ASPECTS REGARDING THE CROP TECHNOLOGY OF ALFALFA AND ALEXANDRIA CLOVER MIXTURE UNDER BURNAS PLAIN CONDITIONS

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ABSTRACT

The cultivation of alfalfa and Alexandria clover mixture, leads to the obtainment of very high yields in the first year of vegetation. At the alfalfa and Alexandria clover mixtures, the dry matter yields obtained in the first year of vegetation, ranged between 7.98 - 11.91 t/ha, unlike the pure alfalfa crop where the yield ranged between 4.00 - 4.86 t/ha. The yield increases of Alexandria clover were between 95 - 182%. On an average, during a crop cycle (three years), the dry matter yield was between 6.61 - 11.12 t/ha. These yield increases (30-35%) were statistically ensured at very significant level. Both the utilized sowing rate from the first year of vegetation and alfalfa and Alexandria clover total nitrogen content, influence the crude protein mean yield with values between 1,210-2,027 kg crude protein/ha. Positive and very significant correlations between both root and aerial vegetative mass of alfalfa, were established. The effect of alfalfa embarrassment by Alexandria clover is bigger, when its weight into the mixture increases. Under dry land conditions and using the exploitation by mowing, the best mixtures were 20-22 kg alfalfa/ha + 4-6 kg Alexandria clover/ha.

Key words: Alfalfa and Alexandria clover mixture, embarrassment effect

INTRODUCTION

The intensiveness of fodder production is one of the most important current concern.The research has tackled essential problems which lead to the quantity increasing and improvement of fodder qualitative value. The optimal structure of fodder assortments on ecological areas in direct or double crops, as well as the influence of fertilization on yield and fodder qualitative value under irrigation conditions, was studied (Moga et al., 1982; Moga and Craiu, 1987; Moga, 1993; Bărbulescu et al., 1991).

In the last decade, in order to avoid the alfalfa embarrassment in the first year of vegetation, a lot of possibilities have been tested. One of them is alfalfa crop under protecting plant. It was established that the sowing of perennial crops under protecting plant is superior to the sowing without protecting plant. This variant of cropping facilitates a more efficient struggle with weeds and erosion, and at the same time the young plants avoid the heat and strong winds and the embarrassment effect of basic crop is minimum or does not exist (Moga et al., 1983, 1996; Rãducanu and Fluera°u, 1997; Zamfir, 1999).

Starting from these results, the research aimed at the utilization of alfalfa and Alexandria clover (*Trifolium alexandrinum*) mixture in order to obtain greater yields than in alfalfa pure crop. As part of the mixture, Alexandria clover is an annual, allogamous plant, with erect growth, does not produce flatulence and is an important source of protein (Kontsiotou, 1990; Prosperi et al., 1995; Varga et al., 1998).

The paper presents the results regarding the alfalfa crop technology for fodder under protecting plant (Alexandria clover), under dry land conditions at A.R.S. Teleorman.

MATERIALS AND METHODS

The research was performed during 1996-1998, in the experimental field from A.R.S. Teleorman, on an argilluvial chernozem with relatively good physical, chemical and hydrophysical features.

The location of field experiment was performed after bifactorial subdivided plots method, in four replications, having as aim the establishment of sowing ratio between alfalfa and Alexandria clover:

- A factor - alfalfa seed rate: a_1 = 22 kg/ha; a_2 = 20 kg/ha; a_3 = 8 kg/ha; a_4 = 16 kg/ha;
- B factor - Alexandria clover seed rate: b_1 = 0 kg/ha; b_2 = 4 kg/ha; b_3 = 8 kg/ha; b_4 = 12 kg/ha.

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Selena alfalfa and Tigri Alexandria clover cultivars were cropped. Research at root system level was performed, in order to observe the competition between these two species. In the first year of vegetation, the growth rhythm of alfalfa and Alexandria clover was investigated, performing measurements from ten to ten days for each cutting.

