The influence of climatic conditions on nitrogen uptake during the vegetative phases for sunflower

E. Kunzová, M. Pechová and M. Vocetková

Crop Research Institute, Drnovská 507, 16106 Praha 6 – Ruzyně, Czech Republic (e-mail: kunzova@vurv.cz)

Abstract Sunflower is becoming an important cash crop for the farmers in the Czech Republic. The obstacle preventing more frequent cultivation of sunflower is the low certainty of good yield levels. The average yields do not reach the level what is realistically possible for our soil and climatic conditions. The reason for that is a number of factors which are interlinked by complex relationships; in particular agrotechnology issues, phytopathology issues, and temperature and rainfall fluctuations.

Apart from the content of nutrients in soil, the uptake of nutrients is influenced also by fertilization and other environmental factors. Balanced and steady update of nutrients by the sunflower plant is the basic prerequisite for achieving optimum sunflower achene yields in required quality. The sunflower receives the majority of nitrogen necessary for its growth from the soil, in which the nutrients are present in relatively low concentrations that fluctuate during the vegetative period. This impacts the speed of nutrient uptake as well as the concentration of nutrients in the sunflower plant. The highest uptake at phase BBCH65 was reached at the site Uherský Brod, hybrid Altesse till 350 N kg/ha in the year 2004, on the other hand, the lowest uptake of nitrogen was at Uherský Brod site hybrid Pilar till 56 N kg/ha in 2003.

Key words: *sunflower, yield, climatic conditions, nitrogen, dry matter*

Introduction

The climatic changes in the 21st century are presumed primarily to be global warming, which will result not only in increased concentration of (CO_2), but also in changes of the nutrient regime of grown crops. Sunflower (*Helianthus annus* L.) is the most important oilseed crop in the Czech Republic. The sunflower is the only oilseed crop grown commercially in this region.

Numerous studies have investigated the effects of N fertilization on sunflower in the various parts of the world (Hussein et al. 1980, Blamey and Chapman 1981, Khokani et al. 1993, Tomar et al. 1999, Zubillaga et al. 2002, Kunzová et al. 2004). Nitrogen is commonly a limiting factor in sunflower production. Managing N fertilization is of particular importance because many environmental and production factors influence sunflower N demand. Nitrogen deficiency reduces vegetative and generative growth and induces premature senescence, thereby potentially reducing yields (Tomar et al. 1999, Kunzová 2006). On the other hand, high N availability may shift the balance between vegetative and reproductive growth toward excessive vegetative development, thus delaying crop maturity and reducing seed yield (Hocking et al. 1987).

Excess N application also increases the risk of disease and lodging, with a consequent reduction in oil content, and may aggravate ground- and surface-water pollution.

Material and methods

For sunflowers, we studied nutrient uptake at ecologically different sites and for different sunflower hybrids (Altesse, Allium, Alexandra, Pilar and PR 64A63). In the experiments of the Union of Oilseeds Growers and Processors, we monitored nutrient intake in the phase (BBCH 19 and BBCH 65) at individual sites in the years 2003-2006. For evaluating the climatic conditions effect on the yields of dry mass for sunflowers in 2003-2006 the Kolín, Znojmo, Louny and Uherský Brod sites were chosen. Agrochemical analyses of crops and soil were done annually by standard methods.

Results

The uptakes of nitrogen are shown in Fig. 9-12. The highest uptake at phase BBCH65 was reached at the site of Uherský Brod, hybrid Altesse - till 350 N kg/ha in the year 2004. On the other hand, the lowest uptake of nitrogen was at Uherský Brod site, hybrid Pilar - only 56 N kg/ha in 2003.

The results show that site and climatic conditions have a dominant effect on the nutrient uptake. Our research shows that, for example, in 2003 and 2006 the Znojmo site had the highest uptake of all monitored hybrides. The limiting factor of nutrient uptake in 2003 and 2006 was water (Fig. 1-4). The highest temperature divergences from monthly temperature normals were also in the years 2003 and 2006 (Fig. 1-8). The changes in nutrient uptake of monitored plants were, besides the site conditions, also influenced by the nitrogen requirements of individual hybrids.

The study of the effect of various temperature and water conditions on the development of plants during their vegetative phases, most importantly during the decisive ones, shows the importance of monitoring the condition of plants from the initial vegetative phases to the time when it is still possible to make corrections to the nutrient condition of the plants.

The significant differences in nitrogen uptake in leaves at monitored hybrids during the growth are shown in Fig. 13. Statistically significant difference was also recorded between dynamic growth of dry matter at leaves dependent on number of days after sowing in the years 2004 - 2006 (Fig.14).

