NO_3^- Uptake and Its Partitioning in Drought Stressed Perennial Ryegrass (*Lolium perenne* L.)

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Key words: drought stress, ^{15}N-uptake, perennial ryegrass

Introduction Drought is the major limitation to crop productivity (Boyer, 1982), and affects up to 45% of the world agricultural lands (Bot *et al*. 2000). The availability of water seems to be the most important factor limiting plant growth and productively in dry areas. It is well documented that nutrient uptake is inhibited in dry soil. Soil drought decreased mineralization of organically bound nutrients (Bloehm *et al*. 1992; Walworth, 1992), and nutrient transport in soil by mass flow and diffusion (Seiffert *et al*. 1995), and thus may diminish nutrient availability at the root surface, which may lead to foliar nitrate depletion (Foyer *et al*. 1998). Perennial ryegrass (*Lolium perenne* L.) is one of the most important plant species in forage ecosystems and used all over the world as a valuable species for turf. The objective of this work is to investigate the kinetics of N uptake and distribution in response to the change of water deficit stress using ^{15}N-tracing in perennial ryegrass.

Materials and methods The $^{15}NO_3^-$ feeding was carried out every day throughout the entire 10 days of sampling period. For ^{15}N feeding for the well-watered (control) treatment, 25 mL of ^{15}N solution (1 mM $K^{15}NO_3$ with 8.34 ^{15}N atom% excess) was administered evenly through three porous plastic tubes buried vertically to a depth of 5 cm in each pot at 10:00 h and 16:00 h, respectively. Using the same protocol of administration, plants submitted to water-deficit received 2.5 mL of ^{15}N solution, containing the same ^{15}N atom% and the same amount of N as applied to the control pot (i.e. 0.7 mg N pot^{-1} d^{-1}). The sample was harvested at 0, 2, 4, 6, 8, and 10 days after treatment. Freeze-dried power samples (1-5 mg) were weighed into tin capsule for total N determination. N content and ^{15}N atom% of total N was determined using N single mode analysis on an ANCA-SL isotopic ratio mass spectrometer (PDZ-Europa, Crewe, UK).

Results Leaf water potential reached a minimum value of 2.5 MPa after 10 days of drought stress treatment. This showed that drought stress occurred during the experiment. ^{15}N-uptake, expressed by the amount of newly absorbed N in the total N fraction in shoot plus roots, was significantly decreased to 58% in drought-stressed plants compared to control after 10 days of treatment. The amount of ^{15}N distributed to shoots of drought-stressed plants was 35% lower than in the control plants 10 days after treatment (Figure 1). In roots, ^{15}N amount in drought stress treatment is decreased to 44% at day 6 and then rapidly decreased to 30.9% at day 10 compared with control (Figure 2).

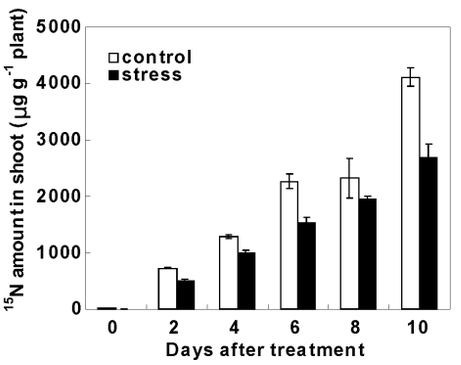

Figure 1

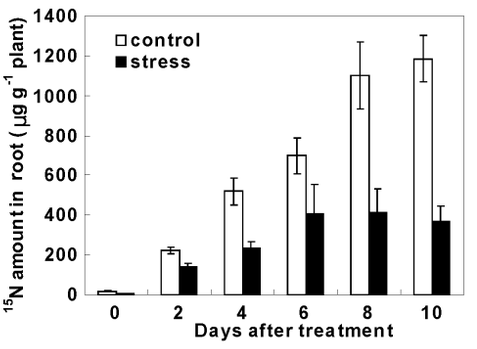

Figure 2

Conclusions In the present study, ^{15}N-uptake was significantly decreased with prolonged periods of drought while the rate of decrease in ^{15}N amount by water deficit was higher in the roots than in the shoots of perennial ryegrass. These results usually were explained by a reduction in N availability and the limitation of N acquisition under drought stress.

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