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EFFECTS OF SALINITY ON LEAF AND GRAIN PROTEIN IN SOME GENOTYPES OF OAT (*AVENA SATIVA* L.)

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Abstract

The protein content in oat, like in the other cereal species, is much influenced by the environmental conditions as well as by the variety. This investigation was carried out on the effect of salinity on protein content in leaves and grains of four genotypes of oat (JHO-822, JHO-851, Kent and UPO-94). The plants were irrigated with different saline waters (3, 6, 7.2, 10, 12 and 14 dSm^{-1}) in the field. Protein in leaf was analyzed at 90 days after sowing. Cv. JHO-822 and JHO-851 contained higher leaf protein at 3 and 6 dSm-1 but lower at 7.2 to 14 dSm^{-1}. Kent and UPO-94 registered an increase in leaf protein only at 3 dSm^{-1} but declined at all salinities. Grain protein of cultivars of oat also registered significant enhancement at 3 dSm-1 but significant reductions at other salinities. The higher protein content in leaves and grains in cv. JHO-822 may be due to higher photosynthetic rate of plants due to higher total leaf area.

Keywords: Salinity, Oat, Leaves, Protein, Grains

Introduction

Soil salinity is one of the most important abiotic stress and limiting factor [1&2] for worldwide plant production. Up to 20% of the irrigated arable land in arid and semi-arid regions is already salt affected and still expanding [3]. Borsani *et al.* [4] suggested that salinity affects most development. Wimmer *et al.* [5] reported that salt stress induces quantitative and qualitative changes in protein content of the plant cell. Progressive decrease in protein with increasing salinity was reported in faba bean leaves [6] and in mung bean seeds [7]. Soluble protein is generally decreased in response to salinity [8&9]. Oat (*Avena sativa* L.) is the most important cereal crop, grown in winter in north-west and central India. It is grown for grain posture, forage and crop rotation. Oat protein is nearly equivalent in quality to soy protein, which has been shown by the world health organization to be equal to meat, milk and egg protein. Although, oat is considered as moderately salt tolerant, yet it is more sensitive to salinity as compared to other cereals such as barley and wheat. The protein content in oat grains, like in the other cereal species, is much influenced by the environmental condition as well as by the variety [10].

Therefore, the purpose of present investigation is to determine the protein content in leaf and grains of oat under various salinity levels.

Materials and Methods

The four varieties of oat (JHO-822, JHO-851, Kent and UPO-94) were sown in experimental plots (1×1 m^2 each). The experimental plots were lined with polythene sheets of 0.2 mm thickness at a depth of 25 cm to avoid leaching of salts.

The experiment was set up in a complete randomized design with three replicates.

Before sowing, each experimental plot was irrigated with 10 liter of saline water to moisten the soil. Saline water of different EC levels (3.0, 6.0, 7.2, 10, 12 and 14.0 dSm^{-1}) were prepared by mixing the salts of NaCl, Na_2SO_4, $NaHCO_3$ and $CaCl_2$ in tube well water as described by [11]. Control sets were irrigated with equal amount of tube well water whose electrical conductivity was observed to be 0.6 dSm^{-1}. Further treatments were given six times at regular intervals of 15 days.

Protein content in leaves and grains of oat were estimated by the method of Lowery *et al.* [12]. For this purpose second and third leaves from the top of 90 days old plant were collected from different sets of salinity in the morning and gently washed with deionized water. These fresh leaves of each variety were dried in hot air oven at 70^0C for 72 hours. Each dried sample was ground separately in pastel and mortar. At harvesting, grains were also collected to evaluate the protein content from each sets (non salinized and salinized).

Grains were ground in grinder to make fine powder. Total protein was estimated in the alcohol insoluble fraction, after initial extraction according to the method as described by Thimann and Loloraya [13]. The samples were collected following completely randomized design considering the replicates and the data were subjected to .one way analysis of variance

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(ANOVA). A critical difference (CD) was computed when F-test indicated statistically significant difference between genotypes using the method described by Bruning and Kintz [14] at P = 0.05.

