Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(6): 1536-1539
Received: 10-09-2019
Accepted: 12-10-2019

Sanjay Dabariya
Department of Plant Physiology, SKN College of Agriculture, Jobner, Rajasthan, India

DL Bagdi
Department of Plant Physiology, SKN College of Agriculture, Jobner, Rajasthan, India

Corresponding Author:
DL Bagdi
Department of Plant Physiology, SKN College of Agriculture, Jobner, Rajasthan, India

Impact of brassinolide in amelioration of salinity induced adverse effects on growth, yield attributes and yield of barley

Sanjay Dabariya and DL Bagdi

Abstract
The study entitled "Impact of brassinolide in amelioration of salinity induced adverse effects on growth, yield attributes and yield of barley'' was conducted in the cage house at Department of Plant Physiology, S.K.N. College of Agriculture Jobner during *rabi* season of 2015-2016 under pot culture experiments. Two wheat cultivars namely RD-2035 (salinity susceptible) and RD-2794 (Salinity tolerant) were grown in cemented pots under salinity (0, 3, 6, 9, and 12 dSm^{-1}). Different concentrations of brassinolide (0.0, 0.5, 1.0 and 1.5 ppm) were sprayed at 45 and 75 days after sowing. Control plants were provided normal water. A significant decrease were recorded in Plant height, Leaf area, number of spikes/plant, number of seeds/spike, length of spike/plant, test weight, grain yield with increase in salt stress up to EC 12 dSm^{-1},Whereas the foliar spray treatment with brassinolide up to 1.5 ppm significantly increased Plant height, Leaf area, number of spikes/plant, number of seeds/spike, length of spike/plant, test weight, grain yield in both the cultivars under salt stress as well as non stress conditions. The 1.5ppm concentration of brassinolide was found most effective under salt stress and non stress conditions. RD-2794 observed superior over RD-2035 on the basis of physio-biochemical analysis.

Keywords: Barley, salinity, brassinolide, growth, yield attributes, yield, RD-2794 and RD-2035

Introduction

World's fourths important cereal crop is barley after wheat, rice and maize. Being the most dependable crop in areas where alkali, frost or draught situation occur, it is cultivated in all most all parts of the world. The major barley producing countries are China, Russia, Germeny, USA, Canada, India, Turkey and Australia. The major use of barley grain is in brewing indurstries for manufacturing malt which is used for making beer, industrial alcohol, whisky, malt syrup, brandy malted milk, vinegar and yeast. Barley contains 12.5% moisture, 11.5% albuminoids, 74.0% carbohydrate, 1.3% fat, 3.9% crude fiber and 1.5% ash. Its surplus grains are used as concentrate for feeding livestock and poultry and as a base in mushroom production. Its straw and husk are good quality roughage for cattle. Barley straw is also used to prepare paper and card board.

It ranks next to wheat both in acreage and production among *rabi* cereals in India. It is so, as it requires lesser water and is fairly tolerant to salinity, alkalinity, frost and draught situations. Barley also does well even with brackish/saline water. It is also more suited to dry land and 'diara land'. Barley is generally grown on marginal and sub-marginal lands with low inputs. In Rajasthan, it is mostly grown on light textured soils, low in nitrogen and organic matter content with poor moisture retentive capacity.

According to the FAO Land and Plant Nutrition Management Service, over 6% of the world's land is affected by either salinity or sodicity. Moreover the low water quality and the poor drainage systems are the greatest causes of these stresses, and this problem is more acute with higher evaporation, especially in arid and semi arid zones, where saline soils are widespread that induced the decreasing of land productivity in many countries over the world [1] Furthermore salinity affects soil fertility and due to these situations some solutions were taken to reduce this problem through soil reclamation or growing tolerant species; however, soil reclamation is a very expensive process, and then the selection of tolerant varieties of crops is still the most practical solutions when salinity is low. Salinity has negative impact on water and nutrient uptake because of osmotic and ionic imbalance. This will produce plants with reduced height, less leaves and tillers as well as reduced yield [2]. Since salinity is complicated trait and genetically controlled, plants show different response when they grown under salinity stress according to their genes content [3].

