GREEN MANURE TECHNOLOGY IN THE CONDITIONS FROM NORH WESTERN ROMANIA

Cornel DOMUŢA [1], Ioana BORZA[2], Cristian DOMUŢA [3]

Abstract. *The paper is based on the research carried out in an experiment placed in 2010, on a soil with 10 % slope at Agricultural Research and Development Station Oradea. The green manure like main crop is 100 %. Like double crop, the green manure will be seeded before 15th Jily. The green manure yield decreased together with the seed datum is later. Both in the first year of the effect, the yields determined in the variant with lupin+oat+rape were bigger than yields obtained in the variant with lupin, pure crop. The same situation was registered concerning the water use efficiency.*

Keywords: Green manure, technology, sustainable agriculture

1. Introduction

The green manure use is very old agricultural practicing. In the midddle of the XX century a lot of research (Eliade et al, 1983) demonstrated the negative influence of the young green manure (due small C/N report) under the soil because the microbiological procceses are intensified and after green manure mineralized too. [18]

Roger 1976, quoted by Eliade Gh et al, 1983 purposed the use of the mixture crop composed by vetch (30-40 kg/ha) +rye (80 kg/ha) +raigras (0-10 kg/ha). The author purposed the use of the rye on the soil with *Agropyron repens*, the use of the rye (50 kg/ha) and rape (5-10 kg/ha) on the soil with *Sinapis arvensis* and *Raphanus raphanistrum.* [18, 21]

Starting by Roger's conclusions, Domuţa C. in 1988 at Pocola and in 1990 at Beiuş and starting in 2000 at Oradea used the mixture crop for green manure composed by lupin+millet+oat, lupin+rye+rape, lupin+oat; the lupin is the most known green manure from Romania and this was the premisa to realize the mixture crop for green. [13, 14, 15, 16, 17]

One of the most important component of the green manure technology is to establish the sowing period because is very important for farmers if the green manure will be seeded in the 1st crop or in the 2nd crop. The effect of the green manure in the 1st and

[1] Prof., PhD, Researcher, Faculty of Environmental Protection, University of Oradea, (*domuta_cornel@yahoo.com*)
[2]Lecturer, PhD, Faculty of Environmental Protection, University of Oradea, (*borzaioanamaria@yahoo.com)*
[3]Lecturer, PhD, Faculty of Environmental Protection, University of Oradea, (*cristian_domuta@yahoo.com*)

2nd year after the harvesting on yield maize and on water use efficiency are studied in this paper.

2. Material and Methods

The experiment placed in 2010 had two factors: organic fertilization and annual fertilization. Organic fertilization included the variants: control, *lupin*; *Lupinus angustifolius* + oat + rape. Annual fertilization included the graduations: N_0P_0, $N_{120}P_{90}$. Number of repetition used: 4; the plot surface: 100 m^2. The green manures, were sowed like 2nd crop in the 15th July, 3rd August and 20th August. The seed rates used were: *Lupinus angustifolius* in pure crop, 200 kg/hectare; *Lupinus angustifolius* in mixture, 100 kg/hectare; oat, 80 kg/hectare; 10 kg/hectare in mixture crop. Green manures were harvestest at the flowering of the *Lupinus angustifolius*; the green manures were maintained on the soil surface 15 days and after that a ploughland was made.

Water use efficiency was calculated reporting the yield with water consumption. The water consumption was determined by soil water balance based on direct determination of the moisture. Water balance depth used was 0-150 cm. [8,9]

3. Results and Disscusions

Green manure technology sowing data

At the sowing data of the green manure, on 0-25 depth, soil water reserve was over the easily available water content (in 15th July) was a little bellow this parameter (in 3rd August), or a deficit of the soil moisture was registered. In the first stage, after 2 days, the rainfall of 8.4 mm were registered; in the next stages, the first rainfall after sowing were registered after 7 days (30.7 mm) and 8 days (3.0 mm, insignificant). The rainfall registered during the vegetation periods of the green manure were much bigger than multi annual average for these periods; the differences were of 78.2 % for first stage, 86.9 % for second stage and 65.8 % for last sowing stage. (Table 1).

Table 1. The analisys of the conditions registered at the green manure sowing, Oradea 2010

Sowing data	Soil water reserve analisys					Number of days to 1st rainfall	1st rainfall (mm)	Total rainfall during the vegetation period (mm)	
	WR (m^3/ha)	Wea		WP				2010	Multianual average
		(m^3/ha)	%	(m^3/ha)	%				
15.07	774	+111	+17	+439	131	2	8.4	271.0	152.1
03.08	576	-87	-13	+241	71	7	30.7	218.3	116.8
20.08	461	-202	-30	+126	37	8	3.0	161.8	97.6

WR-Soil water reserve (on 0-25 cm depth);

Wea- Easily available water content;

WP- Wilting point;

Yields of the green manures

The very favorable regime of the rainfall determined to obtain the big yields of green manure in the first and second stage of the sowing and good yields in the third stage. The variance analysis emphasized that in the other type of the green manure were obtained the yield smaller than in *Lupinus angustifolius*, pure crop; the exception is the mixture *Lupinus angustifolius*- oat- rape. In the average on the 6 green manure types, the sowing datum of 20 August determined a yield decrease, very significant; the differences were of - 44 % in comparison with sowing datum of 15.07 and of – 41 % in comparison with sowing datum of 3th July. (Table 2).

