

THE POSSIBILITY OF REDUCING THE NITROGEN FERTILIZERS BY USING SOME GRAMINEOUS AND PERENNIAL MIXTURES IN THE CONDITIONS OF NORTHERN MOLDAVIA

Constantin SAICU¹

E-mail: saicuconstantin@yahoo.com

Abstract

The studies made in the period 2009-2010 underlined the necessity of using some bigger doses of nitrogen at timothy grass in order to obtain some bigger and qualitative productions. In order to make more efficient the fodder production it's necessary to create mixtures of perennial gramineous and leguminous. The timothy grass is associated very well with the clover (*Trifolium pratense*), this mixture has been used for a long time in Bucovina. The experience with different proportions of the two species on different doses of nitrogen fertilizers highlights the high production of green mass and dry substance with a moderate usage of nitrogen. The best results were obtained at the clover mixture in the ratio of 50-75%, with the timothy grass in the ratio of 25-50% on a nitrogen agricultural background between N_{30} - N_{75} .

Key words: mixture, nitrogen, green mass, dry substance, timothy grass, clover

The timothy grass (*Phleum pratense*) and the clover (*Trifolium pratense*) are part of the most productive fodder grain category, being very used as components in the cultivated meadows, but also as hay (Moga et al 1983, Varga 1993). The pure culture of timothy grass is less and less used because of the high need of nitrogen fertilizer, while in the mixture with the clover, are obtained larger productions, the feed is better than clover or timothy separate and the nitrogen consumption decreases considerably. (Moga 1968, Moga et al 1996). The researches made in different cities and stages underlined the superior rank of the mixtures of the two species in comparison with their separate use (Moga et al 1983, Zamfir Ileana 2004). The researches made in different pedoclimatic areas show that for this type of mixture it's recommended to be applied a dose of 50-80 kg/ha in the first year and N_{80} - N_{150} kg N/ha in the following years, according to the type of soil and proportion between the components, the minimum dose is of at least 70% (Moga et al 1983, Moga et al 1996).

MATERIAL AND METHOD

The researches were made in the period 2009-2010 at the Agricultural Research Development Station Suceava, on a leachate cernoziomoid soil (faeoziom), having the volumetric weight between 1.43-1.49 t/c.m. on the depth of 1.5 m, weak acid (PH in KCl- 5.6), with a medium content of humus – 3%, an environment

supplied in phosphorus and potassium. The experience presented in this paper was bifactorial type 4 x4, four repetitions, having the following factors:

Factor A: species

a 1- timothy grass 100%

a 2- timothy grass 75% + clover 25%

a 3- timothy grass 50% + clover 50%

a 4- timothy grass 25% + clover 75%

Factor B: nitrogen fertilizers

b 1= N_0

b2 = N_{50}

b3= N_{75}

b4 = N_{100}

It was used Rarau timothy grass variety, and for the clover it was used Flora variety. The green mass and dry substance production was expressed in t/ha, and the participation of species in percentage was determined by using the planimetric method.

The calculation and the interpretation of results was made by the variation analysis.

The climatic conditions from the research period are presented in table 1, from where it results that the annual average temperature was of 9.1°C in 2009 and 8.4°C in 2010, in comparison to 7.8°C that is represented by the multiannual average.

The average of the monthly temperatures during the three years was higher than the multiannual average in 10 months, with values ranged between 0.4-5.0°C and in two months, respectively for January and October was smaller with 0.7-1.1 °C.

¹ Agricultural Research Station Development of Suceava

So from the thermal point of view we can say that those two years were very hot in comparison to the multiannual average.

The rainfall recorded in 2009 was of 877.6 mm, and in 2010 of 763.4 mm, and the value of the multiannual average is of 586.8 mm. The greatest amounts of rainfall were registered in May- 117.4 mm, June 196.2 mm and July 116.4 mm, which were valued very well by plants. In both years

there is a more arid period when the vegetation comes back to life in spring, respectively in March and April, when the monthly values are smaller than the multiannual average.