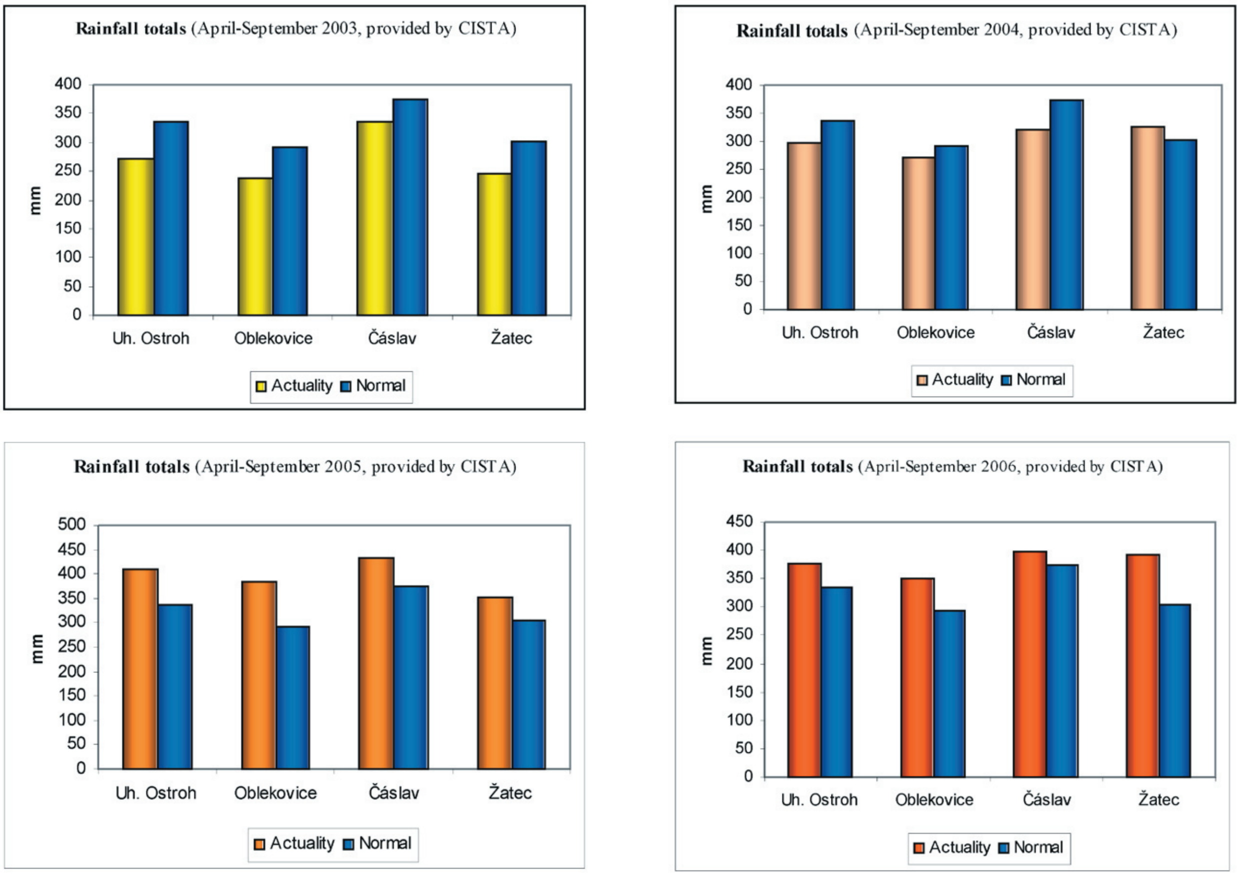


Fig.1-4 The precipitation in the experiments (2003-2006)

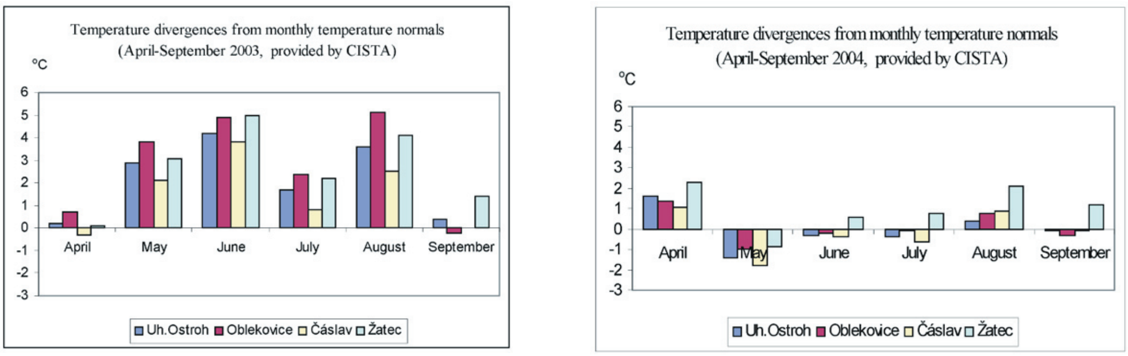


Fig. 5-6 The temperature in experiments (2003-2004)