Table 2. The influence of the sowing datum on green manure yield, t/ha, Oradea 2010

Sowing datum	Green manure variant		The average of the sowing period
	Lupinus angustifolius	*Lupinus angustifolius* +oat + rape	
15.07	41.0	28.7	41.05
03.07	41.3	33.6	39.65
20.08	29.6	18.6	23.00
The average on the variant	37.3^{Mt}	27.00^{000}	-

	Sowing datum	Green manure variant	Green manure variant x sowing datum	Sowing datum x Green manure variant
LSD 5 %	4.20	2.30	2.92	7.28
LSD 1 %	5.62	3.49	4.83	9.74
LSD 0.1 %	7.36	5.60	6.95	12.74

Maize yields the first year of the organic fertilizer effect

In the variant with pure crop of *Lupinus angustifolius*, in comparison with the control, the yields gains were of 499 kg/hectare for first sowing stage of the green manure, 396 kg/hectare for second sowing stage and 380 kg/hectare for third sowing stage. In the *Lupinus angustifolius* mixture the yield gains were bigger than yield gain obtained in *Lupinus angustifolius* pure crop.

Only annual fertilization with $N_{120}P_{90}$ determined to obtain an yield gain of 28 % (1360 kg/ha). (Table 3)

Maize yield in the second year of the organic fertilizer effect

In the second year of the organic fertilization effects, the level of the maize yields were lower because the rainfall registered during the maize vegetation period were of 194.9 mm in comparison with 296 mm in the first year of the effect; the rainfall distribution in the first year of the effect was better, too.

In the variant with *Lupinus angustifolius* without annual fertilization, the differences in comparison with the control were of 273 kg/hectare for first sowing period of the green manure, 374 kg/hectare for second sowing period and of 133 kg/hectare for third sowing period of the green manure.

In the variants with mixture of *Lupinus angustifolius* the difference obtained in comparison with control was bigger than *Lupinus angustifolius* pure crop.

Annual chemical fertilization of the organic variant determined to obtain the maize yield gain bigger than maize yield gain obtained in the variant with organic fertilization only. The yield gains were of 67 % in the variant with *Lupinus angustifolius* + oat + rape. (Table 3)

Table 3. The influence of the fertilization with green manure second crop (15.07.2010) on maize yield (q/ha) 1st and 2nd year of effect, in the conditions from Oradea, Romania

Green manure type	Annual fertilization				Average on green manure fertilization	
	N_0P_0		$N_{120}P_{90}$		V_1	V_2
	V_1	V_2	V_1	V_2		
1. Control	4695	3073	6055	4210	5375	3642
2. *Lupinus* sp	5185	3345	6585	4620	5885	3982
3. *Lupinus* sp + oat + rape	5760	3832	7195	5140	6478	4486
Average on annual fertilization	5213	3417	6612	6060	-	-

V_1-1st year of the effect

V_2-2nd year of the effect

Factor A: green manure type

Factor B: annual fertilization

	A		B		B X A		A X B	
	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
LSD 5 %	140	210	76	150	155	248	197	324

The influence of the green manures and chemical fertilizers on water use efficiency

The green manure use determined the improve of the water use efficiency in comparison with control both first year of the effect and second year of the effect.

Organic fertilization with manure and green manure associated with annual fertilization with $N_{120}P_{90}$ gave the biggest values of the water use efficiency. In comparison with control fertilized with $N_{120}P_{90}$ only, in the first year, the differences were between 5 % (in rape) and 31 % (manure 50 t/hectare) and in the second year the differences were between 9% and 43 % (in the rape and manure 50 t/hectare). (Table 4)

Table 4. The influence of the fertilization with manure on water use efficiency on maize crop in the conditions from Oradea, Romania

Green manure type	Annual fertilization							
	N_0P_0				$N_{120}P_{90}$			
	V_1		V_2		V_1		V_2	
	kg/m^3	%	kg/m^3	%	kg/m^3	%	kg/m^3	%
1. Control	1.11	100	0.89	100	1.44	100	1.22	100
2. *Lupinus* sp	1.23	111	0.97	109	1.56	108	1.34	109
3. *Lupinus* sp + oat + rape	1.37	123	1.11	125	1.71	119	1.49	122