Taking into account the facts presented above, it results that the fodder plants benefited from favorable conditions of development having enough water and temperature.

Table 1

The climatic conditions from the research period 2009-2010, Suceava

| Specification | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | Average or total |
|---------------------------------|-------|------|------|-------|-------|--------|-------|-------|-------|-------|------|------|------------------|
| Monthly average temperatures °C | | | | | | | | | | | | | |
| 2009 | -2,6 | -1,2 | 2,3 | 10,8 | 14,7 | 17,7 | 20,4 | 18,9 | 15,7 | 8,7 | 5,5 | -2,3 | 9,1 |
| 2010 | -7,0 | -3,5 | 2,6 | 9,4 | 15,1 | 17,9 | 21,1 | 21,4 | 13,6 | 5,9 | 8,0 | -3,8 | 8,4 |
| Average 2009-2010 | -4,8 | -2,4 | 2,4 | 10,1 | 14,9 | 17,8 | 20,8 | 20,2 | 14,6 | 7,3 | 6,8 | 3,1 | 8,8 |
| Multiyear average | -4,1 | -2,9 | 1,2 | 8,0 | 13,7 | 16,9 | 18,4 | 18,3 | 14,2 | 8,4 | 2,4 | -1,9 | 7,8 |
| Standard deviation ± | -0,7 | +0,5 | +1,2 | +1,9 | +1,2 | +0,9 | +2,4 | +1,9 | +0,4 | -1,1 | +4,4 | +5,0 | +1,0 |
| Rainfall – mm | | | | | | | | | | | | | |
| 2009 | 45,3 | 19,0 | 29,2 | 8,4 | 82,2 | 154,9 | 120,8 | 30,8 | 40,2 | 62,6 | 18,6 | 37,1 | 649,1 |
| 2010 | 31,4 | 35,2 | 28,6 | 32,0 | 152,7 | 237,4 | 112,0 | 72,2 | 63,5 | 43,1 | 38,0 | 31,5 | 877,6 |
| Average 2009-2010 | 38,3 | 27,1 | 28,9 | 20,2 | 117,4 | 196,2 | 116,4 | 51,5 | 51,9 | 52,9 | 28,3 | 34,3 | 763,4 |
| Multiyear average | 24,2 | 25,6 | 36,2 | 48,2 | 80,2 | 93,6 | 88,6 | 62,8 | 40,8 | 29,5 | 30,6 | 26,5 | 586,8 |
| Standard deviation ± | +14,1 | +1,5 | -7,3 | -28,0 | +37,2 | +102,6 | +27,8 | -11,3 | +11,1 | +23,4 | -2,3 | +7,8 | 176,6 |

RESULTS AND DISCUSSIONS

The green mass production obtained in the two years of experimenting is presented in *table 2*, and it shows us that in the 1st year (2009) the production was modest, being between 13 700 kg/ha for the pure timothy grass culture, which wasn't fertilized with nitrogen and 22 000 kg/ha for the mixture of timothy grass 50%+ clover 50% fertilized with N₁₀₀. In the second year (2010) the production level was between 11 108 kg/ha for the timothy grass pure culture, unfertilized with nitrogen and 53 584 kg/ha for the mixture of timothy grass 25% and clover 75% fertilized with N₁₀₀.

By analyzing the influence of the two factors, we find out that through the addition of 25%, 50% and 75% clover it can be remarked an increase which is statistically insured towards the pure culture of timothy grass. The average of the two years shows us that for the timothy grass pure culture was realized an average production of 19 263 kg/ha, by the addition of 25%clover in mixture, so it was realized an increase of production of 61% (11 716 kg/ha) when the addition of clover increased from 50 and 70% in mixture, the increase of production was over 80%.

The nitrogen fertilizers have determined some gains which were statistically insured when applying the 75 kg/ha and respectively 100 kg/ha nitrogen active substance.

