OPTIMIZATION OF *ALOPECURUS PRATENSIS* L. PRODUCTION UNDER THE INFLUENCE OF CATTLE MANURE, IN BANAT PLAIN CONDITIONS

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Abstract: *The fodder graminaceous generally highly valuate the organic fertilizers, the fertilizer doses being proportional with production level.The cattle manure is a valuable source of nutritive elements for the meadow foxtail cultures because contains all major nutrients that this specie necessitates and also an important number of essential micronutrients (http://www.ssca.ca /agronomics/). There is estimated that fertilizing with cattle manure, the production gains of the specie Alopecurus pratensis L. are significant (Jankowska-Huflejt H., 2000; Wesolowski P., 2001). The performed research concerning the dry matter production of the meadow foxtail takes into account the specie behaviour when were applied different amounts of cattle fertilizer. The goal of this paper is to find a functional dependence of the dry fodder production of the specie Alopecurus pratensis based on different amounts of fertilizer, with the purpose to obtain the technical optimum and also depending on applied technology. The biological material was the variety Alpha of meadow foxtail, seeded in each autumn of the years 2009 and respectively 2010, at distance between rows by 12,5 cm, 25 cm and by scattering method. The present paper presents the obtained results in the specie Alopecurus pratensis, cultivated at different distances between rows and fertilized with different doses of cattle manure (Doze 1- 20t ha, Doze 2- 40t ha, Doze 3- 60t ha and Doze 4- 80t ha). The largest dry matter production were found in all variants for the maximal dose of cattle manure (80 t ha). However, the technical maximum of dry matter was as following: to 7784,3 kg ha^{-1} for an amount of 68,98 t ha^{-1} cattle manure and for 12,5cm distance between rows; to 7688,9 kg ha^{-1} for an amount of 69,29 t ha^{-1} cattle manure and for 25cm distance between rows, and to 8438,8 kg ha^{-1} for an amount of 71,97 t ha^{-1} cattle manure and for sowing by scattering.*

Key words**:** *Alopecurus pratensis L., cattle manure, yield, dry matter.*

INTRODUCTION

To obtain good and superiorly qualitative vegetal productions is necessary to use improving measures. Among these, the fertilization has a decisive role on production and quality of the fodder plants (MOISUC A. et al, 2008).

The fodder graminaceous generally highly valuate the organic fertilizers, the fertilizer doses being proportional with production level.

Due to their complex, improving role, exerted on physical, chemical and trophic characteristics of soils, the usage of organic, natural fertilizers determines important production increases of the fodder cultures.

The cattle manure is a valuable source of nutritive elements for the meadow foxtail cultures because contains all major nutrients that this specie necessitates and also an important number of essential micronutrients (http://www.ssca.ca/agronomics/).

There is estimated that fertilizing with cattle manure, the production gains of the specie *Alopecurus pratensis* L. are significant (JANKOWSKA-HUFLEJT H., 2000; WESOLOWSKI P., 2001).

MATERIAL AND METHODS

The experiments were performed in the experimental field of the discipline of Meadow and forage plant cultivation from the Experimental Didactic Station of the

U.S.A.M.V.B. Timisoara. The soil where the experiments had been placed is a cambic chernozem.

The evolution of climatic resources within the period 2009-2010 distinguishes their oscillatory character, with notable deviations from the multi-annual mean value.

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 (see 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 (see table 2).

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

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 within the two research years was the specie *Alopecurus pratensis*, variety Alpha. The culture was settled each year, in autumn, in October, at 12,5cm and 25 cm distance between rows, by scattering sowing. Disposition of the experiences was in subdivided plots.

The fodder culture was fertilized with different doses of cattle manure, namely: Doze 1- 20t ha, Doze 2- 40t ha, Doze 3- 60t ha and Doze 4- 80t ha.

In the paper we analyzed the mean of the dry matter yield recorded within the two experimental years (2009-2010) in the meadow foxtail, harvested in the ear formation period.

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 (cattle manure 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 cattle manure, the mean production of dry matter for *Alopecurus pratensis* under the influence of the cattle manure for 12,5cm, 25cm distance between rows respectively sowing by scattering were denoted by Manure, Prod12,5, Prod25, and ProdImp. respectively. The statistical analysis has been performed by STATISTICA 8 package (PETERSEN R.G., 1994 ; MEAD R. et al., 2002). .

