The influence of nitrogen stabilized fertilizers on yield forage of semi-natural grasslands

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Abstract: The paper deals with the influence of type of nitrogen fertilizers on the yield of dry forage of semi-natural grasslands. The prerequisite is to determine the effect of stabilized fertilizers on semi-natural grasslands because their influence was monitored just on field crops. Particular variants of fertilization were: not fertilized, urea (100 kg.ha^{-1}), ALZON 46 (100 kg.ha^{-1}), UREA stabil (100 kg.ha^{-1}). The growth is used as double-cutting. Experimental habitat is located at Pardubice region. The results show that the effect of classic or stabilized nitrogen fertilizers on yield of dry forage of the primary production was not statistically significant.

Key-Words: grassland, stabilized fertilizers, yield, inhibitor of urease, inhibitor of nitrification

Introduction

Semi-natural grasslands in Central Europe are threatened by intensive fertilization; forestation or leaving the habitat because of changes in agricultural practices [1]. The unharvest areas of semi-natural grasslands leads to loss of species composition and degradation of growth [2]. Their species diversity cannot be maintained without continuous care, namely: regular cutting or grazing and fertilization. In many cases is fertilizing used to increase the quality of grassland which leads on the contrary to reducing species diversity [3].

Nitrogen is the main nutrient affecting the yield [4]. It supports the formation of new offshoots of grasses and elongation of stalks [5]. Without sufficient nitrogen nutrition leaves are yellowing [6]. Semi-natural grasslands are able to take advantage 200 kg.ha^{-1} of nitrogen, depending on sufficient of soil moisture. With other increasing of nitrogen fertilization the yield is not accrue any. With increasing doses of nitrogen is growing yield and quality of dry forage, but species composition of semi-natural grasslands is declining. Increase of yield forage is mainly cause by grass species. More than half of total is harvested during the first cut. In the case of higher doses of nitrogen fertilization should be doses divided. One part should be applicated at the spring and others after first (second) cut [5]. The protection of groundwater is one of the reasons for the application divided doses of fertilizers. Exists condition to protect drinking water quality in the so-called "vulnerable areas", where the content of NO_3 in groundwater should not exceed 50 mg.l^{-1} (Nitrate Directive). This condition can be reached by divided applications of doses of nitrogen fertilizer. It should be used lightly and slowly soluble forms of nitrogen with respect to habitat conditions, vegetation type, intensity of use and by inflow of nutrients from other sources (symbiosis with nodule bacteria, mycorrhiza, atmospheric precipitation, etc.); [4].

For this reason is possible consider using stabilized fertilizers on semi-natural grasslands. The stabilized fertilizers are applied in one dose, to reduce number of crossings and diesel consumption. Another advantage is the slow release of nitrogen and therefore is nitrogen making available plants continually. The higher dose should not be subject to volatilization or be washed up to outside of the root system of plants. The disadvantage is their higher price compared to classic fertilizers [7].

The aim is to evaluate the effect of nitrogen fertilization on the primary production of dry forage of semi-natural grasslands.

Material and Methods

Characterization of habitat, solving of experiment

It's a field study. The experimental habitat is located at Pardubice region, near village Kameničky. Monitored growth is at an altitude of 650 m above

sea level, orientation to the southwest and an inclination 3 °. Data in climate diagram (see Fig. 1) are from weather station in Svratouch, 7 km far away from experiment in Kameničky. The average annual air temperature is 5.8 °C; average annual rainfall is 758.4 mm for the period 1961 - 2000. The second climate diagram (see Fig 2.) is for experimental year 2014 from Svratouch too.

Fig. 1 The course of the average monthly air temperature and monthly precipitation for the period 1961 - 2000

