THE EFFICIENCY OF FORAGE CROPS AND EFFECT OF FERTILIZERS ON FODDER PRODUCTION UNDER SUCEAVA PLATEAU CONDITIONS

Constantin SĂICU

e-mail: saicuconstantin@yahoo.com

Abstract

In the last years, in the Suceava Plateau, the climatic conditions occurred elevated temperature during summer and rainfall values were close to normal, forage crops were achieved annual production exceeding d.s. and n.u. , the highest values occurring in corn silage and fodder beet followed by forage turnip. The perennial crops, the highest yields were recorded at mix of alfalfa+ orchard grass, followed by simple cultivation of perennial legumes and perennial grasses in pure culture. The effect of fertilizers on annual crops was higher in fodder beet, followed by forage turnip and finally followed by corn. The maximum effect was obtained at perennial grasses, followed by perennial mixtures, and finally followed by perennial legumes in pure culture.

Key words: perennial grasses, perennial legumes, dry substances

Ensuring of the feed is an essential condition for livestock development in both large farms, but also small household system. To achieve this goal it is necessary to use a variety of annual and perennial forage plants adapted to the crop conditions from that area and to the appropriate technologies in order to use at maximum of the environmental conditions (Moga et al., 1983, Săicu C., 2010). The most important piece of technology in feed production is the utilization of mineral and organic fertilizers and especially those with nitrogen, which enhance the quality and quantity of feed (Moga et al., 1996, Varga, 1993). For superior capitalization of soil and climate conditions, but also to ensure feeding for the whole year, it is necessary to cultivate both annual and perennial plants that produce a diverse range of feed on good quality which is used for different animals races and for different age groups of them.

In order to produce sufficient quantities of feed it is necessary to use large amounts of nitrogen, and for nitrogen reducing it is necessary to use mixtures of perennial grasses and legumes (Moga et al., 1983, Săicu, 2011)

MATERIAL AND METHOD

The researches were conducted at ARDS of Suceava during period 2008-2010, on cambic faeoziom soil with a clay content of 31.6%, slightly acidic, with pH 5.6 to 5.8, containing 3.0% humus, medium supplied in phosphor and potassium.

The bifactorial experiments were as follows:

a) Experiment with annual forage plants:

Factor A-crop factor: a1 = corn silage, a2 = forage beet, a3 = forage turnip;

Factor B - nitrogen fertilizer doses: $b_1=N_0$; $b_2=N_{60}$; $b_3=N_{120}$; $b_4=N_{180}$

b) Experiment with perennial forage plants

Factor A – crop: a_1= orchard grass; a_2= timothy; a_3= alfalfa; a_4= red clover; a_5= 50% orchard grass + 50% alfalfa; a_6= 50% timothy + 50% red clover

Factor B - nitrogen fertilizer doses: $b_1=N_0$; $b_2=N_{60}$; $b_3=N_{120}$; $b_4=N_{180}$

Interpretation of experimental data after method variance was made. The climatic conditions of the experimental period (2008-2010) are shown in table 1, which attend the average temperature of the research period was 9.0°C, with 1.2°C higher than the multiannual average. The warmest year was 2008, with an annual average temperature of 9.4°C. The hottest months were those during vegetation period. Rainfall had high values of 887.0 mm in 2008, 649.1 mm in 2009 and 877.6 mm in 2010, the average of the research period was 221.1 mm greater than the multiannual average. Most precipitation occurred in summer, especially in May (108.8 mm), June (163.8 mm) and July (178.1 mm).

We can say that in analyzed period (2008-2010) it was very favorable climatic conditions for forage plants development.

RESULTS AND DISSCUSION

In the experiment of annual forage plants (corn silage, forage beet and forage turnip) nitrogen fertilizer doses: N_0,N_{60},N_{120} and N_{180} which have been applied and yields of green mass and roots which were obtained are presented in table 2.

Soybean is one of the protein and oil essential sources for human and livestock feed.