RESULTS AND DISCUSSIONS

The minimal production of dry matter recorded in the meadow foxtail culture in the two researched years was 6294 kg ha^{-1} in the unfertilized variant, at 25 cm distance between rows, and the maximal production was 8432 kg ha^{-1} in the variant fertilized with 80 t ha^{-1} cattle manure sowed by scattering.

The goal of this paper is to find a functional dependence of the dry matter production

of *Alopecurus pratensis* based on different quantities of cattle manure 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 cattle manure were applied.

A parabolic regression analysis of the *Alopecurus pratensis* dry matter production based on different quantities of cattle manure and a 12,5 cm distance between rows was performed (see Figure 1). It was determined that the proportion of variance (46606121) was statistically significant (F=14957, df=1) for p value under 0,05 (95% confidence interval), where the F ratio provided the test of statistically significance (see Table 3).

Table 3

Significance tests of regression coefficients of *Alopecurus pratensis* based on cattle manure and 12,5cm

	Univariate Tests of Significance for Prod12,5				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept	46606121	1	46606121	14957,86	0,000067
Cattle Manure	500045	1	500045	160,49	0,006173
Cattle Manure^2	182857	1	182857	58,69	0,016616
Error	6232	2	3116		

The regression equation $y=b_0+b_1x+b_2x^2$ was used to fit the best parabolic line to the data (see 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 cattle manure applied by the equation

$$\text{Prod12,5} = 6424,9286 + 39,4171*\text{Manure} - 0,2857*\text{Manure}^2 .$$

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 [6198,897; 6650,961], [26,030; 52,805] and [-0,446; -0,125] respectively were statistically significant. The maximum dry matter production of *Alopecurus pratensis* was estimated to 7784,3 kg ha^{-1} for an amount of 68,98 t ha^{-1} cattle manure. This maximum (see Figure 1) was obtained as the local extremum of the quadratic function above and it was calculated by the vanishing of its first derivative.

It was performed a parabolic regression analysis of the *Alopecurus pratensis* production based on different cattle manure quantities and a 25 cm distance between rows (see Figure 2). It was determined that the proportion of variance (45079338) was statistically significant (F=14417, df=1) for p value under 0,05 (95% confidence interval), where the F ratio provided the test of statistically significance (see Table 4).

The regression equation $y=b_0+b_1x+b_2x^2$ was used to fit the best parabolic line to the data (see 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 applied doses of cattle manure by the equation.

$$\text{Prod25} = 6318,8143 + 39,5486*\text{Manure} - 0,2854*\text{Manure}^2.$$

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 [6092,390; 6545,239], [26,138; 52,959] and [-0,446; 0,125] respectively were statistically significant. The maximum dry matter production of *Alopecurus pratensis* was estimated to 7688,9 kg ha^{-1} for an amount of 69,29 t ha^{-1} cattle manure. This maximum (see Figure 2) was obtained as the local extremum of the quadratic function above and it was calculated by the vanishing of its first derivative.

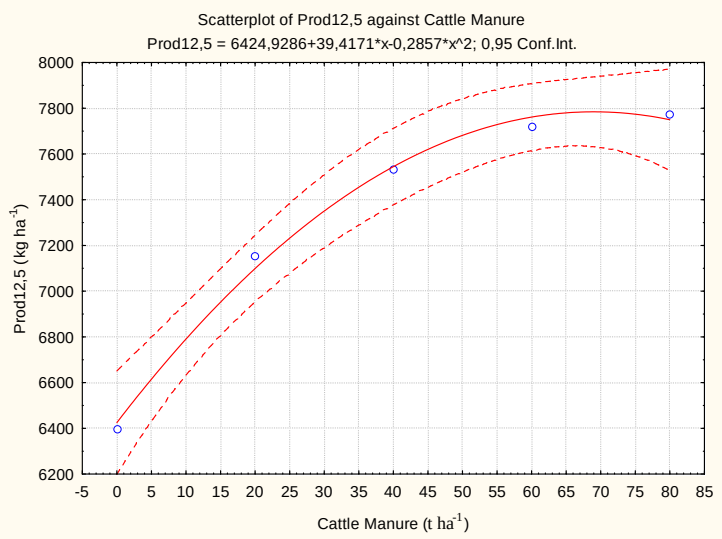

Figure 1: The effect of the cattle manure on the dry matter production in *Alopecurus pratensis* (12,5 cm)

Table 4

Significance tests of regression coefficients of *Alopecurus pratensis* based on cattle manure and 25 cm

	Univariate Tests of Significance for Prod25				
Effect	SS	Degr. of Freedom	MS	F	p
Intercept	45079338	1	45079338	14417,74	0,000069
Cattle Manure	503385	1	503385	161,00	0,006154
Cattle Manure^2	182400	1	182400	58,34	0,016713
Error	6253	2	3127		

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 (see Table 5). It was determined that the proportion of variance in production (55248315) was statistically significant (F=94377, df=1) for p value under 0,05 (95% confidence interval), where the F ratio provided the test of statistically significance.