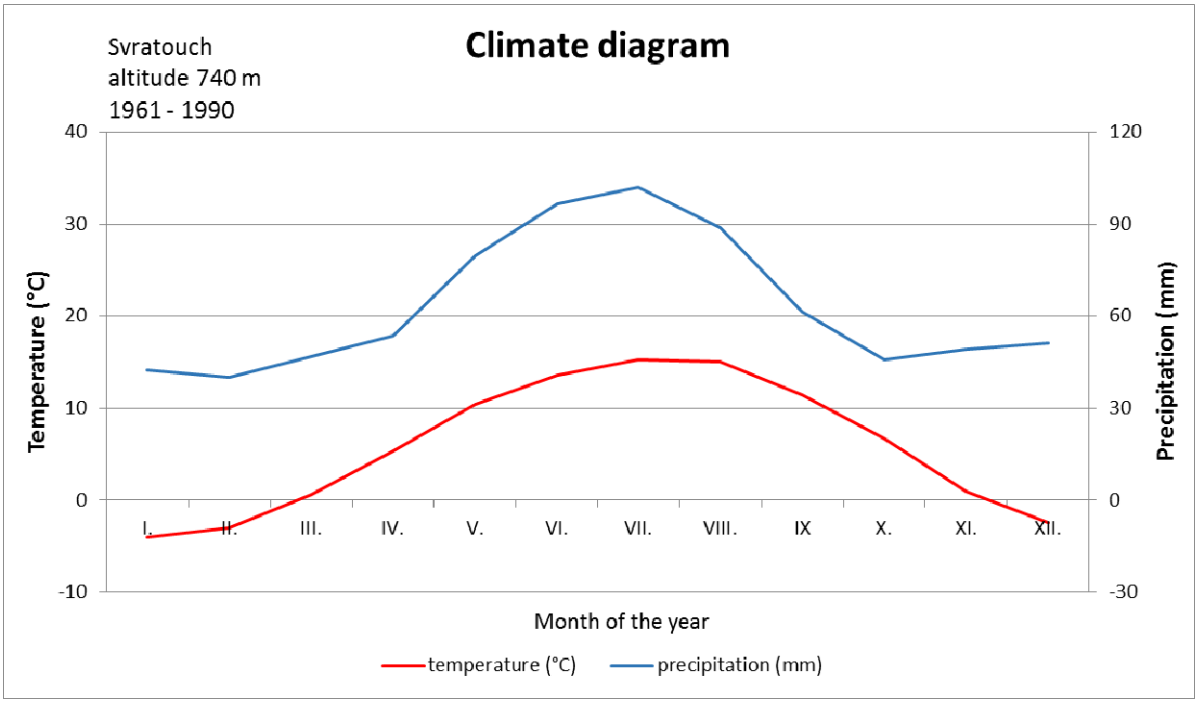
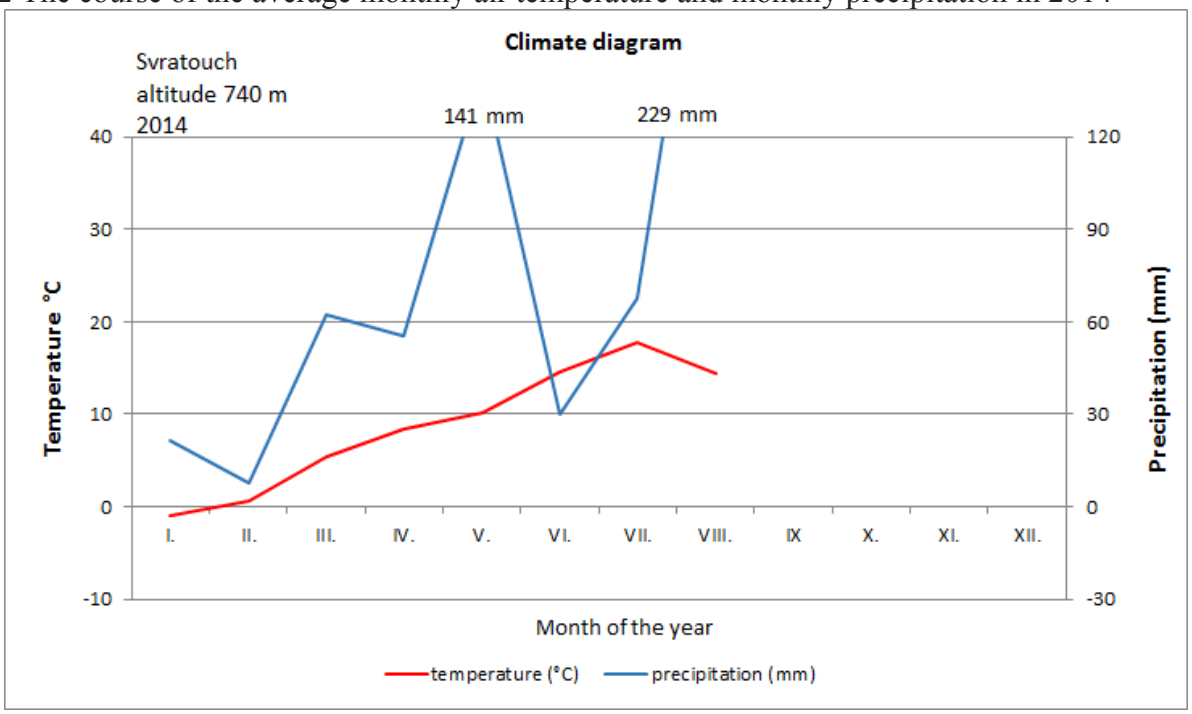