The production of dry substance is presented in *table 3*, and shows us a modest level of the dry substance in the 1st year, and for the 2nd year, the production has increased substantially being ranged between 2149 kg/ha for the pure culture of timothy grass unfertilized with nitrogen and 8719 kg/ha s.u. for the mixture of 75%timothy grass + 25% clover fertilized with N₁₀₀. The average of the two years indicated increases insured statistically for all the experimental varieties in comparison with the witness variety.

By the addition of 25% clover in the mixture, the average of the dry substance increase was 1907 kg/ha (52%) and for the increase of 50%clover and respectively to 75%, the production increase remained approximately the same.

In exchange, the nitrogen fertilizers have determined increases of 18% (795 kg/ha s.u) at N₁₀₀ of 25% (1078 kg/ha s.u) at N₇₅ and 32 % (1378 kg/ha s.u) at N₁₀₀.

From the economical point of view, the best variant is composed from 50% timothy grass + 50% clover with a nitrogen dose of N₅₀.

Table 2

The green mass production obtained for different mixtures of timothy grass and clover on different nitrogen levels (2009-2010)

| Mixture * | N dose | g.m. Production(kg/ha) | | Average (kg/ha) | Difference | | Signification |
|---------------|------------------|---------------------------|-------|--------------------|------------|-----|---------------|
| | | 2009 | 2010 | | Kg/ha | % | |
| Ph 100 % | N ₀ | 13700 | 11108 | 12404 | Mt | 100 | - |
| Ph 100 % | N ₅₀ | 17610 | 16691 | 17151 | 4747 | 138 | xxx |
| Ph 100 % | N ₇₅ | 19010 | 23842 | 21426 | 9022 | 173 | xxx |
| Ph 100 % | N ₁₀₀ | 20530 | 31613 | 26072 | 13668 | 210 | xxx |
| Ph 75 %+T 25% | N ₀ | 15600 | 40506 | 28053 | 15649 | 226 | xxx |
| Ph 75 %+T 25% | N ₅₀ | 18500 | 39191 | 28846 | 16442 | 233 | xxx |
| Ph 75 %+T 25% | N ₇₅ | 20720 | 44960 | 32840 | 20436 | 265 | xxx |
| Ph 75 %+T 25% | N ₁₀₀ | 21700 | 46652 | 34176 | 21772 | 276 | xxx |
| Ph 50 %+T 50% | N ₀ | 16360 | 52842 | 34601 | 22197 | 279 | xxx |
| Ph 50 %+T 50% | N ₅₀ | 19360 | 51554 | 35457 | 23053 | 286 | xxx |
| Ph 50 %+T 50% | N ₇₅ | 20590 | 51071 | 35831 | 23427 | 289 | xxx |
| Ph 50 %+T 50% | N ₁₀₀ | 22200 | 45904 | 34052 | 21648 | 274 | xxx |
| Ph 25 %+T 75% | N ₀ | 16860 | 45007 | 30934 | 18530 | 249 | xxx |
| Ph 25 %+T 75% | N ₅₀ | 19750 | 49834 | 34792 | 22388 | 280 | xxx |
| Ph 25 %+T 75% | N ₇₅ | 21250 | 50347 | 35799 | 23395 | 289 | xxx |
| Ph 25 %+T 75% | N ₁₀₀ | 21790 | 53584 | 37667 | 25283 | 304 | xxx |

*- Ph- timothy grass ;T-red clover

| | | | |
|-----------|-------|-------|-------|
| LSD 5 % | 2 170 | 1 333 | 1 752 |
| LSD 1 % | 3 014 | 2 444 | 2 729 |
| LSD 0.1 % | 4 110 | 3 776 | 3 943 |