Results

Impacts of saline water irrigation on protein content in leaf and grain of four cultivars of oat are presented in tables (a & b). Leaf protein as affected by different saline irrigation was determined at 90th day stage while protein in grains was examined at the final harvest (120 DAS). Table (a) indicates a significant enhancement in leaf protein at 3 and 6 EC levels in cvs. JHO-822 and JHO-851 but not in KENT and UPO-94. Leaf protein was marginally increased in KENT and UPU-94 at 3EC but reduced at 6 EC in these varieties. Leaf protein in cultivars i.e. KENT and UPO-94 was adversely affected at 6 to 14 dSm^{-1} but this pattern was observed in cvs. JHO-822 and JHO-851 at 7.2 to 14 dSm^{-1}. Cv. KENT did not show significant decline at 6 dSm^{-1}, however, significant reduction was noted in all cultivars at 7.2 to 14 dSm^{-1}. Data indicate 4.6 to 25.3% and 6.09 to 27.4% reductions in cvs. JHO-822 and JHO-851 respectively while cvs. KENT and UPO-94 registered 0.7 to 23.1% and 0.7 to 26.8% reductions at 6 to 14 dSm^{-1} respectively. It is also clear from data that cv. JHO-822 had higher leaf protein as compared to JHO-851, KENT and UPO-94 irrespective of saline irrigation.

Data on grain protein indicate that all four cultivars of oat registered significant enhancement at 3 EC and significant reductions at 6 to 14 dSm^{-1} which ranged from 0.8 to 15.7, 0.5 to 17.0, 3.3 to 15.4 and 3.1 to 14.7% reductions in cv. JHO-822, JHO-851, KENT and UPO-94 respectively. It is interesting to observe that maximum grain protein was found in cv. JHO-822 and which was followed by cvs. JHO-851, UPO-94 and KENT. This trend was also noted in leaf protein content.

Table – a: Effect of saline water irrigation on leaf protein (mg/g) in four cultivars of oat (*Avena sativa* L.) at 90 days after sowing

Salinity levels (dSm^{-1})	Varieties			
	JHO-822	JHO-851	KENT	UPO-94
Control	79.3	77.2	69.5	75.6
3	84.0	81.0	70.6#	79.0
6	80.2	78.0	69.0#	75.0#
7.2	75.6	72.5	64.5	71.6
10	72.1	71.0	62.3	70.2
12	64.5	64.0	60.0	68.4
14	59.2	56.0	53.4	55.3
CD at 5%	1.02	1.18	1.24	1.67

NS for salinity

Table – b: Effect of saline water irrigation on grain protein (mg/g) in four cultivars of oat (*Avena sativa* L.) at final harvest (120 DAS)

Salinity levels (dSm^{-1})	Varieties			
	JHO-822	JHO-851	KENT	UPO-94
Control	183.6	181.2	165.8	170.3
3	190.9	185.3	172.5	180.8
6	182.0	180.2#	160.2	165.0
7.2	170.8	176.0	158.8	162.0
10	174.0	168.2	153.9	154.4
12	166.2	163.4	150.0	151.0
14	154.7	160.3	140.2	145.2
CD at 5%	1.16	1.25	1.64	1.56

NS for salinity

Discussion

Protein content in leaf had been invariably affected by salinity in all cultivars of oat. Leaf protein increases in tolerant cultivars JHO-822 and JHO-851 at 3 and 6 EC while this increase was also observed in KENT and UPO-94 only at 3 EC. The tolerant varieties showed reductions in leaf protein at 7.2 to 14 EC but leaf protein in sensitive varieties reduced with increasing salinity levels from 6 to 14 EC. Inhibitory effect of salinity on leaf protein was also reported by

Ashraf and Waheed [15] in wheat and Ashraf and Fatima [16] in safflower. Helal and Mengel [17] have suggested that there is marked decomposition of protein under saline conditions. This may offer an alternative explanation of chlorophyll destruction under saline conditions.

Grain protein in all cultivars differentially declined at all saline irrigations except for 3 EC. Present findings indicate that maximum protein content in grains was observed in JHO-822 which was followed by JHO-851, UPO-94 and KENT. These findings are also similar to the findings of Reddy and Vora [18] in bajara, El-Sayed et al. [19] in cotton and maize and Tammam et al. [20] in wheat. The decrease in protein synthesis may be due to decreased availability of amino acids and denaturation of the enzymes involved in the amino acid and protein synthesis under saline-alkali conditions [21].

