OPTIMIZATION OF CHEMICAL FERTILIZERS APPLICATION AT ALOPECURUS PRATENSIS L., IN BANATPLAIN CONDITIONS

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Abstract – Optimization of chemical fertilizers application at *Alopecurus pratensis L.*, in Banatplain conditions
Application of the fertilizers contributes to the enlargement of the biomass quantity and thus any effort is justified for the fodder plants where is aimed to obtain fodder volume (COJOCARIU L. ET AL., 2010).
The goal of this paper is to find a functional dependence of the dry matter production for the *Alopecurus pratensis* fodder based on different amounts of fertilizer, in order to obtain the technical optimum and also depending on the cultivation technology that is applied.
As biological material we used the variety Alpha of meadow foxtail, seeded in autumn at 12,5 cm and 25 cm distances between rows, by scattering method.
In the paper there are presented the results obtained in the species *Alopecurus pratensis*, cultivated at different distances between rows and fertilized with different doses of nitrogen. The largest yields of dry matter were recorded in all variants for the maximal dose of nitrogen (240 kg ha). However, the technical maximum of dry matter was recorded as following: 8219 kg ha^{-1} for an amount of 214,65 kg ha^{-1} nitrogen and for 12,5 cm distance between rows; 8091,8 kg ha^{-1} for an amount of 216,25 kg ha^{-1} nitrogen and for 25 cm distance between rows, and 8746 kg ha^{-1} for an amount of 208,29 kg ha^{-1} nitrogen and for sowing by scattering.
Keywords: *Alopecurus pratensis* L., nitrogen fertilizer, yield, dry matter.

INTRODUCTION

Selection of a type of fodder plant for each ecological zone is essential to realize superior fodder productions for different species of animals (MOGA ET AL., 1983).
The extension of the species *Alopecurus pratensis* in cultivation is by major importance, both regarding the fodder productions, the quality of the obtained fodder, and because it has a high capacity of adaptation to the environmental conditions, having the capacity to resist in the short drought periods and in the humidity excess existing in the meadows, when the field is saturated (HANNAWAY, D.B. AND MCGUIRE, W.S., 1981; ROGER L. S., 2007).
Fertilization with chemical fertilizers in fodder graminaceous is beneficial, so that the meadow foxtail significantly responses to the nitrogen fertilizers, where the dry matter productions can reach significant values (BOHNERT D. ET AL., 2009).

MATERIAL AND METHOD

The experiments were carried out at the Didactic and Experimental Station of the University of Agricultural Sciences and Veterinary Medicine of Banat from Timişoara.
The location of the territory is in West Plain of Romania, and the soil on which the

experiments were placed is a cambic chernozem.
The evolution of the climatic resources within the period 2009-2010 highlights the oscillatory character of them, with notable deviations comparing to the multiannual mean value.

Table 1. The monthly mean temperatures (°C) registered at Meteorological Station of Timişoara (2009-2010)

SPECIFICATION	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2009	-1,1	1,4	6,6	14,7	18,0	20,1	23,1	22,9	19,0	11,6	7,3	3,2
2010	-0,3	2,8	6,7	12,0	16,6	20,5	23,1	22,5	16,2	9,2	9,3	0,7
Multi-annual means	-1,2	0,4	6,0	11,3	16,4	19,6	21,6	20,8	16,9	11,3	5,7	1,4

The temperatures recorded in the air and soil had high values. The monthly means of the air temperature exceeded the multiannual means, the mean temperature being over the multiannual mean (*Table 1*.). The precipitations fallen during the year of 2009 were fewer than in 2010, when the more abundant precipitations favoured the growth and the development of the meadow foxtail plants (*Table 2*.).