Brassinosteroids (BRs) are a new type of polyhydroxy steroidal phytohormones with significant growth-promoting influence [4] brassinosteroids played important roles in monitoring the stress-protective properties in plants against a number of abiotic stresses like low temperature/chilling, /freezing, salt, high temperature/heat stress, water/drought/water logging, heavy metals and biotic stresses [5]. BRs confer salt tolerance to plants by mitigating its negative effects on the physiological, biochemical and molecular processes in plants [6]. Brassinolide improved the growth, yield and chemical composition of berseem (*Trifolium alexandrinum* L.) grown in saline soils [7]. Problem of salinity is increasing day by day; one of the best solutions is to use saline soils effectively for improved salt tolerance in crops. For this purpose different approaches, were adopted, among those one is the exogenous application of plant growth regulators. The objective of this study was to observe the effect of exogenous application of brassinolide as foliar spray in amelioration of harmful effects of salinity on growth and yield of barley.

Materials and methods

Plant materials and experimental details

A pot experiment were conducted at cage house located in the Department of Plant Physiology, S.K.N. College of Agriculture, Jobner during *Rabi* season 2015-15, to investigate "Role of brassinolide in amelioration of salinity induced adverse effects on growth, yield attributes and yield of barley". The pots were filled with 15kg of loamy sandy soil having a bulk density of 1.5 g cm^{-3}, electric conductivity (EC) 0.4 dSm^{-1}, P^H 8.2, sodium absorption ratio 12.5 and $CaCo_3$ 0.14%. The field capacity and permanent wilting point of the soil were 11.8 and 2.8%, respectively.54 pots for both cultivar RD-2794 (salinity tolerant) and RD-2035 (salinity susceptible) was used for growing of barley up to harvesting. The recommended doses of manures, fertilizers and other inputs were provided at the appropriate time. Salts used to prepare saline irrigation water of EC 3, 6, 9, and 12 dSm^{-1}; Chloride and sulphate in 3:1 ratio by using following salts; NaCl, $NaSO_4$, CaCl and $MgCl_2$. One liter of the saline water was provided to each pot having three plants as and when required. The control plants were irrigated with tap water. The plants were irrigated with saline water as per treatment up to maturity.

The plants were spraid with Brassinolides of following concentration for different treatment. The different concentrations of brassinolide 0.0 (control), 0.5ppm, 1.0 ppm and 1.5 ppm were sprayed at tillering stage (45 DAS), anthesis stage (75 DAS), at haresting and after harvesting. The observations were recorded 7 days after spray of brassinolides using Completely Randomized Design. The height of three randomly selected plants was measured from base to the top of the plant with the help of meter scale, Leaf area was measured with the help of leaf area meter (LICOR 3000 USA), The total number of spike per plant and number of seeds per spike was counted in each pot and then the average was calculated, Length of the main spike excluding awns was measured with the help of scale, 1000-grains were counted and their average weight was recorded and After harvest, plants were air dried and the grain yield (g) was taken and calculated as per plant basis.

Results and Discussion

Varietal response

It is evident from the data in Table 1 that the Plant height, Leaf area, number of spikes/plant, number of seeds/spike, length of spike/plant, test weight, grain yield of RD-2794 was found significantly more than RD-2035 under saline conditions. The per cent increase in plant height of RD-2035 was recorded 12.22 and 11.29 per cent over RD-2794 at 60 and 90 DAS, respectively.

The increase in leaf area of RD-2794 was found significantly more than RD-2035 under both non stress and salt stress conditions. The per cent increase in leaf area of RD-2794 was recorded 8.53 and 11.18 per cent over RD-2035 at 60 and 90 DAS, respectively. The increase in number of seeds per spike of RD-2794 was found significantly more than RD-2035 under both non stress and salt stress conditions. The per cent increase in number of seeds per spike of RD-2794 was recorded 19.36 per cent over RD-2035.The per cent increase in number of spikes per plant of RD-2794 was recorded 20.16 per cent over RD-2035.The per cent increase in length of spike per plant of RD-2794 was recorded 11.74 per cent over RD-2035.The per cent increase in test weight of RD-2794 was recorded 24.97 per cent over RD-2035.The increase in grain yield of RD-2794 was found significantly more than RD-2035 under both non stress and salt stress conditions. The per cent increase in grain yield of RD-2794 was recorded 18.72 per cent over RD-2035.