Fig. 2 The course of the average monthly air temperature and monthly precipitation in 2014



The current area of semi-natural grasslands was divided into plots with an area of 15 m^2 (1.5 * 10 m). They were separated according to different types of fertilizers: urea, urea with urease inhibitor

(UREA stabil) and urea with nitrification inhibitor (ALZON 46); (always with eight replications). They were applied before the first cutting in one dose of 100 kg.ha^{-1}. The fertilization was done by mineral fertilizers at spring 2014 (the 8th of April). Also there was not fertilized plots for compare.

Monitored growth was harvested as double-cutting. The first cut was done in June. For cut was used mower MF-70 with width of cutter bar 1.2 m and height of stubble 0.07 m.

Description of fertilizers

Mineral fertilizer urea is the most widely used nitrogen fertilizer. It is thanks to its high nitrogen content (46%) and relatively low production costs. If is not urea insert to the soil mechanically or by rain, shall be subject to high losses by nitrogen volatilization [8]. Urea is the soil surface hydrolytic degradation by the enzyme urease to ammonium carbonate, which is then converted to carbon dioxide and ammonia [9].

Fertilizer UREA stabil works on a temporary blockage of urease inhibitor. A thanks to this accelerates the penetration of nitrogen in the root zone, and it ensures its better availability of nitrogen to the plants. This procedure eliminates the slow effect of urea and is secured faster effect of applied nitrogen. Urease inhibitor eliminates losses of nitrogen by ammonia to the atmosphere.

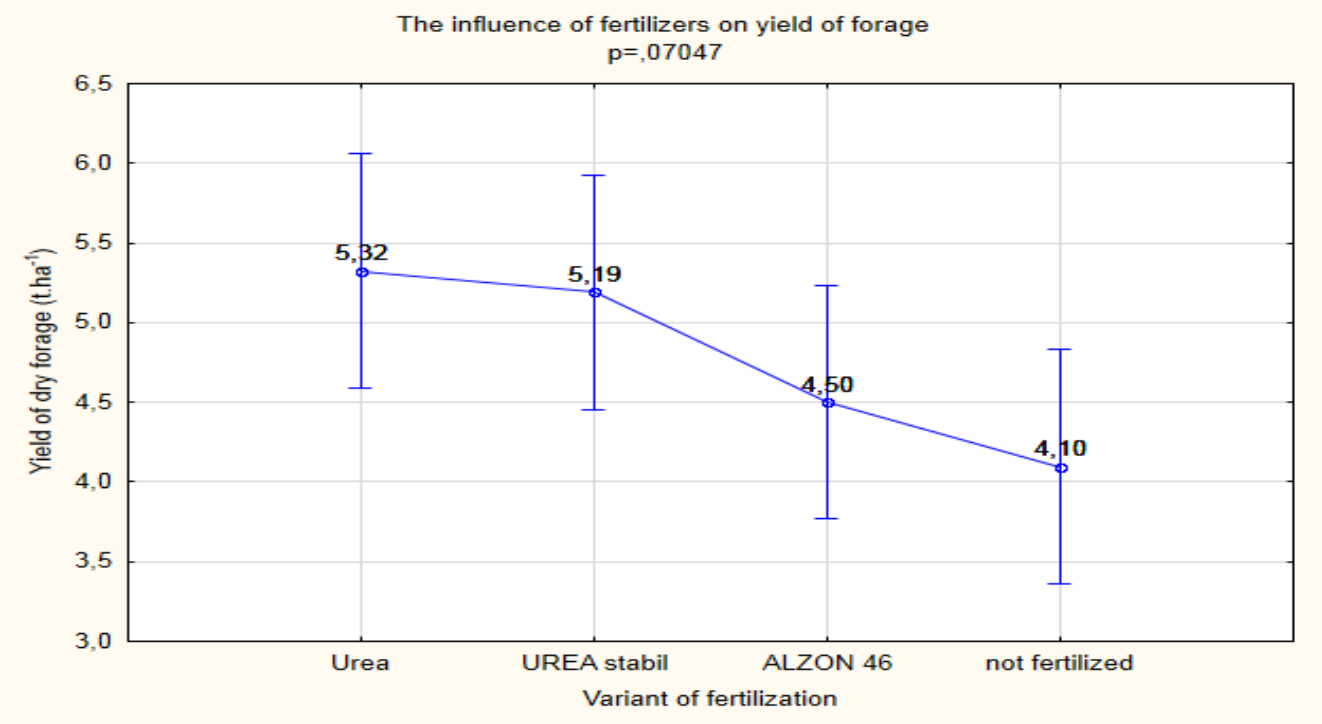
Nitrification inhibitor in fertilizer ALZON 46 slows the conversion of stable ammonium nitrogen on the moving form of nitrate nitrogen, thus allowing better utilization of delivered nutrients and reduces doses of nitrogen by 20%, while maintaining stable yields [7].