Soybean plants due to their good capacity of nitrogen fixation improve soil fertility and reduce doses of industrial fertilizers.

According to literature data this species is very susceptible to drought and low phosphates in soil (Wang X et al., 2010). However, most of the soils in Republic of Moldova as well as at global scale are characterized by low level of phosphorus availability (Andries S., 2007). A large portion of soluble inorganic phosphate applied to soil as chemical fertilizer is rapidly immobilized soon after application and becomes unavailable to plants (Yadav K., Dadarwal H., 1997). Likewise, reserves of rock- phosphorus are finite with an estimated depletion of sources expected to occur within the next 50–60 years (Vance C et al., 2003). It must be emphasized that the higher cost of phosphoric fertilizer became a limiting factor for crop production. Several plant growth-promoting rhizobacteria (PGPR) have shown potential to enhance phosphorus solublization and nutrition of crops (Adesemoye A., Kloepper J., 2009, Krey T et al., 2011**).** The application of rhizobacteria in soybean biotechnology could have a promising benefit for plant nutrition, partially overcome P deficiency. Thus, in the context of increasing international concern for food and environmental quality, the use of PGPR for reducing chemical inputs in agriculture is a potentially important issue.

PGPR have been applied to various crops to enhance growth, seed emergence and crop yield, and some have been commercialized (Dey R et al., 2004). Rhizosphere bacteria can affect plant growth through different mechanisms such as nitrogen fixation, production of plant growth regulators (Vessey K., 2003) and increasing plant water and nutrient uptake (Dey R et al., 2004, Rodrigues H., Fraga R., 1999). The ability of *Pseudomonas* strains to increase solubility of phosphate sources and non-absorbent organic phosphate emphasizes the need of using them to increase the absorbing of nutrients, especially phosphorus, in terms of nutrient shortages (De Freitas J et al., 1997).

The objective of the research was to investigate under greenhouse conditions the influence of P and bacteria *azotobacter chroococcum* and *pseudomonas fluorescence* on the nitrogen, total and inorganic phosphorus contents in soybean under suboptimal moisture regime of soil.

Thus, at the corn silage, at the unfertilized version, 53,080 kg/ha was obtained, and by applying of nitrogen, the larger increases up to 43% were obtained. At forage beet the increases were greater up to 127% and at forage turnip the maximum increase was up to 79% when was applied N_{180}.

The average of factor A shows that physical yield achieved in the three species was 66,330 kg/ha of corn silage, 79,430 kg/ha of forage beet and 69,260 kg/ha of forage turnip.

The average of factor B shows us progressive increases of the physic yields with 31% at N_{60}, with 56% at N_{120} and 95% at N_{180}.

The dry matter production on three annual crops with different applied nitrogen doses are shown in table 3, where by applying of progressive nitrogen doses, progressive increases of dry matter were made. Thus, the maximum yield increase in comparison with unfertilized variant was 35% at corn silage, 133% at forage beet and 86% at forage turnip (table 3).

On the whole, the average of factor A, shows that the highest yield of dry matter was made on corn silage (15,675 kg / ha) followed by forage beet (11,048 kg / ha) and then forage turnip (8758 kg / ha). Factor B shows that nitrogen fertilizers determined increases statistically assured at all fertilized doses.

In the experiment with perennial forage crops, the yield of green mass (Table 4) ranged from 31,307 to 66,137 kg/ha for orchard grass, 19950 – 44573 for timothy and 68867-78583 kg/ha for alfalfa, 48047-52100 kg/ha for red clover, 70650-78630 kg/ha in the mixture between alfalfa and orchard grass and 48583-54693 kg/ha on mixture of red clover and timothy. Production increases due to nitrogen fertilizers are high at orchard grass and timothy and smaller at alfalfa, red clover and simple mixture between perennial legumes and grasses.

