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THE DYNAMICS OF THE DRY MATTER PRODUCTION AS A RESULT OF THE MINERAL FERTILIZERS APPLICATION IN A HAYFIELD FROM BISTRICIOARA BASIN

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Abstract

The cycle of the nutritive elements between soil, plant and animal within a grassland is particularly important because the animals are relying especially on the grassland vegetation to assure their food necessary. The nutritive elements can be introduced into the system through the atmosphere or through organic and mineral fertilization and wasted from the system by washing or volatilization out of the soil (Underwood E.J. and Suttle N.F., 1999; Whitehead D.C., 2000).

The paper has as goal to investigate the plant growth and the productivity of the grassland from Tulgheş, Harghita County, which is affected by the bio-availability of the applied nutritive elements: nitrogen phosphorous and potassium. In the course of the experimental years, it can be observed that the plants response concerning the dry matter production in the case of nitrogen fertilization is very variable. A significant response can be also observed in the case of phosphorous application which, in addition to the nitrogen determines an important increasing of the dry matter production.

The application of the mixed NPK fertilizers determines increasing of the dry matter production but this is inferior to the variant V16 (N100+P100), the K supply determining insignificant increasing of the production.

Key words: grassland, dry matter production, mineral fertilizers.

INTRODUCTION

Grasslands occupy a very important place in the agricultural landscape. Compared with the annual cultures, it constitutes a particular agroecosystem characterized by the complexity and originality of its cycle of mineral elements (Stroia C., 2007).

When the grasslands are managed by intensive system, there are applied fertilizers with N, P and/or K, with the purpose to increase the production and to replace the losses of these elements caused by their export with the harvest (Parfitt R.L., *et al*., 2005; Aerts, R. and Chapin F.S., 2000; Loiseau, P. *et al*., 2001).

The availability for plants of the organic phosphorous in the soil depends very much on the mineralization ratio, and on the other hand on the balance between mineralization and immobilization, the mineralization rate being influenced by the factors which affect the microbial activity (temperature, humidity, aeration and pH) (Morton *et al*., 1999, Whitehead D.C., 2000).

The quantity of P taken by plants depends on the phosphorous concentration in the soil solution in the neighborhood of the roots and on the migration percentage of the ions toward the root (Barber S. A., 1984; Frossard et al., 1995).

The potassium has an important role in plant, because it assures the closing and opening of the stomata by influencing the osmotic potential and the inflexibility of the defensive cells. The opening takes place as response to the osmotic potential increasing of the defensive cells, because of the temporary accumulation of K together with Cl. The potassium is involved in the transportation of the photosynthesis substances from leaves and also it is an activator of a great number of enzymes, including several enzymes involved in the protein synthesis (Blevins D.G., 1994).

MATERIAL AND METHOD

The experiences were made in a grassland (used as hayfield) placed in Tulgheş locality, Harghita County. The pedogenetical factors present particularities specific to the zone (700 m altitude).

Within the paper there is followed the role of the mineral fertilization in interaction with the existing pedological conditions on the biomass production and on the dry matter accumulation. The fertilization variants were: V_1-control, V_{14}-$N_{100,}$ V_{15}-N_{100} + $P_{50,}$ V_{16}-N_{100} + $P_{100,}$ V_{17}-$N_{200,}$ V_{18}-N_{200} + $P_{50,}$ V_{19}-N_{200} + $P_{100,}$ V_{20}-N_{100} + P_{50}+ $K_{50,}$ V_{21}-N_{100}+ P_{100}+ $K_{50.}$

The fertilization with mineral fertilizers with phosphorous and potassium was made in autumn, after what plant growth stopped, and the nitrogen fertilization was made in the spring, at the beginning of the vegetation cycle.

The experimental blocks were arranged as balanced grid type 5*5 using 3 replicates, in this paper being presented only a part of them.

There were determined the quantity of green mass and dry matter. The dry matter was determined by putting the harvested biomass in the oven (*BINDER*) at 80 °C for de 48 hours, after what the weighing was made.

For statistical processing we used the soft *STATGRAPHICS plus* (2000). The performed testes were: analysis of the variance (ANOVA) depending on several factors, analysis of the variance (ANOVA) depending on a single factor and the test of comparison of two samples.

RESULTS AND DISCUSSION

In the Figure 1 (2007) it can be observed that for the first mowing the dry matter productions are ranging between 1.10 ± 0.04 t ha^{-1} in the control variant (V1) and it is 2.63 ± 0.08 t ha^{-1} in V21 ($N_{100} + P_{100} + K_{50}$). In the variants with mineral fertilization it can be remarked that the dry matter production (SU) in the variant V14 (N_{100}) in amount of 1.60 ± 0.08 t ha^{-1} is inferior compared to the another variants. Not the same thing it can be said about the variant V17 (N_{200}) where the recorded dry matter production (1.80 ± 0.07 t ha^{-1}) is superior to those productions obtained in V16 ($N_{100} + P_{100}$) and in V18 ($N_{200} + P_{50}$) in amount of 1.75 ±0.13 t ha^{-1} and respectively 1.78 ±0.16 t ha^{-1}.