The average of the factor A

| Mixture * | Production. green mass (kg/ha) | | Average (kg/ha) | Differences | | Signification |
|---------------|-----------------------------------|-------|--------------------|-------------|-----|---------------|
| | 2009 | 2010 | | (kg/ha) | % | |
| Ph 100 % | 17712 | 20814 | 19263 | Mt | 100 | xxx |
| Ph 75 %+T 25% | 19130 | 42827 | 30979 | 11716 | 161 | xxx |
| Ph 50 %+T 50% | 19628 | 50343 | 34986 | 15723 | 182 | xxx |
| Ph 25 %+T 75% | 19912 | 49693 | 34803 | 15540 | 183 | |

| | | | |
|-----------|-------|-------|-------|
| LSD 5 % | 2 180 | 3 122 | 2 651 |
| LSD 1 % | 3 060 | 5 204 | 4 132 |
| LSD 0.1 % | 4 220 | 7 909 | 6 065 |

The average of the factor B

| N dose | Production. green mass (kg/ha) | | Average (kg/ha) | Differences | | Signification |
|------------------|-----------------------------------|-------|--------------------|-------------|-----|---------------|
| | 2009 | 2010 | | (kg/ha) | % | |
| N ₀ | 15630 | 37366 | 26498 | Mt | 100 | |
| N ₅₀ | 18805 | 39318 | 29062 | 2564 | 110 | |
| N ₇₅ | 20393 | 42555 | 31474 | 4976 | 118 | x |
| N ₁₀₀ | 21555 | 44438 | 32997 | 6499 | 124 | xx |

| | | | |
|-----------|-------|--------|-------|
| LSD 5 % | 2 280 | 4 484 | 3 382 |
| LSD 1 % | 3 280 | 9 342 | 6 311 |
| LSD 0.1 % | 4 406 | 14 199 | 9 302 |

The participation of species in the mixture was different according to the studied factors and of the vegetation year (*table 4*). Therefore in the first year for the 1st mowing, the clover took part in a larger proportion than the one sowed in the mixtures with 25% and 50% clover, and for the 75% clover mixture, the balance in the production was similar. For the 2nd mowing the

participation of the clover was 10-35% bigger than in the 1st mowing. In the 2nd year of vegetation, the clover balance has increased in all types of mixtures being in proportion of 50-55% for the varieties seeded with 25% clover, 65-70% in the variants sowed with 50% clover and 89-91% in the variants seeded with 75% clover.

Table 3

The production of dry substance obtained for different mixtures of timothy grass and clover on different nitrogen levels (2009-2010)

| Mixture * | N dose | Dry substance Production(kg/ha) | | Average (kg/ha) | Difference | | Signification |
|---------------|------------------|---------------------------------|------|-----------------|------------|-----|---------------|
| | | 2009 | 2010 | | Kg/ha | % | |
| Ph 100 % | N ₀ | 2678 | 2149 | 2 413 | Mt | 100 | - |
| Ph 100 % | N ₅₀ | 3424 | 3025 | 3225 | 812 | 134 | xxx |
| Ph 100 % | N ₇₅ | 3704 | 4434 | 4069 | 1656 | 169 | xxx |
| Ph 100 % | N ₁₀₀ | 4049 | 5911 | 4980 | 2567 | 206 | xxx |
| Ph 75 %+T 25% | N ₀ | 3032 | 6593 | 4362 | 1949 | 180 | xxx |
| Ph 75 %+T 25% | N ₅₀ | 3542 | 6613 | 5078 | 2665 | 210 | xxx |
| Ph 75 %+T 25% | N ₇₅ | 4009 | 7953 | 5981 | 3568 | 248 | xxx |
| Ph 75 %+T 25% | N ₁₀₀ | 4169 | 8719 | 6444 | 4031 | 267 | xxx |
| Ph 50 %+T 50% | N ₀ | 3122 | 7456 | 5289 | 2876 | 219 | xxx |
| Ph 50 %+T 50% | N ₅₀ | 3715 | 8529 | 6122 | 3709 | 254 | xxx |
| Ph 50 %+T 50% | N ₇₅ | 3846 | 7784 | 5815 | 3402 | 241 | xxx |
| Ph 50 %+T 50% | N ₁₀₀ | 4107 | 6888 | 5498 | 3085 | 228 | xxx |
| Ph 25 %+T 75% | N ₀ | 3071 | 6598 | 4835 | 2422 | 200 | xxx |
| Ph 25 %+T 75% | N ₅₀ | 3567 | 8637 | 6102 | 3689 | 253 | xxx |
| Ph 25 %+T 75% | N ₇₅ | 3814 | 7776 | 5795 | 3382 | 240 | xxx |
| Ph 25 %+T 75% | N ₁₀₀ | 3937 | 7943 | 5940 | 3527 | 246 | xxx |