Effect of brassinolide

A study of the data in the above table 1 indicated that spray treatment with brassinolide up to 1.5 ppm concentration significantly increased Plant height, Leaf area, number of spikes/plant, number of seeds/spike, length of spike/plant, and grain yield over its preceding levels at 52 and 82 DAS. The increase in plant height due to application of brassinolide at 0.50, 1.0 and 1.0 ppm was obtained 36.53, 19.64 and 18.22, 10.81 and 7.74, 3.96 per cent over that of control at 60 and 90 DAS.

The increase in leaf area due to application of brassinolide at 0.50, 1.0 and 1.5 ppm was obtained 29.14, 24.89 and 14.19, 12.39 and 4.62, 4.37 per cent over that of control at 60 and 90 DAS. The increase in number of seeds per spike due to application of brassinolide at 0.50, 1.0 and 1.5 ppm was obtained 20.58, 11.01 and 4.14 per cent over that of control. The increase in number of spikes per plant due to application of brassinolide at 0.50, 1.0 and 1.0 ppm was obtained 33.48 and 15.00 per cent over that of control.

The increase in length of spike per plant due to application of brassinolide at 0.50, 1.0 and 1.5 ppm was obtained 12.74 and 6.68 per cent over that of control. The significantly higher values for number of spikes per plant, length of spike and number of seeds per spike were obtained with spray treatment of brassinolide is because, foliar application of brassinolide increased yield and yield attributes of treated plants and significantly overcome the depressive effect of saline irrigation water at all levels on crop productivity and photosynthetic pigments [8].

The increase in test weight due to application of brassinolide at 0.50, 1.0 and 1.5 ppm was obtained 28.42 and 12.96 per cent over that of control. The increase in grain yield due to application of brassinolide at 0.50, 1.0 and 1.5 ppm was obtained 37.04, 16.54 and 6.73 per cent over that of control. The maximum increases in these traits were recorded due to use of 1.50 ppm concentration of brassinolide under non stress and salt stress conditions, respectively. Brassinolide (1.0 ppm) was applide on wheat, barley, maize and rice, these cereal crops showed yield increased of 6-9% [9]. Homobrassinolide application caused significant increase in grain yield and related parameters such as 100 grain weight and harvest index under irrigated and stressed plants in green gram as observed by [10]. The findings of [11] also support the present investigation they observed that treatment with exogenous brassinolide at appropriate stage of their development results in increase of crop yield and quality. Use of brassinolide up to 1.50 ppm was observed to increase significantly grain yield, biological yield and harvest index of clusterbean as reported by [12]. Increases in grain yield due to brassinosteroids application have also been reported by various workers [13].

Effect of salinity

Data further indicated that plant height decrease significantly with increasing level of salinity up to EC 12.0 dSm^{-1} at 60 and 90 DAS. The decrease in plant height at EC 3.0 was 12.90, 6.60 and EC 6.0 was 22.90, 12.09 dSm^{-1}, EC 9.0 was 32.03, 17.27 dSm^{-1} and EC 12.0 dSm^{-1} was recorded 42.04, 21.07 per cent over control at 60 and 90 DAS, respectively.

The decrease in leaf area at EC 3.0 was 7.24, 7.54 and EC 6.0 was 15.25, 13.84 dSm^{-1}, EC 9.0 was 23.30, 18.69 dSm^{-1} and EC 12.0 dSm^{-1} was recorded 30.42, 24.04 per cent over control at 60 and 90 DAS, respectively.The decrease in number of seeds per spike at EC 3.0 was 7.93, EC 6.0 was 16.02 dSm^{-1}, EC 9.0 was 24.63 dSm^{-1} and EC 12.0 dSm^{-1} was recorded 28.56 per cent over control, respectively.The decrease in number of spikes per plant at EC 3.0 was 11.68, EC and 6.0 was 23.57 dSm^{-1}, EC 9.0 was 37.17 dSm^{-1} and EC 12.0 dSm^{-1} was recorded 47.06 per cent over control, respectively.

