The petri dishes thus prepared were autoclaved. Seeds of cv. Raj-3077 and Raj-1482 were surface sterilized with 0.1 $HgCl_2$ for 5 min. followed by at least three washing with sterile distilled water and dried.

The twenty dried seeds were raised in each petri-dish at EC 0 (Tap water), 4 and 8 dSm^{-1} for saline set of petri-dishes. Different concentrations of brassinolide (0.0, 0.5, 1.0 and 1.5 ppm) were also added in the 10 ml saline set of petri-dishes, in triplicate. Germination percentage was calculated by counting the number of seeds germinated in each petri-dish at 8 days after treatment.

Length of seedlings

Length of seedlings (cm) was measured at 8 DAS with the help of scale. Fresh weight of seedling (mg $seedling^{-1}$): Five washed seedling from each petri-dish were separated into root and shoot for the determination of fresh weight (8DAS)

Dry weight of seedling (mg $seedling^{-1}$)

Five washed seedling from each petri-dish were separated into root and shoot for the determination of dry weight (8 DAS) of seedling shoot. Dry weight was determined after oven drying the shoot samples at 70^0 C until constant weight was obtained.

Statistical analysis

All the data were statistically analyzed using Completely Randomized Design (CRD) with three replications.

Results and Discussion

Germination percentage (%)

The data given in Table 1, that the germination percentage of wheat cultivars of Raj-1482 and Raj-3077 differed significantly with an increase in salt stress levels. The Raj-3077 variety observed a substantially higher germination percentage than Raj-1482 at 8 days after treatment under stress as well as non-stress conditions.

Further comparison to the data given in the table above shows that the use of brassinolide up to a concentration of 1.5 ppm was observed to substantially increase the percentage of germination over its preceding concentrations at 8 days after treatment.

The maximum germination percentage was recorded due to treatment with 1.5 ppm concentration of brassinolide under both non stress and salt stress conditions. The data further revealed that germination percentage decreased with increasing salinity levels up to EC 8.0 dSm^{-1}.

Root length (cm)

The data presented in Table 1, revealed that salinity was found to decreased significantly root length more in Raj-1482 than Raj-3077 at 8 DAT. Data further showed that the use of brassinolide up to 1.5 ppm concentration was found to increased significantly root length at 8 days after treatment over its preceding levels. The maximum increase in root length was recorded with 1.5 ppm concentration of brassinolide under non stress and salt stress conditions. Table 1 further showed that a significant decrease in the root length was recorded with increasing level of salinity up to EC 8.0 dSm^{-1}.

Shoot length (cm)

It is obvious from the data given in Table 1, that variety Raj-1482 significantly performing better than Raj-3077 under non stress and salt stress conditions. Further reference to data in the above table showed that the use of brassinolide up to 1.5 ppm concentration was found to increased significantly the shoot length at stage of investigation. The maximum increase in shoot length was obtained with 1.5 ppm concentration of brassinolide under non stress and salt stress conditions. The data in the above Table 1 further revealed that salt stress was found to decrease the shoot length significantly up to EC 8.0 dSm^{-1}.

Fresh weight and dry weight of root (mg seedling^{-1})

A critical examination of data given in Table 2, that cultivar Raj-1482 showed marked negative effects on fresh weight and dry weight of root with increasing salinity levels than variety Raj-3077. Further reference to data given in the Table 2 showed that brassinolide up to 1.5 ppm concentration was found to increased fresh weight and dry weight of root significantly over its preceding levels. The maximum increase in fresh weight and dry weight of root was recorded at 1.5 ppm concentration of brassinolide under salt stress as well as non-stress conditions. Data table further showed that with increase in salinity levels up to EC 8 dSm^{-1}, both fresh weight and dry weight of root declined significantly.

Fresh weight and dry weight of shoot (mg seedling^{-1})

A critical examination of data given in Table 2, revealed that maximum reduction in shoot length was observed in cultivar RAJ-1482 however, cultivar Raj-3077 showed relatively less reduction in shoot length at stage of investigation under all the salinity levels. Further data revealed that a significant increase in fresh weight and dry weight of shoot was recorded up to 1.5 ppm concentration of brassinolide over control. The maximum increase in fresh weight and dry weight of shoot was observed due to treatment with 1.50 ppm concentration of brassinolide in salt stress and non-stress conditions. The further examination of data in above table revealed that the fresh weight and dry weight of shoot decreased significantly with increasing salinity levels in the medium which was more pronounced under EC 8 dSm^{-1}.

A significant decrease in germination percentage of wheat seeds at eight days after treatment, was recorded under laboratory. Seeds of most plants attain their maximum germination in distilled water and are very sensitive to elevated levels of salinity at the germination and seedling phases of development. A significantly decreasing trend was observed with regard to root length at 8 days after treatment with increasing salinity levels which was more pronounced under EC 8 dSm^{-1} than EC 4 and control.