Although the dry matter productions obtained in each fertilization variant were much larger than in the control, the test of variance for multiple factors shows that these differences are not significant ($P>0.05$) regardless the factor (different doses of NPK) which actions on the dry matter production.

For the second mowing, the obtained dry matter productions were 0.32 ± 0.00 t ha^{-1} for V1 (control) and 0.85 ± 0.09 t ha^{-1} for V21 (N_{100}+ P_{100}+ K_{50}). This time too, the dry matter production obtained in V17 (N_{200}) in amount of 0.69 ± 0.01 t ha^{-1} is superior to those productions obtained in V16 ($N_{100} + P_{100}$) and in V18 ($N_{200} + P_{50}$) in amount of 0.65 ± 0.01 t ha^{-1} and respectively 0.55 ±0.09 t ha^{-1}. The test of variance for multiple factors shows that only a single factor is significant ($P<0.05$), namely the dose of N_{100}.

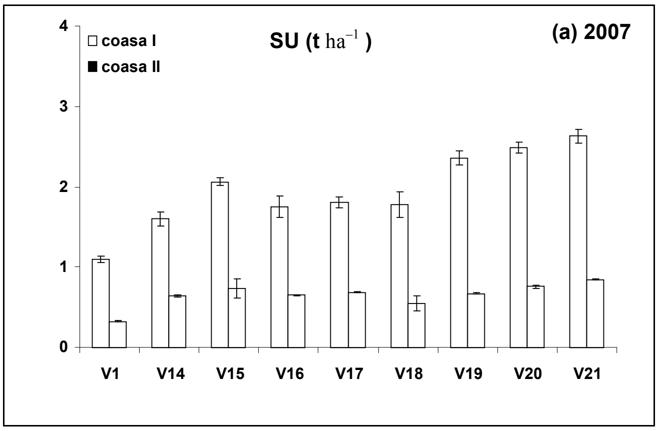

Fig. 1. The dry matter production (mowing I and II) for mineral fertilization (2007)

In the Figure 2 (2008) it can be observed that the dry matter productions for the first mowing are 0.87 ±0.07 t ha^{-1} in the control variant and 3.43 ± 0.07 t ha^{-1} in variant V21 (N_{100} + P_{100} + K_{50}). The mineral fertilization assures production gains ranging from 1.28 t ha^{-1} to 2.55 t ha^{-1}. The statistical test shows that these production differences are significant only in the case of nitrogen (*P<0.01*) and phosphorous application (*P<0.*05 for a dose of 50 kg P ha^{-1}; *P<0.01* for a dose of 100 kg P ha^{-1}), but not in the case when K is applied (*P>0.05*).

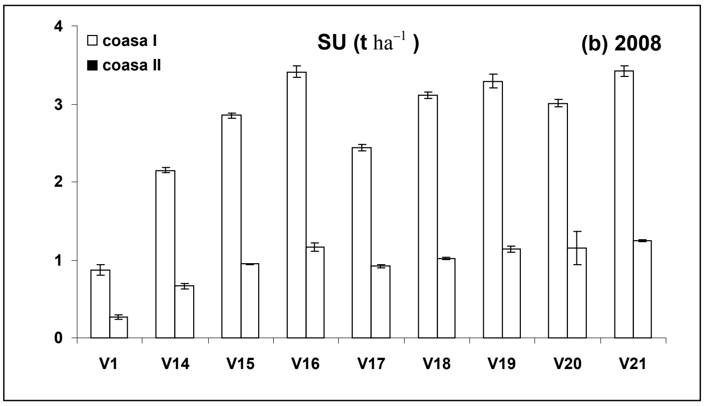

Fig. 2. The dry matter production (mowing I and II) for mineral fertilization (2008)

For the second mowing, the dry matter productions were 0.27 ± 0.03 t ha^{-1} (control) and 1.25 ± 0.01 t ha^{-1} in V12. Neither for the second mowing the variant with 200 kg N ha^{-1} (V17) is not efficient, in this variant being registered a production of only 0.92 ± 0.02 t ha^{-1}. For this mowing too, the mineral fertilization assures production increasing ranging from 0.39 t ha^{-1} to 0.97 t ha^{-1}. However, the statistical test shows that these production differences are significant (*P<0.05*) only for N application and P dose of 100 kg P ha^{-1}.