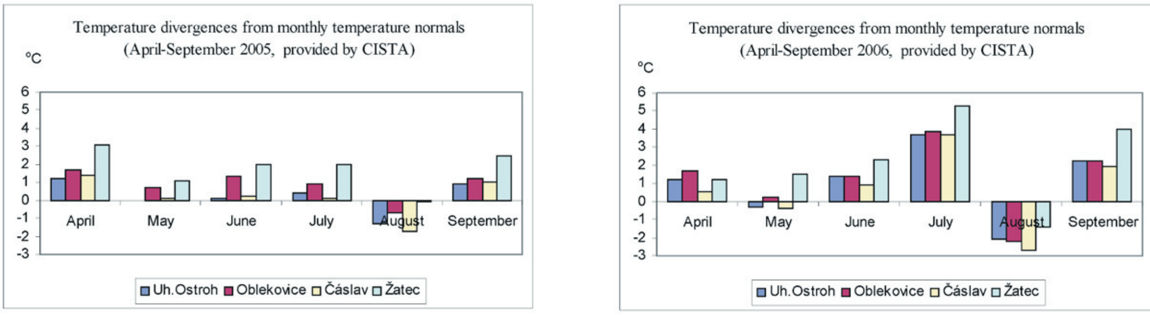


Fig. 7-8 The temperature in experiments (2005-2006)