Table 2. The monthly mean precipitations (mm) registered at Meteorological Station of Timişoara (2009-2010)

SPECIFICATION	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2009	28,3	25,4	48,2	22,8	44,8	110,9	40,4	28,4	4,8	80,4	102,1	79,4
2010	65,0	76,5	32,9	56,6	118	131,3	25,0	81,8	40,5	40,0	48,1	74,6
Multi-annual means	40,9	40,2	41,6	50,0	66,7	81,1	59,9	52,2	46,1	54,8	48,6	47,8

The biological material used during the two research years was the species *Alopecurus pratensis*, the variety Alpha. The culture was established every year, in autumn, in October, at 12,5cm and 25 cm distances between rows and by scattering sowing. The arrangement of the variants was in subdivided plots.
The fodder culture was fertilized with different doses of nitrogen fertilizer fractionally applied, namely: Doze 1- 60kg ha, Doze 2- 120kg ha, Doze 3- 180kg ha and Doze 4- 240kg ha.
In the paper there was analyzed the average of the dry matter yields recorded within two experimental years (2009-2010), in the meadow foxtail plants harvested in the moment of ear formation.
The production results were statistically processed. In numerous situations, the dependence between the effect and the cause is not possible to be linearly expressed, because each cause increase (fertilizer doses) is followed by a different increase of the effect (dry matter production). The effect of the fertilizers is greater for the first applied amounts and becomes lower for equal increases of the fertilizer.
For the sake of simplicity, in our statistical analysis, the quantity of nitrogen, the mean production of dry matter for *Alopecurus pratensis* under the influence of the nitrogen for 12,5cm, 25cm distance between rows respectively sowing by scattering were denoted by Azot, R12,5, R25, and Imp. respectively. The statistical analysis has been performed by STATISTICA 8 package .

RESULTS

During the period 2009 respectively 2010 there was organized an experimental field which aimed to determine the production potential of the specie *Alopecurus pratensis*, being pursued the reaction of these plants at different doses of nitrogen fertilizer.
The minimal production of dry matter (6294 kg ha^{-1}) was recorded in the unfertilized variant for 25 cm distance between rows, and the maximal production by 8714 kg ha^{-1} was recorded in the variant fertilized with 240 kg ha^{-1} by scattering sowing.
The goal of this paper is to find a functional dependence of the dry matter production of *Alopecurus pratensis* based on different quantities of nitrogen in order to get the technical optimum.
The following statistical analysis established the technical maximum of dry matter production of *Alopecurus pratensis* when different doses of nitrogen were applied.
A parabolic regression analysis of the *Alopecurus pratensis* dry matter production based on different quantities of nitrogen and a 12,5 cm distance between rows was performed (*Figure 1*). It was determined that the proportion of variance (46031731) was statistically significant (F=31325, df=1) for p value under 0,05 (95% confidence interval), where the F ratio provided the test of statistically significance (*Table 3*.).

Table 3. Significance tests of regression coefficients of *Alopecurus pratensis* based on nitrogen and 12,5cm

Effect	Univariate Tests of Significance for R12,5				
	SS	Degr. of Freedom	MS	F	p
Intercept	46031731	1	46031731	31325,67	0,000032
Azot	845613	1	845613	575,46	0,001733
Azot^2	286858	1	286858	195,21	0,005084
Error	2939	2	1469		

The regression equation $y=b_0+b_1x+b_2x^2$ was used to fit the best parabolic line to the data (*Figure 1*.). Thus the average dry matter production obtained under the above circumstances for *Alopecurus pratensis* in the experimental years, was expressed in terms of doses of nitrogen applied by the equation

$$R12,5 = 6385,2143 + 17,0862*Nitrogen - 0,0398*Nitrogen^2 .$$

The strong positive linear correlation, after the linearization, was reported by the Pearson coefficient r=+0,99 and determination coefficient r^2=0,9. The confidence intervals for the parabolic regression coefficients [6229,989; 6540,439], [14,022 ; 20,151] and [-0,052; -0,028] respectively were statistically significant. The maximum dry matter production of *Alopecurus pratensis* was estimated to 8219 kg ha^{-1} for an amount of 214,65 kg ha^{-1} nitrogen. This maximum (*Figure 1*.) was obtained as the local extremum of the quadratic function above and it was calculated by the vanishing of its first derivative.

