Table 3 Activity of enzymes in the winter spelt and winter wheat grain cultivars.

Cultivar / Enzymes	Bauländer Spelz[a]	Franckenkorn[a]	Holstenkorn[a]	Rouquin[a]	Schwabenkorn[a]	Samanta[b]
α-amylase (μkat/g)	1.31	0.70	0.57	0.69	0.80	1.80
Exoproteases (U/mg.100)	0.00	0.00	0.00	0.00	0.00	0.00
Endoproteases (U/mg.100)	13.79	14.34	12.76	11.05	13.37	19.32

[a] *Triticum spelta* L., [b] *Triticum aestivum* L.

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EFFECT OF N-NUTRITION ON GAS EXCHANGE CHARACTERISTICS OF WHEAT (*TRITICUM AESTIVUM* L.)

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Summary

Wheat plants grown under two N-nutritional regimes were used to determine the effect of N-nutrition on the regulation of $C0_2$ assimilation rate (A) and stomatal limitation to A under drought stress. Drought stress reduced leaf water potential (-0.5 to -1.92 MPa) and A (23 to 0
μmol.m^{-2}.s^{-1}). Gas-exchange measurements indicated greater sensitivity high-N plants compared to low-N plants as water stress developed. Daily range of stomatal related changes was greater in high-N plants, as well. WUE was changing with increasing water limitation. Osmotic effect of N-nutrition was mediated by increasing concentration of prolin during the water stress.

***Key words*:** winter wheat, N-nutrition, gas exchange, water stress

Introduction

Both stomatal and metabolic factors have been shown to limit gas exchange rates in lives (Lawlor, 1995, Cornic, Massacci, 1996). Water limitation and N-nutrition has numerous effects on photosynthesis. While physiological responses of plants to either water stress or N nutrition have been extensively investigated, the interaction of these two factors has received little attention (Morgan, 1984). N-nutrition has both the nutritional and osmotic effect in plants (McIntyre, 1997). Osmotic effect of N via amino acids, mainly prolin is known (Kameli, Lösel, 1993). In two experiments the effect of N-nutrition on photosynthesis and water regimes were investigated.

Material and methods

Two experiments were done. Plants of wheat (*Triticum aestivum* L. cv. Samanta) were grown in 15 1 containers containing a soil substrate. No N-fertiliser was supplied to low-N plants. High-N plants have two nitrate treatments (1gN/SkgSoil): first before sowing, second at the end of tillering. Plants grown outdoors were placed in the glasshouse to be drought stressed just before anthesis.

In the first experiment portable photosynthetic system Li-Cor 6250 was used to measure a gas exchange parameters. Daily measurements were done always in the same time (10 AM) and the same photosynthetic photon flux density 1000 $\mu mol.m^{-2}.s^{-1}$.
Leaf water potential (WP) was determined by leaf dew point thermocouple psychrometry using Wescor microvoltmeter.
In a second study similar N and water treatment were imposed. Abaxial and adaxial stomatal resistance were measured using a diffusion porometer (Delta-T) calibrated every day before measurement.

Nitrogen concentration of the oven dried flag leaf was determined using Kjeldahl technique Kovačik, 1997). Prolin concentration was detected by photocolorimetric method (Bates, 1973). Osmotic potential values were obtained psychometrically using leaf sections that were first frozen in liquid nitrogen. For determining leaf water potential were used the same technique as in the first experiment.

Results

In the first experiment $C0_2$ assimilation rate of the drought stressed plants decreased gradually during the stress (figure 1.). However high-N plants (SH) were more affected by drought. Well-watered plants had a relatively stabile rate of assimilation and high-N (NH) plant had a greater value of assimilation in this case. Differences in water potential between stressed and unstressed became apparent only after 6 days of withholding water (figure 2). Water use efficiency WUE calculated $C0_2$ assimilation rate (A)/stomatal conductance (g_S). The changes in $C0_2$ assimilation rate (A) were mainly due to limitation by the stomatal conductance (g_S) and dependencies are similar for all variants. The variations in WUE are in a relation with the water status but they are still not too clear.
Second study was focused on the water regime and actions occurring in plants subjected to the same conditions. Nitrogen concentration decreased form 2nd to 7th day in the all variants but mostly in the low-N variant (figure 3.). Concentration of the prolin increased in drought stressed leaf (figure 4.) that means prolin play a role in osmotic adjustment (figure 8-9.) and concentration of prolin is N dependent. From the figure 5 can be seen the differences in the water management of low-N and high-N plants.