The average factor A indicates green mass production of 33.3 t/ha for timothy, 48.7 t/ha for orchard grass, 50.7 t/ha for red clover, 73.0 t/ha for alfalfa and 74.3 t/ha for mixture of alfalfa and orchard grass.

The average B factor shows that nitrogen fertilizer provided the green mass increases, statistically assured.

Dry matter production function by fertilizer doses presented in the table 5, shows large production increases, up to 100% for perennial grasses and smaller increases for mixtures of perennial legumes and grasses. The average factor A shows that the lowest dry matter production was recorded for red clover and the highest dry matter yields were made for orchard grass (11956 kg / ha), alfalfa (12266 kg / ha) and for mixture of orchard grass and alfalfa (15400 kg / ha).

Table 1

Climatic conditions during research period 2008 - 2010

Specification	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average or total
Monthly average temepratures ^{0}C													
2008	-3,1	3,3	4,9	9,6	13,7	18,3	19,2	20,0	13,0	9,7	3,8	0,6	9,4
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 2008-2010	-4,2	-0,5	3,3	9,9	14,5	18,0	20,2	20,1	14,1	8,1	5,8	-1,8	9,0
Multiannual average	-4,1	-2,3	+1,2	+8,0	13,7	16,9	18,4	18,3	14,2	8,4	2,4	-1,9	7,8
Standard deviation ±	-0,1	-2,4	+2,1	+1,9	+0,8	+1,1	+1,8	+1,8	-0,1	-0,3	+3,4	-0,1	+1,2
Precipitation -mm													
2008	5,7	23,9	15,9	135,2	91,5	99,2	301,6	72,3	60,4	43,4	8,0	29,9	887,0
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 2008-2010	27,5	26,0	24,6	58,5	108,8	163,8	178,1	58,4	54,7	49,7	21,5	32,8	807,9
Multiannual 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 ±	+3,3	+0,4	-11,6	+11,3	+28,6	+70,2	+89,5	-4,4	+13,9	+20,2	-9,1	+6,3	+221,1

Table 2

Yields of green mass obtained at the annual fodder plants

Variant	Yield g.m (kg/ha)			Average	Difference		Significance
	2008	2009	2010	yield (kg/ha)	Kg/ha	%	
a1b1	49600	50550	59090	53080	-	100	
a1b2	61850	70420	67290	66520	13440	125	xx
a1b3	69330	72050	68740	70040	16960	132	xxx
a1b4	73800	77560	75680	75680	22600	143	xxx
a2b1	45500	53200	46860	48520	-4560	91	
a2b2	58120	64060	66220	62800	9720	118	x
a2b3	84130	88650	85070	85950	32870	162	xxx
a2b4	118800	125500	117050	120450	67370	227	xxx
a3b1	40300	49180	47020	45500	-7580	86	
a3b2	63300	61280	63820	62800	9720	118	x
a3b3	70120	75140	75360	73540	20460	138	xxx
a3b4	90850	96520	85180	95200	42120	179	xxx

DL 5%
8960
Average of the factor A

a1	63645	67645	67700	66330	-	100	
a2	76637	82852	78800	79430	13100	120	xx
a3	66142	70530	67845	69260	2932	104	

DL 5% 9810
Average of the factor B

b1	45133	50977	50990	49033	-	100	
b2	61090	65253	65777	64040	15007	131	x
b3	74527	78613	76390	76510	27477	156	xxx
b4	94483	99860	92637	95660	46627	195	xxx