The decrease in length of spike per plant at EC 6.0 was 6.75 dSm^{-1}, EC 9.0 was 10.00 dSm^{-1} and EC 12.0 dSm^{-1} was recorded 12.61 per cent over control, respectively. The decrease in length of spike per plant at EC 3.0 was 7.63 dSm^{-1}, EC 6.0 was 16.22 dSm^{-1}, EC 9.0 was 24.67 dSm^{-1} and EC 12.0 dSm^{-1} was recorded 32.33 per cent over control, respectively.

Data further indicated that grain yield decrease significantly with increasing level of salinity up to EC 12.0 dSm^{-1}. The decrease in grain yield at EC 3.0 was 12.02 dSm^{-1}, EC 6.0 was 21.04 dSm^{-1}, EC 9.0 was 30.53 dSm^{-1} and EC 12.0 dSm^{-1} was recorded 39.94 per cent over control, respectively. The results of [14] also showed that the yield per plant, fertility percentage, and number of productive tillers, panicle length and number of primary braches per panicle were reduced by salinity. Reduction of spikelet and kernel number per spike under the influence of root zone salinity was observed by [15]. [16] Also found a reduction in tillering capacity, spike length, number of spikelets and kernels per spike of moderately salt-stressed wheat. Reduction in grain yield was significantly higher in KRL-19 than more tolerant Kharchia-65 in salinity stress as reported by [17].

Interactive effect

The interactive effect of variety and salinity; and variety and brassinolide on these parameters were found to be non-significant.

Table 1: Effect of brassinolide on growth, yield tributes and yield of barley under salinity

Treatments	Plant height		Leaf area		Seeds/ spike	Spike/ plant	Length of spike/ plant	Test weight (g)	Grain yield (g/plant)
	60 Das	90 Das	60 Das	90 Das	After harvesting	After harvesting	After harvesting	After harvesting	After harvesting
Varieties									
RD-2794	32.33	48.27	80.06	97.82	46.48	2.92	8.95	35.98	4.25
RD-2035	36.28	53.72	73.77	87.98	38.94	2.43	8.01	28.79	3.58
S.Em ±	0.42	0.46	0.76	0.98	0.46	0.04	0.11	0.49	0.06
CD(P=0.05)	1.19	1.30	2.14	2.75	1.29	0.11	0.32	1.36	0.18
Salinity levels									
Control	41.22	56.55	87.84	104.22	48.88	3.25	9.02	37.25	4.66
3.0	36.51	53.05	81.91	96.91	45.29	2.91	8.73	34.61	4.16
6.0	33.54	50.45	76.22	91.55	42.13	2.63	8.45	32.05	3.85
9.0	31.22	48.22	71.24	87.81	39.22	2.37	8.20	29.88	3.57
12.0	29.02	46.71	67.35	84.02	38.02	2.21	8.01	28.15	3.33
S.Em ±	0.67	0.73	1.20	1.55	0.73	0.06	0.18	0.77	0.10
CD(P=0.05)	1.88	2.05	3.38	4.34	2.04	0.17	0.50	2.15	0.29
Brassinolide									
0	28.66	46.08	66.07	81.55	38.39	2.24	7.93	27.76	3.24
0.5	33.10	49.75	74.72	90.62	41.70	2.60	8.38	31.56	3.81
1.0	36.32	53.03	81.55	97.59	44.45	2.87	8.68	34.58	4.16
1.5	39.13	55.13	85.32	101.85	46.29	2.99	8.94	35.65	4.44
S.Em ±	0.60	0.65	1.08	1.38	0.65	0.05	0.16	0.69	0.09
CD(P=0.05)	1.68	1.83	3.02	3.88	1.83	0.15	0.45	1.92	0.26

DAS=Days After Sowing

Conclusion

RD-2794 was found to performed better in comparison to RD-2035 with respect to growth, yield and yield attributes under salt stress. The adverse effects of salinity on growth, yield and yield attributes of barley varieties were observed to reduce by the use of brassinolide up to 1.5ppm concentration as foliar spray. It may be concluded from this investigation that the 1.5ppm concentration of brassinolide may be recommended to farmers for the cultivation of wheat under salt stress up to EC 10 dSm^{-1}.