References

1. Debez, A., D. Saadaoui, B. Ramani, Z. Ouerghi, H.W. Koyro, B. Huchzermeyer, and C. Abdelly, 2006. Leaf H^+-ATPase activity and photosynthetic capacity of Cakile maritime under increasing salinity. Environ. Exp. Bot. 56: 285-29
2. Koyro, H.W., 2006. Effect of salinity on growth, photosynthesis, water relation and solute composition of the potential cash crop halophyte *Plantago coronopus* (L.). Environ. Exp. Bot. 56: 136-146
3. Mühling K.H., A. Läuchli, 2003. Interaction of NaCl and Cd stress on compartmentation pattern of cations, antioxidant enzymes and proteins in leaves of two wheat genotypes differing in salt tolerance. Plant Soil 253: 219-231.
4. Borsani, O., V. Valpuesta, and M. A. Botella, 2003. Developing salt tolerant plants in a new century: A molecular biology approach. Plant Cell, .Tiss. Org. Cult., 73: 101-115.
5. Wimmer, M.A., K.H. Muhling, A. Lauchli, P.H. Brown and H.E. Goldbach, 2003. The interaction between salinity and boron toxicity affects the subcellular distribution of ions and proteins in wheat leaves. Plant Cell Environ., 26: 1267-1274.
6. Gabbalah, M.S. and A.M. Gomma, 2004. Performance of faba bean varieties grown under salinity stress and biofertilized with yeast. J. Appl. Sci. 4: 137-142.
7. Kanta, R., 2004. Effect of salinity on morphological, anatomical and reproductive aspect in mungbean (*Vigna radiata* L.) and their hybrids. Ph.D. thesis, C.C.S. Haryana Agricultural University, Hissar (India).
8. Parida A, A.B. Das, P. Das, 2002. NaCl stress causes changes in photosynthetic pigments, proteins and other metabolic components in the leaves of a true mangrove, *Bruguiera parviflora* in hypotonic cultures. J. Plant Biol. 45: 28-36.
9. Abed-Latef, A.A., 2005. Salt tolerance of some wheat cultivars. Ph.D. Thesis, South valley Univ. Qena, Egypt. 1-159.
10. Burrows, V. D., 1986. Tibor oats. Can. J. Plant Sci., 66:254-262.
11. United state salinity Laboratory staff, 1954. Diagnosis and improvement of saline and alkali soils, Richards, L.A. ed. U.S. Department of Agriculture, Hand Book No. 60. Washington D.C.
12. Lowary, O.H., N.J. Rosebrough, A.L. Farr and R.J. Randall, 1951. Protein measurement with the folin phenol reagent. Washington Uni., Missouri.
13. Thimann, K.V. and M.M. Laloraya, 1960. Plantarum 13: 165-178.
14. Bruning, J.L. and B.L. Kintz, 1977. Computational Handbook of Statistics. Scott Foresman and Company, Oakland, N.J.
15. Ashraf, M. and A. Waheed, 1993. Responses of some local/exotic accessions of lentil (*Lens culinaris* Medic.) to salt stress. J. Agron. Soil. Sci., 170: 103-112.
16. Ashraf, M. and H. Fatima, 1995. Responses of some salt tolerant and salt sensitive lines of safflower (*Carthamus tinctorius* L.). Physiol. Plant., 17: 61-71.
17. Helal, H.M. and K. Mengal, 1981. Interaction between light intensity and NaCl salinity and their effects on growth, CO_2 assimilation and photosynthetic conversion in young broad beans. J. Plant Physiol. 67: 265-275.
18. Reddy, M.P. and A.B. Vora, 1985. Effect of salinity on protein metabolism in bojra (*Pennsetium typhoides* S & H) leaves. Ind. J. Plant Physiol. 28(2): 190-195.
19. El-Sayed, H., R.C. Kirkwood, and N.B. Graham, 1995. Studies on the effects of salinity and Hydrogel polymer treatments on the growth, yield production and solute accumulation in cotton and maize. J. King Said Univ. Vol.7, Agric. Sci. (2), pp. 209-227. Riyadh (A.H.A. 1415).
20. Tammam, A.A., M.F. Alhand, and M.M. Hemeda, 2008. Study of salt tolerance in wheat (*Triticum aestivum* L.) cultivar Banysoif 1. Aust. J. Crop Sci. 1 (3): 115-125.
21. Levitt, J. 1972. Response of plants to environmental stress. Monograph Academic press,NewYork.