DL 5% 12130

Table 3

The dry substances yield obtained at the annual forage plants

Variant	Yield d.s.(kg/ha)			Average Yield (kg/ha)	Diference		Signific.
	2008	2009	2010		Kg/ha	%	
a1b1	12053	12284	14359	12899	-	100	
a1b2	15030	16760	16015	15935	3036	123	xxx
a1b3	16292	16932	16153	16459	3560	128	xxx
a1b4	16974	17839	17406	17406	4507	135	xxx
a2b1	6598	7714	6795	7036	-5863	55	000
a2b2	8253	9096	9403	8917	-3982	69	000
a2b3	11610	12233	11740	11861	-1038	92	
a2b4	16150	17068	15919	16379	3480	127	xx
a3b1	5400	6590	6301	6097	-6802	47	000
a3b2	8229	7966	8297	8164	-4735	63	000
a3b3	8975	9618	9646	9413	-3486	73	000
a3b4	11356	12065	10647	11356	-1543	88	0
DL 5%				1480			
Average of the factor A							
a1	15087	15954	15983	15675	-	100	
a2	10653	11528	10964	11048	-4627	70	000
a3	8490	9060	8723	8758	-6917	56	000
DL 5%				1760			
Average of the factor A							
b1	8017	8863	9152	8677	-	100	
b2	10504	11274	11238	11005	2328	127	xxx
b3	12292	12928	12513	12578	3901	145	xxx
b4	14827	15657	14657	15047	6370	173	xxx
DL 5%				1655			

Table 4

The dry substances yield obtained at perennial forage plants

Variant	The yield d.s. (kg/ha)			Average yield (kg/ha)	Difference		Signification
	2008	2009	2010		Kg/ha	%	
a1b1	30150	30420	33350	31307	-	100	
a1b2	41650	39850	38450	39983	8676	128	xxx
a1b3	59860	55150	57560	57523	26216	184	xxx
a1b4	68350	70040	60130	66173	34866	211	xxx
a2b1	20160	18650	21040	19950	-11357	64	000
a2b2	31050	30250	29880	30393	-914	97	
a2b3	38880	40120	36550	38517	7210	123	xxx
a2b4	45500	43160	45060	44573	13266	142	xxx
a3b1	69850	71500	65250	68867	37560	220	xxx
a3b2	71550	73840	66200	70530	39223	225	xxx
a3b3	75840	77220	69520	74193	42886	237	xxx
a3b4	80120	79810	75820	78583	47276	251	xxx
a4b1	51250	49850	43040	48047	16840	153	xxx
a4b2	54150	53200	45120	50823	19516	162	xxx
a4b3	55200	56190	44020	51803	20496	165	xxx
a4b4	53420	58780	44100	52100	20793	166	xxx
a5b1	70420	72030	69500	70650	39343	226	xxx
a5b2	72530	73300	72030	72620	41313	232	xxx
a5b3	74150	76150	75540	75280	43973	240	xxx
a5b4	79020	79150	77720	78630	47323	251	xxx
a6b1	49830	48120	47800	48583	17276	155	xxx
ab2	51060	49220	49320	49867	18560	159	xxx
a5b3	53940	52760	50960	52553	21246	168	xxx
a5b4	55400	55800	52880	54693	23386	175	xxx
DL 5%				2974			
Average of the factor A							

a1	50003	48865	47372	48747	-	100	
a2	33898	33045	33132	33358	15389	68	000
a3	74340	75592	69198	73043	24296	150	xxx
a4	53505	54505	44070	50693	1946	104	
a5	74030	75158	73698	74295	25548	152	xxx
a6	52558	51475	50240	51424	2677	105	
DL 5%				4875			

Average of the factor B

b1	48610	48428	46663	47900	-	100	
b2	53665	53277	50167	52370	4470	109	x
b3	59645	59598	55692	58312	10412	122	xxx
b4	63635	64457	59285	62459	14559	130	xxx
DL 5%			4260				

