RESEARCH ON *TRIFOLIUM PRATENSE* L. FERTILITY IN RELATION WITH THE CROP SYSTEM

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Abstract. *The importance of red clover as forage crop and in rotations for soil improvement is well known, but a great attention is being paid in various countries, to the study of those factors which influence the seed-set of this plant. The present work deals with two of the factors, namely the influence of sowing system and harvest years on red clover seed set. We have tested in one stationary experiment the seed-set capacity of Select 1 Romanian variety of red clover, in relation with 5 different sowing systems and two cropping years. There were done observations regarding the number of offshoots per plant, the number of branches per offshoot, the number of capitula (heads) per plant, the number of flowers per capitulum, the number of seeds per capitulum in the both years of culture. Correlations between the red clover productivity elements were done also, and recommendations for the farmers who are interested in seed productions for red clover crops.*

Keywords: red clover, seed-set, sowing systems, productivity elements

INTRODUCTION

Red clover is one of the cultivated plants in Romania and in over the world, of which seeds yield comes under a very large oscillations.

Red clover seed production is dependent on several factors, including: plant morphology, crop technology, soil fertility, climatic conditions, frequency of pollinators, the method of harvesting, etc. Seed yield range from 60-300 kg/ha depending on season and management [1]. Number of capitula (heads) per plant (and per unit area), number of flowers per capitulum and percentage of seeds in capitulum are very important morphological elements for red clover seed yield [7]. As a rule of thumb, 30 seeds per head indicate about 130-150 kg/ha [2].

Every variety of red clover has these morphological productivity elements influenced by some technological aspects [8].

Our research purpose is to establish the influence of sowing systems of red clover in two growing years, and the interactions between sowing systems and productivity elements, specific for an important Transilvanian area.

MATERIAL AND METHOD

The research upon establishing the optimal sowing system of red clover crop for seed yield, took place during 2010 and 2012 agricultural years in one stationary experience on a private property field from Ludus city, which belongs to Mureş County. The experimental field is situated on a moderately inclined northern slope. The soil type is haplic luvisol (haplic luvisol –FAO, UNESCO), with medium fertility, content of 2,7-3,29% humus, slightly-moderate acid reaction (pH = 5,17-

6,06), clay texture (40-42% clay in Ap), moderately mesobasic, medium content of nitrogen and potassium, small content of phosphorus, the underground water layer at 12-13 m depth. This soil is classified in the 3rd quality class with 47 points of fertility potential of arable using.

The experiment was a two factorial one, organized by the method of randomized blocks, with five variants in four rehearsals.

The factors which were studied are as follows:

- Factor A: the year of red clover harvest:
  - a_1 – first year of vegetation,
  - a_2 – second year of vegetation.
- Factor B: the sowing system:
  - b_1 – 20 kg/ha seed, 15 cm between the rows,
  - b_2 – 16 kg/ha seed, 15 cm between the rows,
  - b_3 – 10 kg/ha seed, 30 cm between the rows,
  - b_4 – 5 kg/ha seed, 45 cm between the rows,
  - b_4 – 2.5 kg/ha seed, 60 cm between the rows

The observations were done at harvest time, when the flower heads reached the light-brown colour stage.

Statistical methods for data processing where Analyses of Variance and Correlations. The differences between variants were interpreted by LSD 5%, 1% , 0.1% and Duncan test for p5%. The correlation significance were established for p 5%, 1% and 0.1% upon Fisher and Yates (1957).

RESULTS AND DISCUSSION

One of the disputed issues related to red clover seeding culture, is the establishment of special lots or harvesting of seeds from ordinary crops for forage. Some researchers [3], [4] and [5] recommend red clover culture in special lots, using seed amounts between 6 and 10 kg/ha, and 30 and 40 cm distances between rows. Other researchers [6], [9] and [3] opt for ordinary sowing (for forage) using 18-20 kg seed per ha and the distance of 12.5 cm between rows. They affirm that the rare sowing is not justified unless it is necessary that a valuable variety to be multiplied in a very short time.