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

$$ProdImp = 6989,8714 + 16,8718*Manure - 0,0405*Manure^2.$$

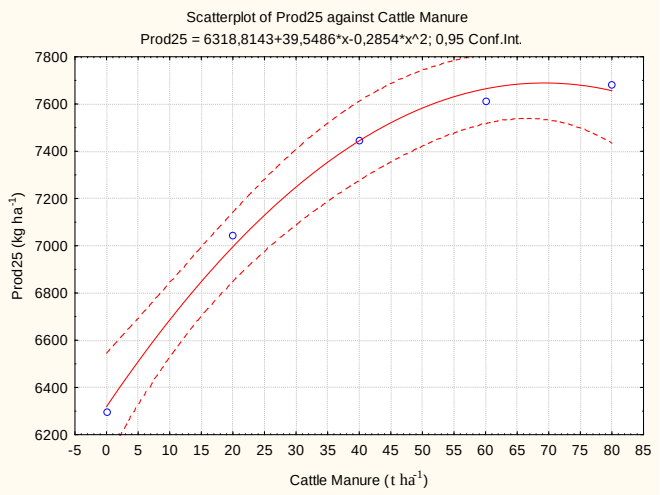

Figure 2: The effect of the cattle manure on the dry matter production in *Alopecurus pratensis* (25 cm)

Table 5

Significance tests of regression coefficients of *Alopecurus pratensis* based on cattle manure and sowing by scattering

Effect	Univariate Tests of Significance for ProdImp				
	SS	Degr. of Freedom	MS	F	p
Intercept	55248315	1	55248315	94377,03	0,000011
Cattle Manure	517908	1	517908	884,71	0,001128
Cattle Manure^2	174052	1	174052	297,32	0,003346
Error	1171	2	585		

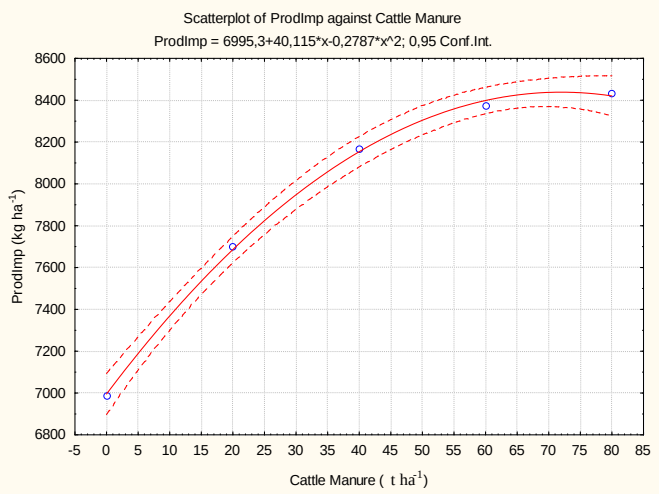

Figure 3: The effect of the cattle manure on the dry matter production in *Alopecurus pratensis* (sowing by scattering)

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 [1119,298;1277,502], [34,710; 44,080] and [-0,330; -0,218] respectively.

The maximum dry matter production of *Alopecurus pratensis* was estimated to 8438,8 kg ha^{-1} for an amount of 71,97 t ha^{-1} cattle manure. This maximum (see Figure 3) was obtained as the local extremum of the quadratic function above and it was calculated by the vanishing of its first derivative.

CONCLUSIONS

Due to the different doses of cattle manure, the meadow foxtail registered an increase of dry matter production proportional with the quantity of manure, so that in the variant with 80t/ha cattle manure, the production in the two years was the largest for all cultivation technologies taken in study.

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 cattle manure.

The maximum dry matter production of *Alopecurus pratensis* was estimated: to 7784,3 kg ha^{-1} for an amount of 68,98 t ha^{-1} cattle manure and for 12,5cm distance between rows; to 7688,9 kg ha^{-1} for an amount of 69,29 t ha^{-1} cattle manure and for 25cm distance between rows, and to 8438,8 kg ha^{-1} for an amount of 71,97 t ha^{-1} cattle manure and for sowing by scattering.

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

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