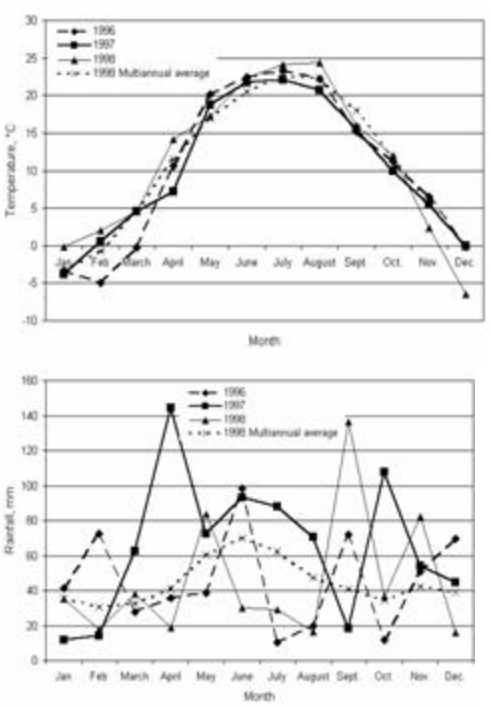

Figure 1. Evolution of mean temperatures and monthly rainfall in comparison with multiannual means of 100 years, during the experimentation period (Teleorman, 1996 – 1998)

The experiment was harvested as follows: in the first year of vegetation, the first cutting at the beginning of Alexandria clover flowering and in the second and third years of vegetation, at the beginning of alfalfa budding; the next cuttings at intervals of 36-38 days.

From the thermic and pluviometric point of view, the three years of experimentation have been characterized as follows: 1996 – droughty, 1997 – rainy and 1998 – droughty (Figure 1).

RESULTS AND DISCUSSIONS

From the analysis of data obtained and presented in table 1 results that in the first year of vegetation, the alfalfa and Alexandria clover mixture achieved, on an average, at three cuttings, double or almost triple dry matter yields (7.98 - 11.91 t/ha) in comparison with pure alfalfa crop (4.00 - 4.86 t/ha). The yield gains of Alexandria clover were statistically ensured at very significant level and ranged between 3.76 t/ha (18 kg alfalfa/ha + 4 kg Alexandria clover/ ha) and 7.69 t/ha (22 kg alfalfa/ha + 12 kg Alexandria clover/ha).

Alexandria clover participates to the achievement of the first and second cutting yields, the third cutting yield being totally ensured by alfalfa.

Because of biological adjustment between these two species (alfalfa and Alexandria clo-

Table 1. Effect of sowing rate on dry matter yield (t/ha) of alfalfa and Alexandria clover mixtures, under dry land conditions (A.R.S. Teleorman, 1996-1998)

Sowing rate		Years									Average of years		
		1996*			1997**			1998**			1996-1998		
Alfalfa kg/ha	Alex. clover kg/ha	t/ha	%	diff. t/ha	t/ha	%	diff. t/ha	t/ha	%	diff. t/ha	t/ha	%	diff. t/ha
22	0	4.22	100	mt.	12.92	100	mt.	9.21	100	mt.	8.78	100	mt.
	4	9.57	226	+5.35	13.62	105	+0.70	9.99	108	+0.78	11.06	126	+2.28
	8	10.56	250	+6.34	13.00	101	+0.08	9.81	107	+o.60	11.12	127	+2.34
	12	11.21	282	+7.69	12.94	100	+0.02	7.76	84	-1.45	10.87	124	+2.09
20	0	4.71	111	+0.49	12.86	100	-0.06	9.00	98	-0.21	8.86	101	+0.08
	4	8.71	206	+4.49	13.55	105	+0.63	9.70	105	+0.49	10.65	121	+1.87
	8	9.75	231	+5.53	12.21	95	-0.71	8.86	96	-0.35	10.27	117	+1.49
	12	10.07	238	+5.85	11.44	89	-1.48	7.95	86	-1.26	9.82	112	+1.04
18	0	4.86	115	+0.64	11.90	92	-1.02	7.44	81	-1.76	8.07	92	-0.71
	4	7.98	189	+3.76	10.78	83	-2.14	7.02	76	-2.12	8.59	98	-0.19
	8	9.39	222	+5.17	10.34	80	-2.58	7.19	78	-2.02	8.97	102	+0.19
	12	9.61	227	+5.39	9.58	74	-3.34	5.93	64	-3.28	8.37	95	-0.41
16	0	4.00	95	-0.22	10.27	79	-2.65	5.55	60	-3.66	6.61	75	-2.71
	4	8.27	195	+4.05	9.59	74	-3.33	6.12	66	-3.09	7.99	91	-0.79
	8	8.99	213	+4.77	8.79	68	-4.13	6.31	69	-2.90	8.03	91	-0.75
	12	9.36	221	+5.14	7.82	61	-5.10	5.47	59	-3.74	7.55	86	-1.23
	B x A												
	LSD 5%		1.58			0.26			0.81			0.51	
	LSD 1%		2.12			0.35			1.07			0.68	
	LSD 0.1%		2.80			0.47			1.39			0.88	

ver) the yield differences from the second and third years of vegetation were relatively small, depending on the sowing rate.