The experiment was focus on the primary production. To evaluate the effect of fertilization on the yield was used statistical program Statistica.

Results and Discussion

According to Watson [10] is interested in stabilized nitrogen fertilizers, because of their potential to reduce nitrogen losses to the environment and increase crop yields. With time after application of nitrification inhibitors to the soil, they are degraded. Their influence on yields can be quite variable depending on the crop, soil properties, climatic factors and type of management. Exactly their rate of degradation increases with increasing soil temperature, pH, moisture content and soil organic matter. With temperature below five degrees nitrification inhibitors can be effective up to six months. In case at temperature up to twenty five degrees the inhibitory effect only lasts for a few weeks. With increasing soil moisture nitrification inhibitors are generally less effective. They become unstable and hydrolyse.

Fig. 3 The influence of type of nitrogen fertilizers on the yield of dry forage



The temperature in April and May 2014 was normal, but the precipitation was very unbalanced. After fertilization in April started raining and precipitation in May were more than 140 mm. So not just urea, but the stabilized fertilizers too, could be dissolved earlier than the growth took the nutrients. It could be one of the reasons, why the effect of fertilization on yield of dry forage wasn´t statistically significant (see Fig. 3). Despite the fact that yield of dry forage increase with the doses of nutrients. The highest yield had plots with a one-shot dose (100 $kg.ha^{-1}$) of Urea (5.32 $t.ha^{-1}$). The lowest yield was at: not fertilized plots (4.10 $t.ha^{-1}$). UREA stabil had a higher yield than ALZON 46.

Henning et al. [11], examined the use of stabilized fertilizer on grass species: *Poa pratensis* L. and *Lolium perenne* L. Was concluded that urease inhibitor and nitrification inhibitor in comparison with urea don´t change production, color or quality of the grass species. Even though the efficacy of inhibitors was demonstrated in laboratory and for a number of crops. Likewise other research [12] show that influence of nitrification and urease inhibitors on crop yield is variable, depending on environmental conditions and management of care. Urease inhibitor in alkaline soils showed the highest results. However, the experiment in Kameničky soil has got pH 4.5.

Conclusion

The results don´t support theory about the stabilized fertilizers that slow release of nitrogen making it available for plants continually, because of it increase crop yields. The effect of fertilization on yield of dry forage wasn´t statistically significant. Main reason could be unbalanced precipitation in May (more than 140 mm). Stabilized fertilizers could be dissolved earlier than the growth took the nutrients. Generally are stabilized fertilizers less effective with increasing soil moisture. Urea (100 $kg.ha^{-1}$) had the highest yield (5.32 $t.ha^{-1}$). Not fertilized plots had the lowest yield (4.10 $t.ha^{-1}$).

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