*- Ph- timothy grass ;T-red clover

| | | | |
|-----------|-----|-----|-----|
| LSD 5 % | 321 | 200 | 261 |
| LSD 1 % | 539 | 305 | 422 |
| LSD 0.1 % | 750 | 393 | 572 |

The average of the factor A

| Mixture * | Production green mass (kg/ha) | | Average (kg/ha) | Differences | | Signification |
|---------------|-------------------------------|-------|-----------------|-------------|-----|---------------|
| | 2009 | 2010 | | (kg/ha) | % | |
| Ph 100 % | 3 464 | 3 880 | 3 672 | Mt | 100 | - |
| Ph 75 %+T 25% | 3 688 | 7 470 | 5 579 | 1907 | 152 | xxx |
| Ph 50 %+T 50% | 3 698 | 7 664 | 5 681 | 2009 | 155 | xxx |
| Ph 25 %+T 75% | 3 597 | 7 739 | 5 668 | 1996 | 154 | xxx |

| | | | |
|-----------|-----|-----|-----|
| LSD 5 % | 260 | 601 | 431 |
| LSD 1 % | 340 | 788 | 564 |
| LSD 0.1 % | 420 | 985 | 702 |

The average of the factor B

| N dose | Production green mass (kg/ha) | | Average (kg/ha) | Differences | | Signification |
|------------------|-------------------------------|-------|-----------------|-------------|-----|---------------|
| | 2009 | 2010 | | (kg/ha) | % | |
| N ₀ | 2 976 | 5 699 | 4 337 | Mt | 100 | - |
| N ₅₀ | 3 562 | 6 701 | 5 132 | 795 | 118 | x |
| N ₇₅ | 3 843 | 6 987 | 5 415 | 1 078 | 125 | xxx |
| N ₁₀₀ | 4 065 | 7 365 | 5 715 | 1 378 | 132 | xxx |

| | | | |
|-----------|-----|------|-----|
| LSD 5 % | 402 | 815 | 608 |
| LSD 1 % | 515 | 1094 | 805 |
| LSD 0.1 % | 660 | 1277 | 969 |

For the following mowing it is maintained a higher clover production in comparison to the seeding proportion, but it is registered a tendency of decrease from the 1st mowing to the other mowing.

The nitrogen fertilizers have influenced very little the proportion of the clover in the mixture, by registering a slight decrease when are increased the nitrogen fertilizers N₁₀₀.