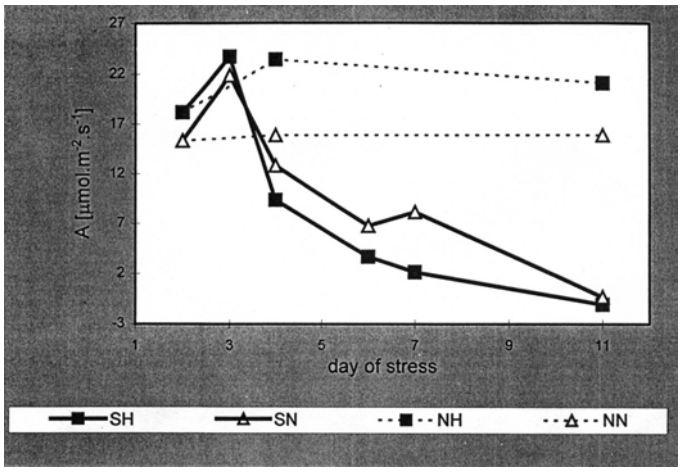

Figure 1. CO_2 assimilation rate (A) of the flag leaf of wheat *(Triricum aestivum)* during the water stress *(***SH** – stress, high N, **NH** – no stress high N, SN – stress, low N, **NN** – no stress, low N)

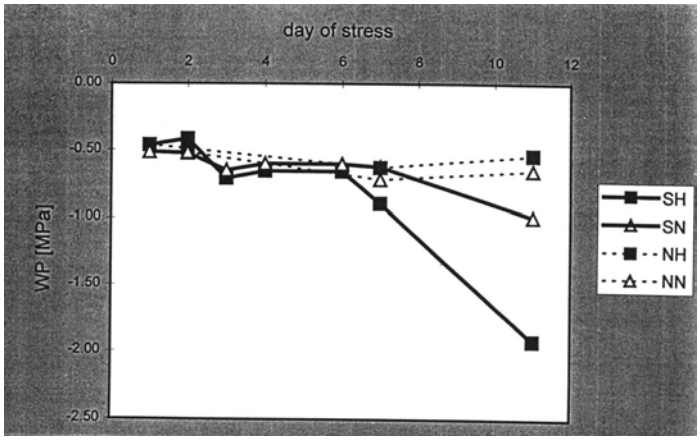

Figure 2. Water potential (WP) of the flag leaf of wheat *(Triricum aestivum)* during the water stress *(***SH** – stress, high N, **NH** – no stress high N, SN – stress, low N, **NN** – no stress, low N)

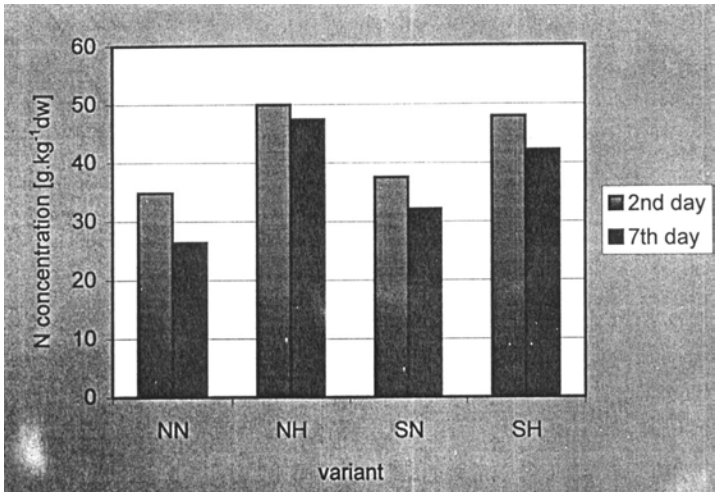

Figure 3. N concentration of the flag leaf of wheat (*Triricum aestivum* at the 2nd and 7th day of the water stress (**SH** – stress, high N, **NH** – no stress high N, SN – stress, low N, **NN** – no stress, low N)

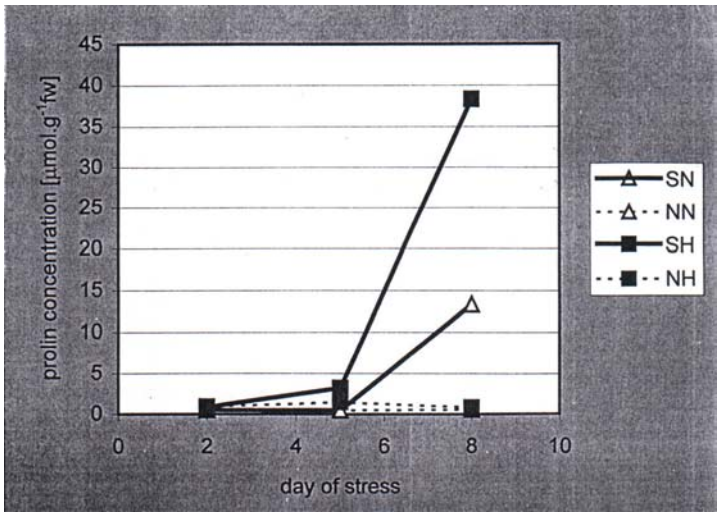

Figure 4. prolin concentration of the flag leaf of wheat *(Triricum aestivum)* during the water stress (**SH** – stress, high N, **NH** – no stress high N, SN – stress, low N, **NN** – no stress, low N)

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