On an average, during one crop cycle, the dry matter yields were influenced by the sowing rate as well as the evolution of climatic factors during the experimental years. Very significant yield gains (1.04-2.34 t/ha) were obtained in variants with 20-22 kg alfalfa seed/ha, no matter of Alexandria clover seed quantities utilized in the first year of vegetation. When 18 or 16 kg alfalfa seed/ha have been used, the yield differences were negatively significant or very significant. It was established that the best mixture consists of 20-22 kg alfalfa/ha and 4-6 kg Alexandria clover/ha.

In the first and second years of vegetation, the effect of alfalfa embarrassment by the Alexandria clover plants was put in evidence by the root development degree on 0-25 cm level. The data presented in table 2, show the alfalfa embarrassment degree depending on the Alexandria clover weight.

Table 2. Effect of sowing rate on root quantity (t dry matter/ha) accumulated into soil (0-25 cm) at the end of first and second years of alfalfa vegetation, under dry land conditions (A.R.S. Teleorman, 1996,1997)

Sowing rate		First year		Second year	
Alfalfa kg/ha	Alexandria clover kg/ha	t/ha	%	t/ha	%
22	0	2.24	100	4.32	100
	4	1.92	86	3.04	70
	8	1.76	89	2.72	63
	12	1.60	71	2.56	59
20	0	1.92	86	4.00	93
	4	1.76	79	3.04	70
	8	1.60	71	2.63	61
	12	1.44	64	2.08	48
18	0	1.60	71	3.04	70
	4	1.44	64	2.88	67
	8	1.28	57	2.40	56
	12	1.12	50	2.24	52
16	0	1.44	64	2.72	63
	4	1.26	56	2.56	59
	8	1.12	50	2.10	49
	12	0.80	36	1.92	44
B x A					
LSD 5%			0.23		0.20
LSD 1%			0.31		0.27
LSD 0.1%			0.41		0.35

In order to emphasize the importance of root system development on aerial vegetative mass yield, the correlation between these two component parts was calculated. A very significant positive correlation, between root mass and aerial vegetative mass (r = 0.97 and r = 0.75 respectively) at the end of the first year as well as at the end of the second year of vegetation, was noticed (Figures 2, 3).

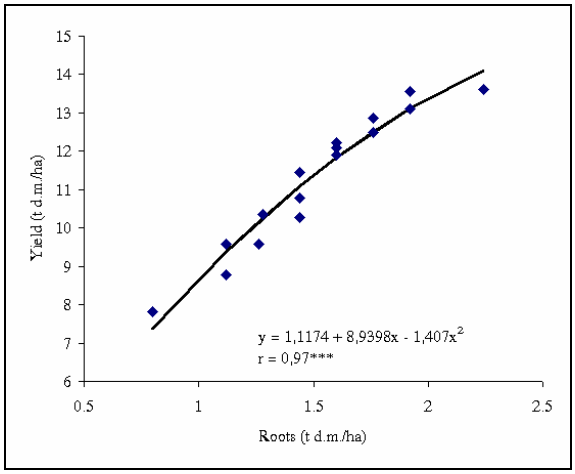

Figure 2. Relationship between root mass and aerial vegetative mass of alfalfa in the first year, depending on the sowing rate, under dry land conditions (on 0-25 cm depth)

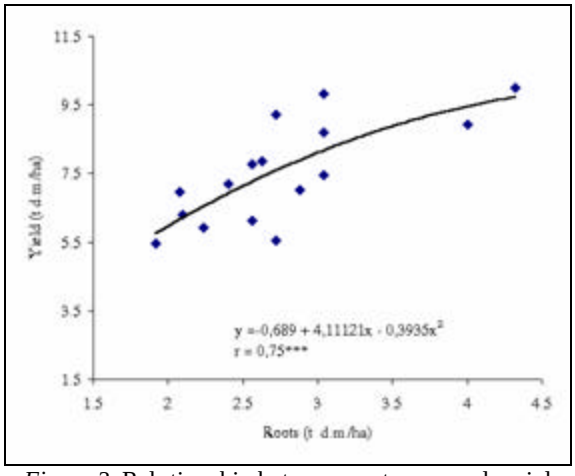

Figure 3. Relationship between root mass and aerial vegetative mass of alfalfa in the second year, depending on the sowing rate, under dry land conditions (on 0-25 cm depth)

It has been also established that the Alexandria clover had an influence on the soluble carbohydrates content of alfalfa roots and root neck, more accentuated in the first year of vegetation and much more reduced in the second and third years (Table 3).