V_1-1st year of the effect

V_2-2nd year of the effect

CONCLUSIONS

The research carried out in an experiment placed in 2010 at Agricultural Research and Development Station Oradea and there are the following conclusions:

- the green manure were seeded like second crop in 2010 and the first rainfall was registered 2 days after seeding in 15th July, 8 days after seeding in 3rd July and 8th days after seeding in 20th August. The rainfall registered during the green manure vegetation period were bigger than multiannual average: 271.0 mm vs. 152.1 mm; 218.3 mm vs 116.8 mm; 161.8 mm vs 97.6 mm;the biggest quantities of the green manure were registered seeding in 15th July; the maize yields determined in the first and second year of the green manure fertilization effect show the bigger yields in the variants with *Lupinus angustifolius*+oat+rape in comparison with the yields obtained in the variant with Lupinus angustifolius pure crop both in the variants with N_0P_0 and in the variants with $N_{120}P_{90}$.
- the smallest yields were determined in the control. Both in the variant with N_0P_0 and in the variant with $N_{120}P_{90}$ the smallest quantity of maize yield obtained for 1 m^3 water used was obtained in the variant without organic fertilization both in the first year and in the second year.

In the second crop the seeding data will be before 15th July because after that, the quantity and regime of the rainfall don't provide the assurance of the green manure yields.

References

[1] Berca M., 2011, Agrotehnica-transformarea modernă a agriculturii. Editura Ceres, 2004.
[2] Berca M., 2011, Agrotehnica-transformarea modernă a agriculturii. Editura Ceres, 2004.
[3] Bogdan Ileana, Guş P., Rusu T., 2003, Agrotehnica diferenţiată, Editura Risoprint, Cluj-Napoca.
[4] Borlan Z. şi colab, 1994, Fertilitatea şi fetilizarea solurilor (compendiu de agrochimie). Editura Ceres Bucureşti.
[5] Brejea R., 2009, Tehnologii de protecţie sau refacere a solurilor. Editura Universităţii din Oradea
[6] Brejea R, 2010, Ştiinţa solului – îndrumător de lucrări practice, Editura Universităţii din Oradea.
[7] Brejea R, 2011, Practicum de pedologie, Editura Universităţii din Oradea.
[8] Brejea R . 2011 Practicum de Tehnologii de Protecţie a Solurilor. Editura Universităţii din Oradea
[9] Budoi Gh., Penescu A., 1996, Agrotehnică, Ed. Ceres, Bucureşti.
[10] Canarache A., 1990, Fizica solurilor agricole. Ed. Ceres, Bucureşti.
[11] Ciobanu Gh., 2003, Agrochimie. Editura Universităţii din Oradea.
[12] Ciobanu Gh., 2011, Practicum de agrochimie, Editura Universităţii din Oradea.
[13] Domuţa C. et al., 2004, Research regarding the green manure technology and the influences in maize yield in the contest of the sustainable agriculture practising in Western Romania, 15th International Symposium of the International Scientific Center of Fertilizers (CIEC), Pretoria, South Africa, 27-30 September.
[14] Domuţa C., 2005, Agrotehnica terenurilor în pantă din nord-vestul României, Editura Universităţii din Oradea.
[15] Domuţa C. et al., 2007, Influence of crop rotation and green manure on wheat yield in the conditions of the eroded soils of Bihor (Romania), Analele USAMVB Timisoara, Lucrări ştiinţifice Facultatea de Agricultura, vol. XXXIX, Editura Agroprint, Timisoara.
[16] Domuţa C., Brejea R., 2010, Eroziunea terenurilor în pantă din nord-vestul României, Editura Universităţii din Oradea.
[17] Domuţa C., Brejea R., 2011, Eroziunea terenurilor în panta din Bihor, Editura Universităţii din Oradea.
[18] Eliade Gh., Ghinea L., Ştefanic Gh., 1983, Bazele biologice ale fertilităţii solului, Ed. Ceres, Bucureşti.
[19] Guş P. et al., 1998, Agrotehnica, Editura Risoprint, Cluj-Napoca.
[20] Jităreanu G., 1995, Ingineria conservării solului şi apei. Curs. Ed. Univ. Agronomice şi de Medicină Veterinară, Iaşi.
[21] Neamţu T., 1996, Ecologie, eroziune şi agrotehnică experimentală, Editura Ceres, Bucureşti.
[22] Samuel A.D., 2003, Evaluarea microbiologică şi enzimologică a efectelor tehnologiilor agricole asupra biologiei solului. Editura Universităţii din Oradea
[23] Samuel A.D., Drăgan-Bularda M., Domuţa C., 2006, The effect of green manure on enzymatic activities in a brown luvic soil, Studia Universitatis Babeş-Bolyai, Biologia, LI, 1.
[24] Samuel A.D., 2009, Influence of long term fertilization on soil enzyme activities. Analele Universităţii din Oradea, Fascicula Biologie, Tom. XVI, pp. 113-116.