Our results show that the both experimental factors studied exercise a large influence on the seed-set elements and red clover seed yield (tab.1).

Low rates of seed per hectare (less than 10 kg) completed by sowing at distance over 30 cm between rows favor seed production very significantly. Close sowing does not favor the production of seed, although seed sown rate per hectare is increased.

Delaying seed harvest in the second year of culture favors increase of production in close seeded variats, but not close to production of spaced sowed variants.

At very large distances between rows (60 cm), from variants on which were used only 2.5 kg seed/hectare, delaying of clovers seed harvesting for the second year leads to diminished of the production distinctly significantly.

Table 1.

The influence of sowing system and year of harvest on the Red Clover seed yield

Number of variant	Sowing variant	Seed yield (kg/ha)			
		1st year (2010)	2nd year (2011)	Significance 2nd year/1st year	average
1	20kg/ha; 15 cm	196Ct	249Ct	**	222.5 Ct
2	16 kg/ha; 15 cm	237*	266	*	251.5*
3	10 kg/ha; 30 cm	328***	323***	-	325.5***
4	5 kg/ha; 45 cm	378***	351***	-	364.5***
5	2.5kg/ha; 60 cm	417***	375***	oo	396.5***
	*/o	$LSD_{5\%}$ = 30.84		$LSD_{5\%}$ = 28.24	$LSD_{5\%}$ = 23.51
	**/oo	$LSD_{1\%}$ = 44.42		$LSD_{1\%}$ = 40.15	$LSD_{1\%}$ = 34.19
	***/ooo	$LSD_{0.1\%}$=65.66		$LSD_{0.1\%}$=58.13	$LSD_{0.1\%}$=51.29

Ct = control variant, */o = statistically significant differences, **/oo = distinctly significant differences, ***/ooo = higly significant differences

According to Duncan Classification, sowing system that leads to obtaining the best red clover seed production include: 2.5 kg/ha seed rate; 60 cm distance between the rows and seed harvesting in the 1st year (tab.2). Next version in order of seed yield (significant different by the first) is provided by the sowing system: 5 kg/ha seed rate; 45 cm distance between the rows and seed harvesting in the 1st year. The same sowing systems follow, but the seed harvesting is in the second year of red clover crop.

Table 2.

Duncan classification of seed yield from tested variants

Rating	Variant	Seed yield (kg/ha)	Classification
1	20kg/ha; 15 cm , 1st year	196	A
2	16 kg/ha; 15 cm ,1st year	237	B
3	20kg/ha; 15 cm , 2nd year	249	B
4	16 kg/ha; 15 cm , 2nd year	266	B
5	10 kg/ha; 30 cm, 2nd year	323	C
6	10 kg/ha; 30 cm, 1st year	328	C
7	5 kg/ha; 45 cm, 2nd year	351	CD
8	2.5kg/ha; 60 cm, 2nd year	375	D
9	5 kg/ha; 45 cm, 1st year	378	D
10	2.5kg/ha; 60 cm, 1st year	417	E

The variation of studied fertility elements are lergely influenced by amount of seed sown and sowing distance (tab.3). Thus, it may be asserted that there were obtained significant differences at all the studied elements in the case when there were used smaller seed quantities: 5 or 2.5 kg/ha sown at 45 and 60 cm distance between rows, in both harvest year.

Table 3.

The influence of sowing system and year of harvest on the elements of seed-set capacity

Seed-set elements / Variant	Average number of offshoots per plant		Average number of branches of main offshoots		Average number of hads per plant		Average number of flowers per head		The rate of seed-setting %	
year	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
20kg/ha 15 cm	14.3	30.1	2.2	2.6	41.5	42.6	78.3	89.5	39.5	40.5
16 kg/ha 15 cm	15.5	31.5	2.5	2.7	43.2	44.3	92.5	95.1	44.8	46.2
10 kg/ha 30 cm	16.7	32.2	2.9	3.5	48.1	45.1	115.4	106.3	57.0	54.3
5 kg/ha 45 cm	18.9	35.0	4.2	2.8	52.3	47.6	119.3	117.7	60.1	56.6
2.5kg/ha 60 cm	20.1	35.2	3.2	5.0	55.7	49.8	125.7	110.3	63.4	61.4
LSD 5%	0.94	1.49	0.30	0.24	2.96	4.64	16.38	9.43	2.94	2.31
LSD 1%	1.37	2.17	0.43	0.35	4.31	6.74	23.83	13.71	4.27	3.35
LSD 0.1%	2.06	3.25	0.64	0.53	6.46	10.12	35.74	20.56	6.41	5.03

Table 4.