Table 3. Effect of sowing rate on soluble carbohydrates content of alfalfa (roots and root neck), under dry land conditions (A.R.S. Teleorman, 1996-1998)

Sowing rate		Soluble carbohydrates content (%)			
Alfalfa kg/ha	Alexandria clover, kg/ha	First year	Second year	Third year	Years average
22	0	13.12	14.13	15.00	14.08
	4	12.18	13.75	14.52	13.48
	8	12.14	13.38	14.08	13.20
	12	12.03	12.67	13.75	12.82
20	0	14.50	14.06	14.94	14.50
	4	13.13	13.75	14.25	13.71
	8	12.50	13.18	14.20	13.29
	12	12.43	13.13	14.18	13.25
18	0	15.31	15.62	16.00	15.64
	4	14.13	14.06	14.91	14.37
	8	13.05	14.06	14.88	14.00
	12	13.03	13.75	14.44	13.74
16	0	14.10	14.20	15.00	14.43
	4	13.38	13.50	14.35	13.74
	8	13.18	13.45	14.12	13.58
	12	12.34	13.18	14.08	13.20
	B x A				
	LSD 5%	0.33	0.22	0.14	0.48
	LSD 1%	0.48	0.38	0.26	0.65
	LSD 0.1%	0.66	0.50	0.44	1.12

The embarrassing effect of Alexandria clover on further development of alfalfa decreases beginning with the second year of vegetation, but is being maintained during the whole crop cycle; this is minimum in variants consistind of 20-22 kg alfalfa/ha + 4 kg Alexandria clover/ha.

As regards the growth rhythm (Table 4), Alexandria clover has an intense growth during the whole vegetation (0.27 cm/day at first cutting and 0.47 cm/day at the second cutting), with great yield gains obtained at these cuttings.

One of the important morphological features, which contributes to the improvement of fodder quality, is the proportion of leaves. In this sense, the results obtained stand out that, the weight of plant valuable components (leaves, flower buds) to the fodder yield achievement, gradually decreases from the first year to the third year of vegetation, in favour of stems and it is influenced by the utilized sowing rate (Table 5).

Table 4. Growth rhythm (cm) of mixture component parts in the first year of vegetation (first cutting and second cutting) under dry land conditions (A.R.S. Teleorman, 1996)