Reference

1. Atlassi PV, Nabipour M, Meskarbashee M. Effect of salt stress on chlorophyll content, Fluorescence, Na^+ and K^+ ions content in Rape plants. Asian Journal of Agriculture. 2009; 3:28-37.
2. Yaycili O, Alikamanoglu S. Induction of salt tolerant potato (*Solanum tuberosum* L.) mutants with gamma irradiation and characterization of genetic variations via RAPD-PCR Analysis. 2012; 36:405-412.

3. Gupta B, Huang B. Mechanism of Salinity Tolerance in Plants: Physiological, Biochemical and Molecular Characterization. J. of Genomics, 2014, 1-18.
4. Vardhini BV, Anjum NA. Brassinosteroids make plant life easier under abiotic stresses by modulating major components of antioxidant defense system. Frontiers in Environ. Science. 2015; 2:67.
5. Vardhini BV. Brassinosteroids, Role for amino acids, peptides and amines modulation in stressed plants - A review In: Plant Adaptation to Environmental Change: Significance of Amino Acids and their Derivatives**,** (Eds.) Anjum, N.A., Gill, S.S. and Gill, R.CAB International of Nosworthy Way, Wallingford OX10 8DE, United Kingdom, 2013, 300-316**.**
6. Ashraf M, Akram NA, Arteca RN, Foolad MR. The physiological, biochemical and molecular roles of brassinosteroids and salicylic acid in plant processes and salt tolerance. Crit. Rev. Plant Sci. 2010; 29:162-190.
7. Daur I, Tatar O. Effects of gypsum and brassinolide on soil properties and berseem growth, yield and chemical composition grown on saline soil. Legume Research. 2013; 36:306-311.
8. Mona E Eleiwa, Samera O Bafeel, Brahim SA. Influence of brassinosteroids on wheat plant (*Triticum aestivum* L.) production under salinity stress conditions I-growth parameters and photosynthetic pigments. Australian Journal of Basic and Applied Sciences. 2011; 5(5):58-65.
9. Luo BS, Qu YL, Liu DH. Application and physiological effects of brassinolide on crops and their appraisal. Journal of Huazhang Agricultural University. 1992; 19:41-47.
10. Takemastsy TY, Takenchi and Koguchi M. New plant growth regulators. Brassinolide analogues their biological effects and application to agriculture and biomass production. Chemical Regulators Plant. 1983; 18:2-15.
11. Khripach VA, Zhabinskii VN, De Groot AE. Twenty years of brassinosteroids: Steroidal plant hormones warrant better crops for the XXI century. Annals of Botany. 2000; 86:441-447.
12. Jat G, Bagdi DL, Kakralya BL, Jat ML, Shekhawat PS. Mitigation of salinity induced effects using brassinolide in clusterbean (*Cyamopsis tetragonoloba* L.). Crop Research (Hisar). 2012; 44(1/2):45-50.
13. Takemastsy TY, Takenchi and Koguchi M. New plant growth regulators. Brassinolide analogues their biological effects and application to agriculture and biomass production. Chemical Regulators Plant. 1983; 18:2-15.
14. Ali Y, Aslam Z, Ashraf MY, Tahir GR. Effect of salinity on chlorophyll concentration, leaf area, yield and yield components of rice genotypes grown under saline environment. International Journal of Environmental Science and Technology. 2004; 1:221-225.
15. Mass EV, Grieve CM. Spike and leaf development in salt stressed wheat. Crop Science. 1990; 30:1309-1313.
16. Grieve CM, Lesch SM, Francois LE, Maas EV. Analysis of main spike and yield components in salt stressed wheat. Crop Science. 1992; 32:697-703.
17. Sairam RK, Srivastava GC. Changes in antioxidant activity in sub-cellular fraction of tolerant and susceptible wheat genotypes in response to long term salt stress. Plant Science. 2002; 162:897-904.