Table 5

The dry substances yield obtained at some perennial forageplants

Variant	Yield d.s (kg/ha)			Average yield (kg/ha)	Difference		Signific.
	2008	2009	2010		Kg/ha	%	
a1b1	7839	7909	8671	8140	-	100	
a1b2	10621	10162	9805	10196	2056	125	xxx
a1b3	14366	13236	13814	13805	5665	170	xxx
a1b4	16199	16599	14251	15683	7543	193	xxx
a2b1	4919	4551	5134	4868	-3272	60	000
a2b2	7297	7109	7122	7176	-964	88	
a2b3	8554	8826	8041	8474	334	104	
a2b4	9874	9366	9778	9673	1533	119	xx
a3b1	12433	12727	11614	12258	4118	151	xxx
a3b2	12164	12553	11254	11990	3850	147	xxx
a3b3	12514	12741	11471	12242	4102	150	xxx
a3b4	12819	12770	12131	12573	4433	154	xxx
a4b1	7483	7278	6284	7015	-1125	86	0
a4b2	7581	7448	6317	7115	-1025	87	0
a4b3	7452	7586	5943	6994	-1146	86	0
a4b4	6945	7641	5733	6773	-1367	83	00
a5b1	15140	15486	14943	15190	7050	187	xxx
a5b2	15231	15393	15126	15250	7110	187	xxx
a5b3	15201	15611	15485	15433	7293	189	xxx
a5b4	15804	15830	15544	15726	7586	193	xxx
a6b1	9866	9528	9464	9619	1479	118	xx
a6b2	9957	9598	9617	9724	1584	119	xx
a6b3	10249	10249	9682	10060	1920	124	xxx
a6b4	10249	10323	9783	10118	1978	124	xxx
DL 5%				1368			
Average of the factor A							
a1	12256	11977	11635	11956	-	100	
a2	7661	7463	7519	7548	-4408	63	000
a3	12483	12698	11617	12266	310	102	
a4	7365	7488	6069	6974	-4982	58	000
a5	15344	15580	15275	15400	3444	129	xxx
a6	10080	9924	9637	9880	-2076	83	0
DL 5%				1580			
Average of the factor B							
b1	9613	9580	9352	9515	-	100	
b2	10475	10377	9874	10242	727	108	
b3	11389	11375	10740	11168	1653	117	xx
b4	11892	12088	11203	11728	2213	123	xxx
Dl 5%			1380	1380			

CONCLUSIONS

1. Annual forage plants: corn silage, forage beet and forage turnip produced large quantities of fresh mass, such as: 79 t/ha of forage beet, 69 t/ha of forage turnip and 66 t/ha of corn silage.

2. Average production increases when it used different nitrogen fertilizer doses were: 31% N_{60}, 56% and 95% at N_{180} and N_{120}

3. Dry matter production was: 15.6 t/ha for corn silage, 11.0 t/ha for forage beet and 8.7 t/ha for forage turnip

4. In the climatic conditions of Suceava Plateau the highest yields of dry matter in the mixture of alfalfa and orchard grass and for alfalfa in pure culture have obtained, and the lowest yields for perennial grasses were achieved

5. The biggest increases through utilization of nitrogen fertilizers were obtained at pure cultures of perennial grasses and in the case of perennial legumes in pure culture and mixtures the increases were small, which leads to the conclusion of the utilization of higher nitrogen doses in the first case and small doses in the second case

REFERENCES

Moga I., Varga P., Kellner E., Burlacu Gh., Paulian Fl., Ulinici A., Sipoş Gh.,1983 - *Plante furajere perene*, Ed.Academiei RSR Bucureşti ;

Moga I., Schitea Maria., Mateiaş M.C.,1996, *Plantente furajere*,Editura Ceres, Bucureşti<

Săicu C. *Cercetări privind cultura unor specii de leguminoase şi graminee furajere în condițiile din Nordul Moldovei,* 2010, Analele INCDA Fundulea ,vol. XXXVIII,nr 1;

Săicu C. *Posibilități de reducere a îngrăşămintelor cu azot prin utilizarea unor amestecuri de graminee cu leguminoase perene în condițiile din nordul Moldovei*, 2011, Lucrări ştiințifice, vol 54, seria Agronomie,USAMV Iaşi;

Varga P.1993 - *Producerea furajelor,* Editura Ceres, Bucureşti