Table 4

The participation of species in the mixture %

| Mixture * | N dose | 1 st year (2009) | | | | 2 nd year (2010) | | | | | |
|-----------------|------------------|-----------------------------|----|------------------------|----|-----------------------------|----|------------------------|----|------------------------|----|
| | | 1 st mowing | | 2 nd mowing | | 1 st mowing | | 2 nd mowing | | 3 rd mowing | |
| | | Ph | T | Ph | T | Ph | T | Ph | T | Ph | T |
| Ph 100 % | N ₀ | 100 | - | 100 | - | 100 | - | 100 | - | 100 | - |
| Ph 100 % | N ₅₀ | 100 | - | 100 | - | 100 | - | 100 | - | 100 | - |
| Ph 100 % | N ₇₅ | 100 | - | 100 | - | 100 | - | 100 | - | 100 | - |
| Ph 100 % | N ₁₀₀ | 100 | - | 100 | - | 100 | - | 100 | - | 100 | - |
| Ph 75 % + T 25% | N ₀ | 60 | 40 | 40 | 60 | 45 | 55 | 50 | 50 | 55 | 45 |
| Ph 75 % + T 25% | N ₅₀ | 60 | 40 | 35 | 60 | 45 | 55 | 48 | 52 | 57 | 43 |
| Ph 75 % + T 25% | N ₇₅ | 65 | 35 | 38 | 62 | 48 | 52 | 50 | 50 | 57 | 43 |
| Ph 75 % + T 25% | N ₁₀₀ | 70 | 30 | 35 | 65 | 50 | 50 | 52 | 48 | 58 | 42 |
| Ph 50 % + T 50% | N ₀ | 40 | 60 | 30 | 70 | 30 | 70 | 35 | 65 | 42 | 58 |
| Ph 50 % + T 50% | N ₅₀ | 42 | 58 | 25 | 75 | 32 | 68 | 37 | 63 | 44 | 56 |
| Ph 50 % + T 50% | N ₇₅ | 45 | 55 | 25 | 75 | 34 | 66 | 37 | 63 | 43 | 57 |
| Ph 50 % + T 50% | N ₁₀₀ | 50 | 50 | 20 | 80 | 35 | 65 | 38 | 62 | 43 | 57 |
| Ph 25 % + T 75% | N ₀ | 28 | 72 | 20 | 80 | 11 | 89 | 15 | 85 | 27 | 73 |
| Ph 25 % + T 75% | N ₅₀ | 25 | 75 | 20 | 80 | 10 | 90 | 12 | 88 | 26 | 74 |
| Ph 25 % + T 75% | N ₇₅ | 25 | 75 | 15 | 85 | 9 | 91 | 18 | 82 | 30 | 70 |
| Ph 25 % + T 75% | N ₁₀₀ | 30 | 70 | 15 | 85 | 9 | 91 | 20 | 80 | 31 | 69 |

Ph – *Phleum pretense*; T – *Trifolium pratense*

CONCLUSIONS

By the use of the timothy grass and clover mixtures is realized a superior net fodder from a quantitative and qualitative point of view in comparison with the fodder produced by the two species, separately.

The obtained green mass production was influenced especially by the mixture, the increases registered for only 25% clover were over 15 t/ha, and for 50% clover, the production increase was over 22 t/ha.

The dry substance production was influenced positively by the participation of the clover with over 50% and of the fertilizers was of 18% at N₅₀, 25% at N₇₅ and 32% at N₁₀₀.

We consider as being optimal the seeding variety of the mixture obtained from 50% timothy grass + 50% clover, fertilized with N₅₀- N₇₅.

The optimal recommended variety behaved very well also regarding the components of the production of the two species.

BIBLIOGRAPHY

- Moga, I., 1968** - *Researches and results obtained in the field of culture technology at fodder plants*, Analele ICCPT Fundulea, Vol. LV, Bucharest.
- Moga, I., Varga, P., Kellner E., Burlacu, Gh., Paulian, Fl., Ulinici, A., Sipos, Gh., 1983** - *Perennial fodder plants*, Pub. House Academiei R.S.R. Bucharest.
- Moga, I., Schitea, Maria, Mateias, M.C., 1996** - *Fodder plants*, Ceres Publishing House, Bucharest.
- Varga, P., 1993** - *Fodder production*, Ceres Publishing House, Bucharest.
- Zamfir, Ileana, Zamfir, M.C., Dihoru, Alexandrina, , Dragan, Lenuta, Raducanu, C., 2004** - *The effect of the seeding report on the production and quality of the mixtures constituted from perennial leguminous, perennial gramineous and annual leguminous*. Agronomical researches in Burnasului Plain, vol 3, Agris Publishing House, Agricultural Magazine, Bucharest.