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Salinity effects on plant growth , photosynthesis , and ion content of covered and naked oat

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Key words : oats , salinity , growth , photosynthesis , ion content

Introduction Salinity affects plant growth , water and nutrients uptake . The objective of this study was to determine the effects of salt levels and stress duration on seedling growth , ion content and photosynthesis of covered and naked oat , to provide a more comprehensive understanding of the role of the physiological processes in salt tolerance in oats .

Materials and methods A 2×6 factorial experiment with 4 replications was conducted . Twenty seeds of covered oat variety Prescott and naked oat VAO-2 were planted in each pot and thinned to 12 plants after emergence . Pots were irrigated with distilled water for 7d after emergence . At 14d after seedling emergence , salinity treatments of 0 , 50 , 100 , 150 , 200 , and 250 mM NaCl (NaCl : CaCl₂=5 :1 molar concentration) were imposed through Hoagland solution . The experiment was conducted in a greenhouse with 25/16°C temperatures , 16h photoperiod . Plant dry matter (PDM) samples were taken at 1 , 9 , 17 , and 25 d after salt application (DASA) and dried at 70 °C for 72 h . RGR was calculated according to Kingsbury et al . (1984) . At the 25 DASA , total leaf area (TLA) , leaf greenness , photosynthetic rate (A) and stomatal conductance (gs) were measured . The Na⁺ , K⁺ and Ca²⁺ content were determined . All data were subjected to analysis of variances using SAS .

Results and discussion

Response of plant growth to salinity

With the increasing salt stress , RGR of both species decreased remarkably . Compared with control , RGR dropped 37 .2% in the 1st week of salinity stress , 76% in the 2nd and 50% in the 3rd week . Varietal difference was also significant through the stress duration . Prescott had higher RGR than VAO-2 . As a result , TLA and PDM varied significantly (Fig .1) . Under 3 weeks of 250mM salt stress , TLA and PDM were only 12 .5% and 25 .4% of that of controls , respectively . VAO-2 had higher TLA than Prescott .

Response of photosynthesis to salinity

Photosynthesis showed significant variation under salinity stress . Both A and g_s decreased with the increasing salinity concentration and duration . Prescott had higher photosynthetic rate (9%) and stomatal conductance (11 .6%) than VAO-2 . No significant difference was observed on Ci .

Response of leaf greenness to salinity

There was no significant difference on SPAD at the 1st week of salinity . With the increasing of salt concentration and duration , significant variation was observed . Medium salinity (50-100mM) increased SPAD , higher stress reduced SPAD by 7 .3% at 2nd week . The 3rd week gave different performance with all the stress concentration reduced SPAD significantly , except 50mM .

Response of ion content to salinity

Salinity affected ion content significantly . With the increase of Salt concentration , Na⁺ content increased about 35 times under 250mM NaCl . While K⁺ reduced by 60 .2% . The variation of Ca²⁺ was not as great as Na⁺ , but a 61 .8% increment was observed under the highest salinity stress (Figure 2) . This is in contrast with the findings of El-Hendawy (2005) that salinity stress significantly decreased Ca²⁺ content in wheat . But Alpaslan (1998) also found that the concentrations of Ca²⁺ in rice were increased by salinity .

Conclusions Salinity stress significantly inhibited oat growth by reducing total leaf area and plant dry weight , decreasing photosynthetic rate and stomatal conductance . Ion content was also affected , both Na⁺ and Ca²⁺ content increased with the increasing salinity concentration . Meanwhile , K⁺ accumulation was decreased significantly . According to the parameters measured , VAO-2 is more sensitive to salinity than Prescott .

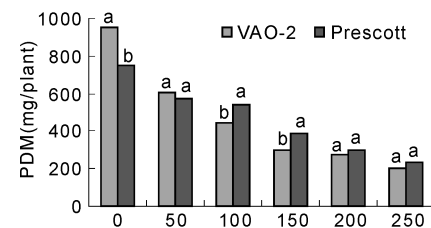


Figure 1 Salinity effect on PDM .

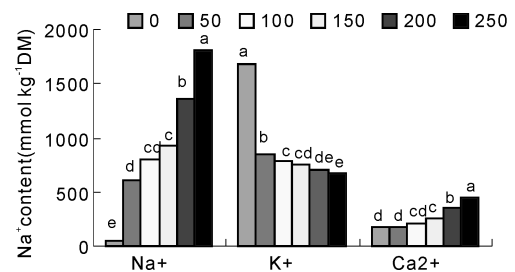


Figure 2 Salinity effect on ion content .