Matrix of correlation coefficients (r) for red clover productivity elements

The variable	Number of offshoots per plant	Number of branches of main offshoots	Number of hads per plant	Number of flowers per head	The rate of seed-setting %	Seed yield (kg/ha)
Number of offshoots per plant	1.000	0.739	0.993***	0.933*	0.949*	0.980**
Number of branches of main offshoots	-	1.000	0.775	0.775	0.790	0.796
Number of hads per plant	-	-	1.000	0.950*	0.967**	0.991***
Number of flowers per head	-	-	-	1.000	0.997***	0.982**
The rate of seed-setting %	-	-	-	-	1.000	0.992***
Seed yield (kg/ha)	-	-	-	-	-	1.000

*p 5%, **p1% and ***p 0.1% (Fisher and Yates, 1957)

Inasmuch as the harvest year is concerned, there has been established that in the variants sown at larger distance, the productivity elements are higher at seed producers harvested during first year of vegetation. The exception is in the average number of offshoots per plant which is higher in the second year of vegetation.

If we analise the relation between the red clover morphological seed production elements (tab. 4) we can conclude that the number of hads per plant and the rate of seed-seting per heads are in higly significant relation with the seed yield. Starting with the number of offshots per plant which defines higly significant the number of hads per plant, continuing with the number of flowers per head which higly defines the rate of seed-setting, we can say that the whole technology for seed red clover has to participate for a good offshooting, flowering and pollination, for a hight seed production.

CONCLUSIONS

We may conclude that:

- the number of offshoots per plant, the number of branches per offshoots, the number of heads (capitula) per plant, the number of flowers per head, the number of seeds per heads, represent those elements which determine, to a greater extent, the seed-set capacity of red clover.
- Besides the genetic traits of the Select 1 variety, it is belived that the crop sistem has an important rol in the evolution of the elements of seed-set capacity.
- It is recommended, in order to stymulate the seed yield, to sow at 45 or 60 cm between the rows.
- In case of emergency, the seed could be harvested in the first year of cuture, in which case the yield may be even larger than in the second one.
- In order to prevent a possible decrease in plant perenity, it is avoid to use of this technique for several years.

REFERENCES

1. Bowley S.R.and R.A.Upfold (1985) Producing Red Clover seed in Ontario, OMAFA Factshet 85-068/June 1985.

2. Hawkins R.P.(1956) A preliminary survey of red clover seed production, Annals of Applied Biology, 44:657-664. Doi: 10.1111/j.1744-7348.1956.tb02165.x.

3. Janossy A. (1968) Production and breeding of clovers. Academiai kiadó. Budapest

4. Picard J. (1967) Quelque aspects de la production de semences de trefle violet. Fourage.8.

5. Piua I. (1977) Red clover crop for seed. Production and storage for forages. Ed. Did. And Ped., Bucharest

6. Popa T., I. Tucra (1964) Experimental results regarding red clover crop for seed. Rev. Zoot. and Med. Vet. 6. Bucharest

7. Savatti M. (1976) Contributions to the *Trifolium pratense* L biology for it breeding. Not.Bot. Horti Agrobot. Cluj Napoca. 8: 47-48.

8. Stana Doina (1997) Research regarding some crop technology aspects for red clover. USAMV Cluj Napoca. Ph.D Diss.45-59

9. Steiner, J.J., R.R. Smith, and S.C. Alderman (1997) Red clover seed production: IV. Root rot resistance under forage and seed production systems. Crop Sci. 37:1278–1282