Variants	Species*	Date:								Medium rhythm (cm/day)	
		12.05	29.05	03.06	13.06	23.06	16.07	26.07	05.08		
		First cutting					Second cutting			12.05-23.06	16.07-05.08
a_1b_1	A	3.05	7.20	12.90	23.75	36.55	14.90	27.85	39.60	0.21	0.41
	C	-	-	-	-	-	-	-	-	-	-
a_1b_2	A	3.00	7.00	12.10	21.45	37.20	13.85	25.40	38.65	0.20	0.39
	C	3.55	8.02	12.90	27.30	44.80	19.25	26.50	38.50	0.21	0.41
a_1b_3	A	2.98	6.20	13.70	22.55	34.75	15.20	25.10	41.95	0.20	0.41
	C	3.72	8.14	13.45	29.70	44.15	20.25	28.90	36.35	0.25	0.43
a_1b_4	A	3.00	6.22	11.25	24.00	37.50	13.35	26.90	36.80	0.20	0.39
	C	4.05	9.00	15.20	30.00	45.60	21.10	28.30	33.60	0.26	0.42
a_2b_1	A	3.10	6.04	13.70	25.50	35.30	17.20	29.05	41.05	0.21	0.42
	C	-	-	-	-	-	-	-	-	-	-
a_2b_2	A	2.78	5.51	12.30	25.75	38.00	16.25	26.55	39.60	0.21	0.41
	C	3.38	8.66	13.70	29.30	43.55	18.85	29.00	40.05	0.25	0.41
a_2b_3	A	2.96	6.52	13.30	25.10	38.85	14.95	26.50	38.70	0.22	0.40
	C	3.75	8.35	13.90	29.95	47.45	21.90	27.95	37.55	0.26	0.44
a_2b_4	A	3.06	5.70	12.50	24.10	39.05	13.85	23.55	36.70	0.21	0.37
	C	3.60	8.00	13.55	30.10	47.75	19.85	28.95	37.75	0.26	0.43
a_3b_1	A	3.27	8.20	13.85	26.10	37.30	21.15	28.80	40.50	0.22	0.45
	C	-	-	-	-	-	-	-	-	-	-
a_3b_2	A	3.02	6.34	14.95	23.30	35.45	16.60	27.60	36.40	0.21	0.40
	C	3.52	7.85	13.45	29.35	43.30	20.65	29.45	36.85	0.24	0.44
a_3b_3	A	2.91	5.74	13.95	20.45	38.15	14.53	27.50	40.05	0.20	0.41
	C	3.70	7.96	13.40	32.00	44.60	20.95	28.85	39.70	0.25	0.45
a_3b_4	A	3.04	6.88	14.05	22.50	38.20	15.45	27.35	39.76	0.21	0.41
	C	4.32	9.38	14.10	30.95	43.05	21.60	30.15	40.95	0.25	0.46
a_4b_1	A	3.00	6.73	14.00	21.50	34.70	17.70	28.05	38.70	0.20	0.42
	C	-	-	-	-	-	-	-	-	-	-
a_4b_2	A	3.13	7.00	14.25	22.90	36.10	17.05	27.00	39.45	0.20	0.42
	C	4.56	9.88	15.00	29.05	43.25	20.10	30.55	40.90	0.25	0.47
a_4b_3	A	3.15	7.00	15.60	24.15	35.25	15.60	25.05	36.55	0.21	0.39
	C	4.23	9.00	14.20	30.70	41.95	20.30	27.75	38.00	0.25	0.43
a_4b_4	A	2.70	5.77	13.00	24.20	36.40	15.50	24.00	40.55	0.21	0.40
	C	4.66	9.43	14.30	30.75	48.93	20.75	27.70	40.70	0.27	0.45

Table 5. Sowing rate effect on the weight of plant components from alfalfa and Alexandria clover mixture to the fodder yield achievement, under dry land conditions (A.R.S. Teleorman, 1996- 1998)

Sowing rate		First year					Second year			Third year		
		Alex. clover			Alfalfa***		Alfalfa***			Alfalfa***		
Alfalfa kg/ha	Alex. clover kg/ha	Leaf %	Stem %	Floral bud %	Leaf %	Stem %	Leaf %	Stem %	Floral bud %	Leaf %	Stem %	Floral bud %
22	0	-	-	-	60	40	56	41	3	53	44	3
	4	37	59	4	56	44	52	46	2	49	50	1
	8	45	48	7	54	46	48	47	5	46	53	1
	12	52	40	8	52	48	48	49	3	46	52	2
20	0	-	-	-	58	42	53	44	3	50	48	2
	4	39	56	5	55	45	49	48	3	46	50	4
	8	44	48	8	48	48	49	47	4	46	53	1
	12	49	41	10	51	49	47	47	6	44	55	1
18	0	-	-	-	55	45	49	49	2	46	52	2
	4	36	59	5	53	47	48	48	4	45	53	2
	8	42	49	9	50	50	46	52	2	43	54	3
	12	48	41	11	48	52	46	49	5	43	54	3
16	0	-	-	-	52	48	45	50	5	43	54	3
	4	36	57	7	50	50	43	54	3	41	57	2
	8	46	44	10	49	51	43	55	2	41	57	2
	12	51	37	12	46	54	42	54	4	40	56	4

In order to observe the embarrassment effect of Alexandria clover on alfalfa development in the second and third years of vegetation, the leaf area (cm^2/plant) for each species and for each cutting and experimentation year was determined. The greatest leaf area was achieved in the first year of vegetation (67.97 - 75.48 cm^2/plant), aspect which underlines the important contribution of Alexandria clover to the superior yield achievement in comparison with pure alfalfa crop. Taking into account other technological factors, the leaf area is influenced by the utilized sowing rate and it diminishes from the first cutting to the fourth one and from the first year of vegetation to the third one (Table 6).