In the year of 2009 (Figure 3) it can be observed that for the first mowing the dry matter productions are 0.82 ± 0.08 t ha^{-1} in the control variant (V1) and 3.83 ± 0.09 t ha^{-1} in V16 (N_{100} + P_{100}), and in third year the production gains are ranging between 1.47 and 3.01 t ha^{-1}. Comparing the dry matter productions obtained in each variant of fertilization, the statistical test shows that nitrogen and phosphorous significantly influence the production: for N_{100} – *P<0.05*, for N_{200} – *P<0.01*, for P_{50} – *P<0.05* and for P_{100} – *P<0.01*, while the K application is not significantly influencing the dry matter production. For the second mowing the obtained dry matter productions were 0.26 ± 0.03 t ha^{-1} in the control variant (V1) and 1.35 ± 0.01 t ha^{-1} in V21 (N_{100}+ P_{100}+ K_{50}). The test of variance for multiple factors shows that for the second mowing there are three factors which determine significant production differences, namely: N_{100} – *P<0.05*, N_{200} –

$P<0.05$ and P_{100} – $P<0.05$, while the doses P_{50} and K_{50} are not significantly influencing the productions obtained at the second mowing.

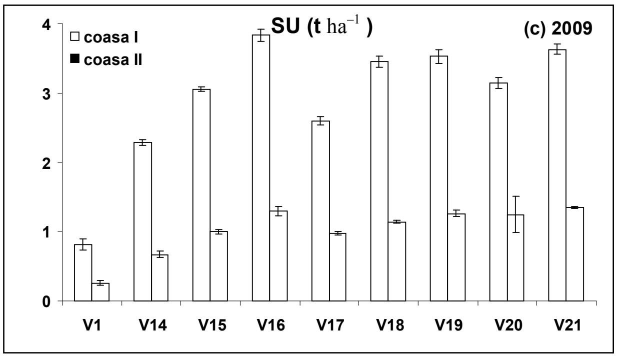

Fig. 3. The dry matter production (mowing I and II) for mineral fertilization (2009)

The production differences between all three experimental years are statistically different both for the first mowing (*P<0.05*) and for the second mowing (*P<0.05*).

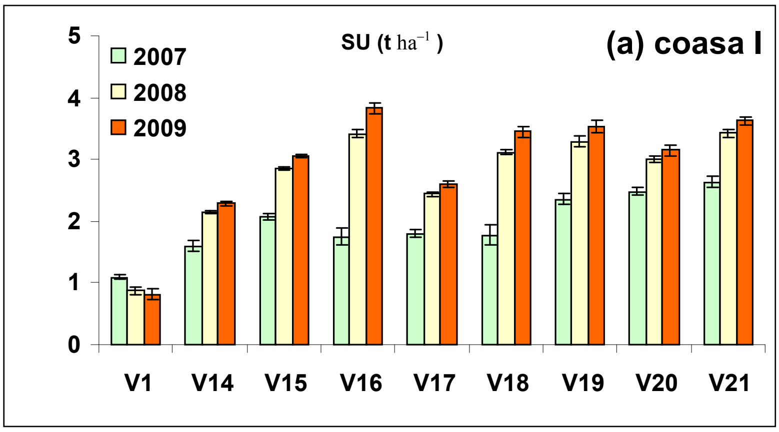

Fig. 4. The dry matter production for mineral fertilization (comparisons between the three experimental years for the first mowing)

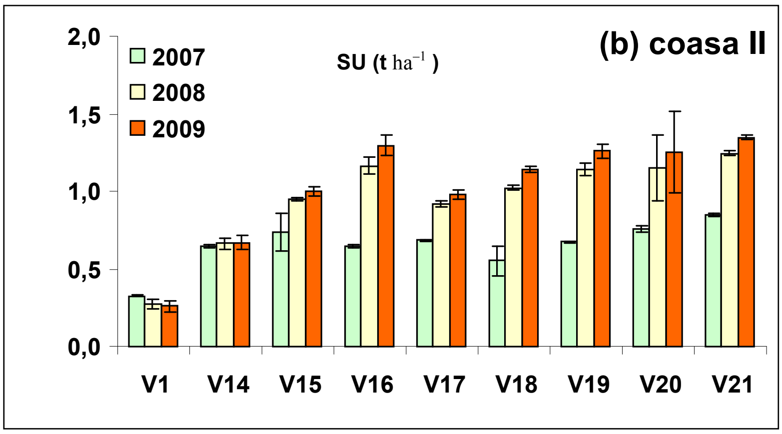

Fig. 5. The dry matter production for mineral fertilization (comparisons between the three experimental years for the second mowing)

Even from the first year (figures 4 and 5) it can be noticed that the application of the fertilizers positively stimulated the dry matter production, the largest gains being recorded in the variants where the three nutritive elements were applied.

In the case of application of an equilibrated dose of N and P (V14, N100 + P100), it was found that the dry matter productions in the last years of experimentation are superior to those registered in the other fertilization variants. Eliott D.E., Abbott R.J., (2003) showed that fertilization, especially that with N and P, can lead to an increasing of the dry matter production until two or three times, depending on the precipitation conditions.

CONCLUSIONS

During the experimental years it can be observed that the response of plants concerning the dry matter production in condition of nitrogen fertilization is high variable.

Phosphorous in addition with nitrogen determine an important increasing of the dry matter production.

The application of the mixed fertilizers with NPK determines an increasing of dry matter production, but this is inferior to that obtained in the variant V16 (N100+P100), the K supplying determining insignificant increasing of the production.

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