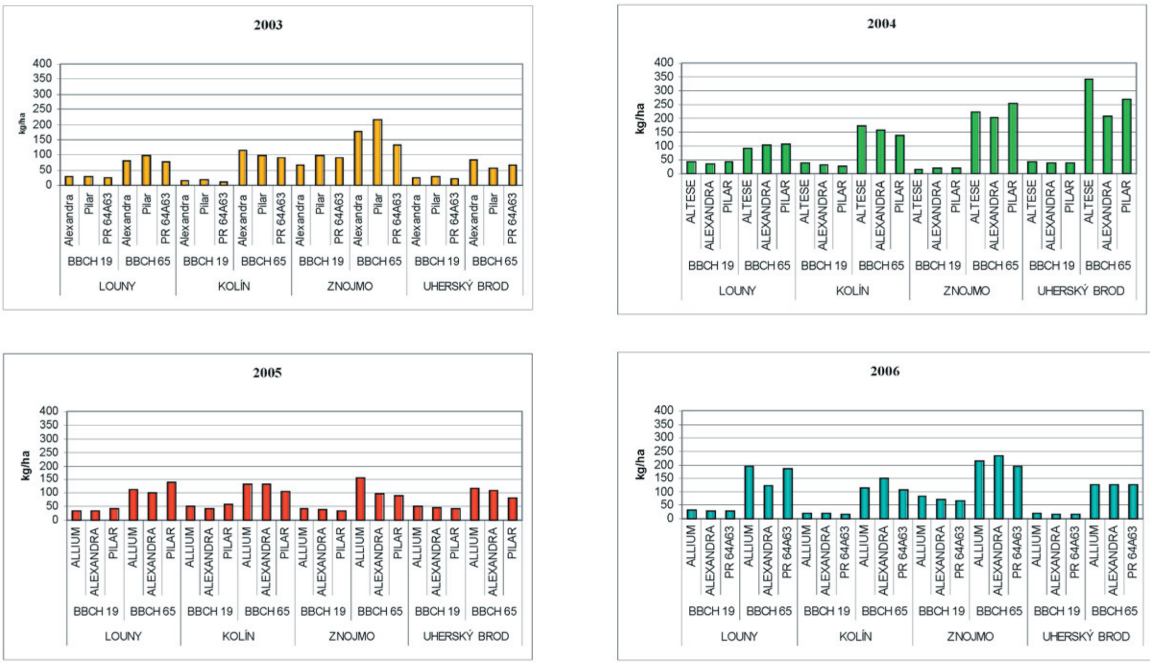
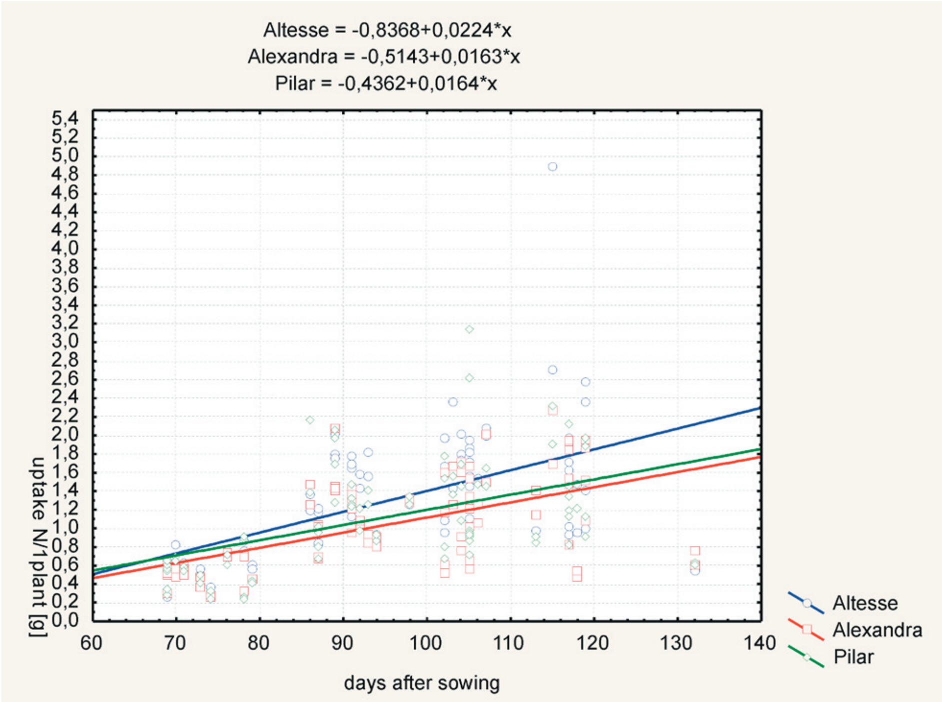
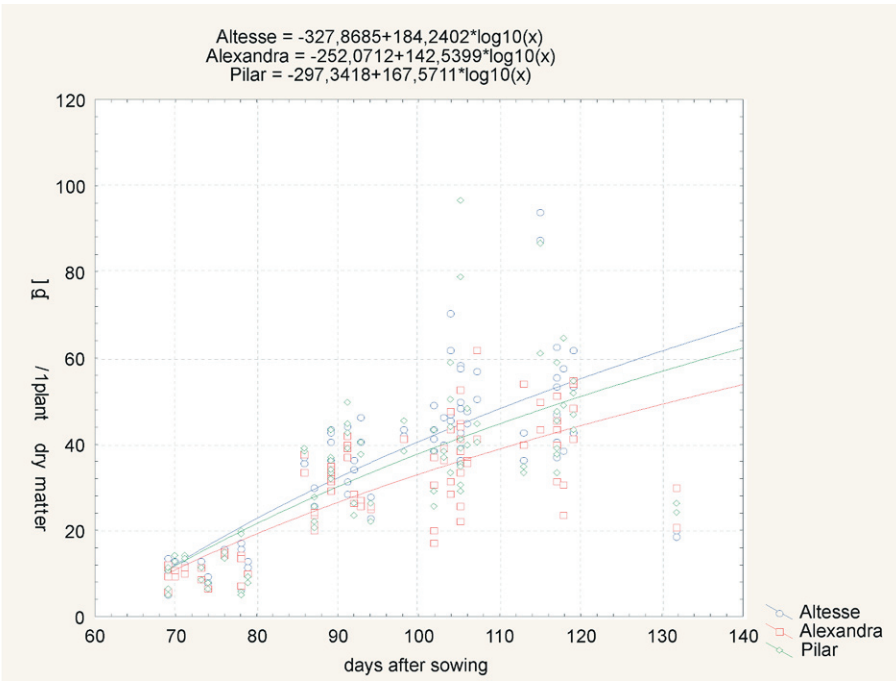


Fig. 9-12 Nitrogen uptake of all monitored hybrids in the years 2003 - 2006



Altesse: r^2 = 0,2824; r = 0,5314; p = 0,0000001; y = -0,836750777 + 0,0223873004*x
Alexandra: r^2 = 0,3006; r = 0,5483; p = 0,00000005; y = -0,514268448 + 0,016305816*x
Pilar: r^2 = 0,2345; r = 0,4843; p = 0,000002; y = -0,43621705 + 0,0163542233*x

Fig 13 The nitrogen uptake in leaves at monitored hybrids during the growth



Altesse: r = 0,7377; p = 0,0000; y = -43,3808 + 0,8278*x
Alexandra: r = 0,7511; p = 0,0000; y = -32,1691 + 0,6425*x
Pilar: r = 0,6947; p = 0,0000; y = -38,849 + 0,7556*x

Fig.14 Dynamic growth of dry matter at leaves dependent on number of days after sowing in the years 2004 - 2006

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