Table 6. Sowing rate effect on leaf area (cm^2/plant) realized by alfalfa and Alexandria clover mixture, under dry land conditions (A.R.S. Teleorman, 1996-1998)

Sowing rate kg/ha		First year		Second year		Third year	
		Alfalfa + Alex. clover		Alfalfa		Alfalfa	
Alfalfa	Alex. clover	cm^2/plant	%	cm^2/plant	%	cm^2/plant	%
22	0	48.68	100	50.85	100	40.34	100
	4	67.97	140	48.77	96	39.55	98
	8	75.03	154	47.01	92	39.08	97
	12	75.48	155	45.88	90	38.86	96
20	0	47.80	98	58.29	115	40.43	100
	4	70.52	145	50.10	99	40.34	100
	8	72.04	148	47.76	94	38.76	96
	12	73.81	152	45.17	89	39.85	99
18	0	46.53	96	54.90	108	39.80	99
	4	69.81	143	52.23	103	38.54	96
	8	74.12	152	49.35	97	36.28	90
	12	74.03	152	47.52	93	38.75	96
16	0	44.78	92	49.16	97	39.18	97
	4	71.38	147	47.24	93	37.18	92
	8	71.28	146	44.06	87	35.33	88
	12	73.66	151	43.26	85	35.20	88
B x A							
LSD 5%			1.51		0.86		0.75
LSD 1%			2.07		1.16		1.00
LSD 0.1%			2.79		1.53		1.33

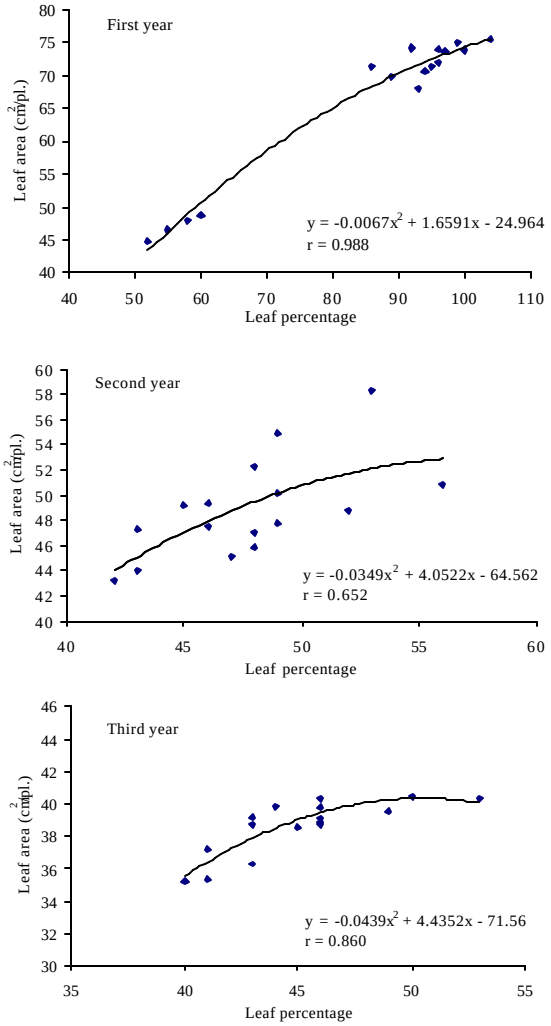

Figure 4. Relationship between leaf percentage and leaf area of alfalfa, depending on the sowing rate, under dry land conditions (A.R.S. Teleorman, 1996-1998)

The coefficients of quadratic regression, which describe the relationship between leaf percentage and leaf area, suggest a very significant positive correlation between these two factors, depending on the utilized sowing rate (Figure 4).

If we take into account the crude protein yields achieved during the three years of vegetation, we notice at sowing of alfalfa and Alexandria clover mixture, an yield gain in comparison with pure alfalfa crop of 720-1266 kg crude protein/ha (92-162%) in the first year of vegetation. In the second and third year of vegetation, the crude protein yields become normally uniform (Table 7).

On an average, as regards the crude protein yield during one crop cycle, the alfalfa with Alexandria clover mixture exceeds the alfalfa pure crop with a very significant gain of 412 kg crude protein/ha in comparison with alfalfa pure crop which achieves less with 405 kg crude protein/ha, yield difference very negatively significant, because of medium crude protein content from plant.

The calculation of regression equations emphasized the close connection (r = 0.99***) between mean yield of dry matter and mean yield of crude protein (Figure 5).