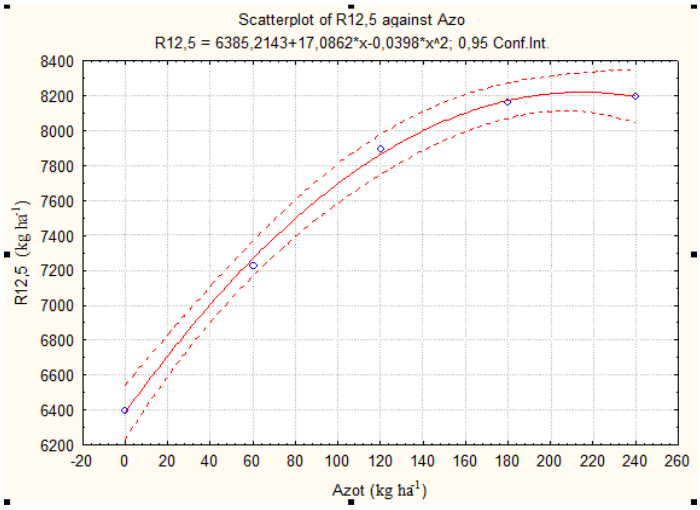

Figure 1: The effect of the nitrogen on the dry matter production in *Alopecurus pratensis* (12,5 cm)

In the following it was performed a parabolic regression analysis of the *Alopecurus pratensis* production based on different nitrogen quantities and a 25 cm distance between rows (*Figure 2.*). It was determined that the proportion of variance (44622084) was statistically significant (F=13870, df=1) for p value under 0,05 (95% confidence interval), where the F ratio provided the test of statistically significance (*Table 4.*).

Table 4. Significance tests of regression coefficients of *Alopecurus pratensis* based on nitrogen and 25 cm

	Univariate Tests of Significance for R25				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept	44622084	1	44622084	13870,90	0,000072
Azot	807301	1	807301	250,95	0,003961
Azot^2	270911	1	270911	84,21	0,011667
Error	6434	2	3217		

The regression equation $y=b_0+b_1x+b_2x^2$ was used to fit the best parabolic line to the data (*Figure 2.*). So the average dry matter production obtained under the above circumstances for *Alopecurus pratensis* in the experimental years, was expressed in terms of doses of applied nitrogen by the equation

$$R25= 6286,6857+ 16,6946*Nitrogen - 0,0386*Nitrogen^2.$$

The strong positive linear correlation, after the linearization, was reported by the Pearson coefficient r=+0,99 and determination coefficient r^2=0,99. The confidence intervals for the parabolic regression coefficients [6057,015;6516,357], [12,160; 21,229] and [-0,057; -0,021] respectively were statistically significant. The maximum dry matter production of *Alopecurus pratensis* was estimated to 8091,8 kg ha^{-1} for an amount of 216,25 kg ha^{-1} nitrogen. This maximum (*Figure 2.*) was obtained as the local extremum of the quadratic function above and it was calculated by the vanishing of its first derivative.

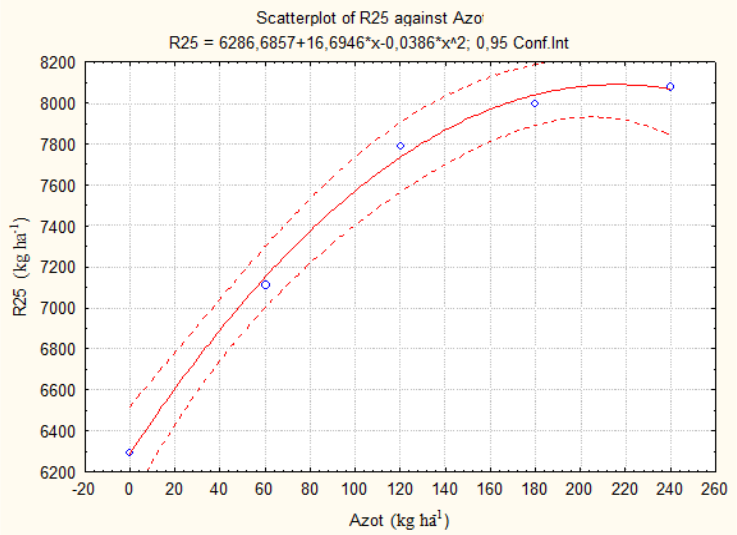

Figure 2. The effect of the nitrogen on the dry matter production in *Alopecurus pratensis* (25 cm)

A parabolic regression analysis of the *Alopecurus pratensis* dry matter production based on different quantities of nitrogen and the sowing by scattering was also performed (*Table 5.*). It was determined that the proportion of variance in production (55162600) was statistically significant (F=73002, df=1) for p value under 0,05 (95% confidence interval), where the F ratio provided the test of statistically significance.