Table.1 Effect of salinity and brassinolides on germination percentage, length of seedling root and shoot of wheat (8 DAT) of wheat

Treatments		Length of seedlings (cm)	
Varieties	*Germination (%) at 8 DAT*	Root	shoot
Raj-3077	85.74	3.76	5.26
Raj-1482	76.47	3.38	6.56
S.Em.±	0.72	0.11	0.16
C.D. (P=0.05)	2.03	0.32	0.45
Brassinolides (ppm)			
0	74.00	2.60	4.72
0.5	76.60	3.25	5.50
1.0	82.44	3.82	6.20
1.5	88.75	4.40	7.08
S.Em.±	1.01	0.16	0.23
C.D. (P=0.05)	2.87	0.46	0.64
Salinity levels (dSm^{-1})			
0	86.50	4.10	6.74
4	82.44	3.58	5.98
8	74.33	3.04	5.01
S.Em.±	0.88	0.14	0.20
C.D. (P=0.05)	2.49	0.40	0.56

DAT = Days After Treatment

Table.2 Effect of salinity and brassinolides on fresh, dry weight of seedlings root fresh and dry weight of seedlings shoot (8 DAT)

Treatments	Root		Shoot	
	Fresh weight (mg/seedling)	Dry weight (mg/seedling)	Fresh weight (mg/seedling)	Dry weight (mg/seedling)
Varieties				
Raj-3077	8.91	1.28	29.79	5.55
Raj-1482	7.83	1.25	26.40	4.70
S.Em.±	0.19	0.05	0.34	0.07
C.D. (P=0.05)	0.55	0.13	0.96	0.21
Brassinolides (ppm)				
0	6.79	1.66	23.60	4.08
0.5	7.86	1.91	25.30	4.72
1.0	8.89	2.21	28.50	5.49
1.5	9.95	2.48	31.80	6.22
S.Em.±	0.28	0.06	0.48	0.11
C.D. (P=0.05)	0.78	0.18	1.35	0.30
Salinity levels (dSm^{-1})				
0	9.30	2.41	31.80	7.11
4	8.40	2.09	26.90	4.31
8	7.30	1.69	24.40	3.95
S.Em.±	0.24	0.05	0.41	0.09
C.D. (P=0.05)	0.68	0.16	1.17	0.26
DAT = Days After Treatment				

Cultivar Raj-3077 showed marked negative effects on root length with increasing salinity levels than variety Raj-1482 showed relatively less decrease in this regard over control. With increasing salinity radicle length decreased progressively.

Shoot length showed significant reduction with increasing salinity levels in the medium which was more pronounced under EC 8 dSm^{-1} than its preceding levels at 8 days after treatment (Table 2).

Maximum reduction in shoot length was observed in cultivar Raj-1482 however, cultivar Raj-3077 showed relatively less reduction in shoot lengths at all stages of investigation under all the salinity levels. Variety Raj-3077 showed relatively less decrease in shoot length showed higher salt tolerance. Root fresh weight (8 days after treatment) and dry weights of 2 wheat cultivars showed that salt stress significantly reduced (maximum at EC 8 dSm^{-1}) root fresh and dry weights of both cultivars. Wheat cultivars were markedly inconsistent from each other with respect to these growth attributes.

Among tested wheat cultivars, Raj-3077 (salinity tolerant), was recorded higher fresh and dry weight of seedling root as compared to Raj-1482 (salinity susceptible), under saline and non-saline conditions. A significant decrease in the fresh as well as dry weight of seven days old seedling shoot of wheat with increase in salt stress up to EC 8 dSm^{-1} over control. Maximum fresh and dry weight of shoot was observed in cultivar Raj-3077 however, cultivar Raj-1482 showed relatively more reduction in shoot fresh and dry weight under all the salinity levels. production.

A considerable decrease in the percentage of wheat seed germination was reported 8 days after treatment. It has been found that genotypic variance is important. Under salt tension conditions, root length decreased to 8 days after treatment and their fresh weight (8 days after treatment) and dry weight decreased. The salinity-susceptible Raj-1482 genotype performed higher than Raj-3077. The salt tension was also observed to decrease the shoot length substantially over control at 8 DAT and their fresh weight (8 DAT) and dry weight. In these respects, the genotype Raj 3077 substantially performs better than Raj-1482. Germination percentage of wheat seeds increased significantly up to 1.50 ppm concentration of brassinolide over control at 8 days after treatment.

Brassinolide increased length of seedling root and shoot at 8 DAT and fresh weight and dry weight of root and shoot of 8 days old seedling of wheat significantly over control. Maximum increase in these parameters were observed at 1.50 ppm concentration brassinolide. On the basis of present investigation, it may be concluded that cultivar Raj-3077 performed better in comparison to Raj-1482 with respect to germination percentage, length of seedling root, seedling shoot, fresh and dry weight of root and shoot.

Application of brassinolide significantly increased all the considered parameters and 1.5 ppm concentration of brassinolide was found most effective under non stress and salt stress conditions. It may be further concluded that between both the cultivars studied Raj-3077 was observed to be recommended to farmers for cultivation in saline areas.

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