The advantage of the proposed technology, consists in the fact that, economically, the yield expenses decreases with 30% compared

Table 7. Effect of sowing rate on crude protein yield achieved by alfalfa and Alexandria clover mixture, under dry land conditions (A.R.S. Teleorman, 1996-1998)

Sowing rate		Years									Average years I-III		
		I			II			III					
Alfalfa kg/ha	Alex. clover kg/ha	kg/ha	%	diff. kg/ha	kg/ha	%	diff. kg/ha	kg/ha	%	diff. kg/ha	kg/ha	%	diff. kg/ha
22	0	781	100	control	2406	100	control	1658	100	control	1615	100	control
	4	1693	217	+912	2487	103	+81	1823	110	+165	2001	124	+386
	8	1828	234	+1047	2445	102	+39	1809	109	+151	2027	126	+412
	12	2047	262	+1226	2426	100	+20	1401	84	-257	1958	121	+343
20	0	916	117	+135	2379	99	-27	1643	99	-15	1646	102	+31
	4	1590	204	+809	2490	103	+84	1831	110	+173	1970	122	+355
	8	1725	221	+944	2289	95	-117	1661	100	+3	1892	117	+277
	12	1762	226	+981	2123	88	-283	1436	87	-222	1774	110	+159
18	0	926	119	+145	2231	93	-175	1409	85	-249	1522	94	-93
	4	1501	192	+720	2001	83	-405	1273	77	-385	1592	99	-23
	8	1702	218	+921	1887	78	-519	1299	78	-359	1629	101	+14
	12	1742	223	+961	1802	75	-604	1115	67	-543	1553	96	-62
16	0	765	98	-16	1855	77	-551	1010	61	-648	1210	75	-405
	4	1535	197	+754	1726	76	-680	1148	69	-510	1470	91	-145
	8	1596	204	+815	1616	67	-790	1171	71	-487	1461	94	-154
	12	1674	214	+893	1442	60	-964	1026	72	-632	1383	86	-234

with traditional technology.

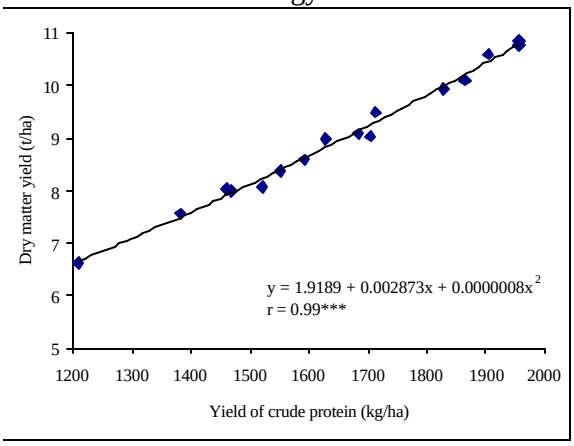

Figure 5 - Relationship between dry-matter yield and crude protein yield, the I-III year average, depending on the sowing rate, under dry land conditions (A.R.S. Teleorman, 1996-1998)

CONCLUSIONS

The alfalfa with Alexandria clover mixture is superior as regards the productivity as well as the fodder quality achieved in comparison with pure crop.

The cultivation of alfalfa under protecting plant (especially in the south of the country) can give yield gains till 60%, in the first year of vegetation.

At A.R.S. Teleorman, under dry land conditions, the best mixture consists of 20-22 kg alfalfa/ha + 4 kg Alexandria clover/ha. Taking into account these sowing rates, the competition between the two component parts is relatively balanced and it achieves very significant yield gains. In this variant of mixture (20-22 kg alfalfa/ha + 4 kg Alexandria clover/ha), on an average of three years, 1,970 – 2,001 kg crude protein/ha (17-24% gain) in comparison with pure alfalfa crop were obtained.

Considering a mixture in a quantity of 12 kg/ha, the embarrassment effect of Alexandria clover on the alfalfa plants is enough obvious.

The roots accumulation on 0-25 cm depth is considerably influenced by the nutrition space of plants and by the sowing rate; root quantity of alfalfa decreases according to the increasing of Alexandria clover seed rate.

The leaf area and the leaf percentage were influenced by the sowing rate, by the evolution of climatic factors during the experimentation years as well as by the characteristics of tested cultivars. The advantage of the proposed technology is expressed by the significant yield gains and by the fodder production with low energetic consumptions.

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