Table 5. Significance tests of regression coefficients of *Alopecurus pratensis* based on nitrogen and Imp

	Univariate Tests of Significance for Imp				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept	55162600	1	55162600	73002,27	0,000014
Azot	824524	1	824524	1091,18	0,000915
Azot^2	298278	1	298278	394,74	0,002524
Error	1511	2	756		

The regression equation $y=b_0+b_1x+b_2x^2$ was used to fit the best parabolic line to the data (*Figure 3.*). The average dry matter production obtained under the above circumstances for *Alopecurus pratensis* in the experimental years, was expressed in terms of doses of applied nitrogen by the equation

$$Imp = 6989,8714 + 16,8718*Nitrogen - 0,0405*Nitrogen^2.$$

After the linearization, the strong positive linear correlation was reported by the Pearson coefficient r=+0,99 and determination coefficient r^2=0,99. The confidence intervals for the parabolic regression coefficients were [6878,561; 7101,182], [14,674;19,069] and [-0,049; -0,032] respectively. The maximum dry matter production of *Alopecurus pratensis* was estimated to 8746 kg ha^{-1} for an amount of 208,29 kg ha^{-1} nitrogen. This maximum (*Figure 3.*) was obtained as the local extremum of the quadratic function above and it was calculated by the vanishing of its first derivative.

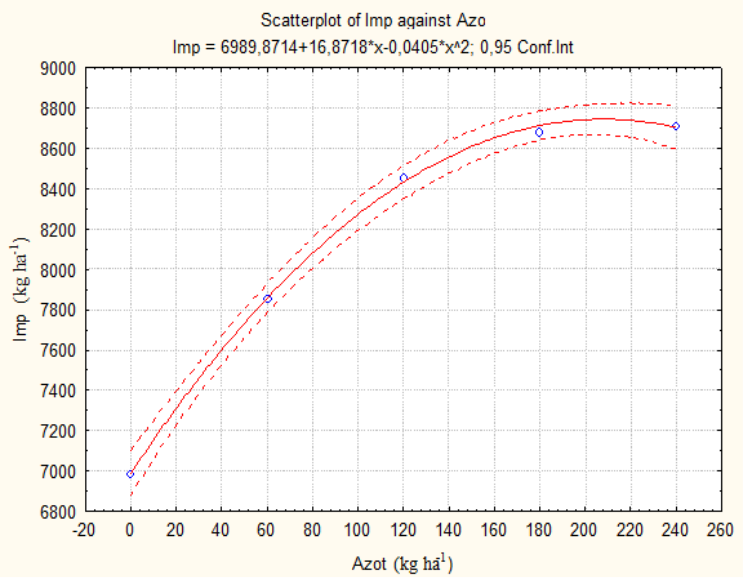

Figure 3. The effect of the nitrogen on the dry matter production in *Alopecurus pratensis* (Imp)

CONCLUSIONS

The production results recorded in *Alopecurus pratensis* depending on different nitrogen doses and different methods of sowing can be resumed as following:

By this study we obtained mathematical models regarding the functional dependency (quadratic functions) of the dry matter production in *Alopecurus pratensis* depending on the applied dose of nitrogen.

The maximum dry matter production of *Alopecurus pratensis* was estimated: to 8219 kg ha^{-1} for an amount of 214,65 kg ha^{-1} nitrogen and for 12,5cm distance between rows; to 8091,8 kg ha^{-1} for an amount of 216,25 kg ha^{-1} nitrogen and for 25cm distance between rows, and to 8746 kg ha^{-1} for an amount of 208,29 kg ha^{-1} nitrogen and for sowing by scattering.

The application of a larger dose is not justified. Whether we apply a smaller dose of nitrogen we could estimate the production that will be obtained.

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