

## MANURE AND GREEN MANURE INFLUENCE ON MAIN PHYSICAL PROPERTIES OF THE SOIL IN THE CONDITIONS OF NORTH-WESTERN ROMANIA

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**Abstract.** *The paper based on the researched obtained in 2011 in an experiment placed in 2000 in Oradea on a hill with 10% slope. The mixtures of green manure lupin+oat+rape and lupin+oat determined a better values of the structure, bulk density, total porosity, penetration rezistance and hydraulic conductivity than lupin like pure crop and than the mixture vetch+oat and ryegrass. The manure 25 t/ha and especially manure 50 t/ha determined the best values of the studied physical properties than green manure. The results researches sustain the opportunity of the green manure like mixture (lupin+oat+rape, lupin+oat) and of the manure for improve of the physical parameters of the eroded soils.*

**Key words:** green manure, manure, structure, bulk density, penetration rezistance, hydraulic conductivity

### 1. Introduction

One of the components of the sustainable agriculture is the organic fertilization. [1, 2, 3, 11, 12] Among the type of the organic fertilizer, the green manure occupied a distinct place, very important. [10,13]

During the time, many researches (Broadbent and Norman, 1947; Hallam and Bartholomew, 1953, Flaig et al, 1975 etc., referenced by Eliade et al, 1983) established that the green manure of *Lupinus* sp. in pure crops, due the small C/N report, does not improve the soil's humus content. The biological school from Western Europe solved this problem using leguminous (vetch) with gramineous (rye, oat, ryegrass) mixture (Roger, 1976, referenced by Eliade et al, 1983); this mixture has an optimum report monosaharide (cellulose) nitrogen. In Romania, the vetch is known only as a fodder and to recommend it for green manure would not be successful. *Lupinus* sp. was and is known as a green manure. The use of the green manure on the eroded soil is very important possibility to improve the soil parameters and to increase the yields (Neamtu, 1996, Pintilie et al, 1980). Domuța, was made the research regarding the use of the mixture with *Lupinus* sp. and gramineous starting 1988 on eroded soil from Pocola, Bihor county [4, 5, 7].

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## 2. Materials and methods

The research started in 2000 and were carried out at Agricultural Researches and Development Station Oradea on a preluvosoil with 10% slop. The soil is characterized by a humus content of 2.1% in Ap (0-20 cm) horizon, pH of 6.3, phosphorus of 31.5, bulk density of 1.44 g/cm<sup>3</sup> and total porosity is of 47%. Field capacity (24.3%) and wilting point (9.1%) have the median values.

The experiments had two factors: organic fertilization and annual fertilization. Organic fertilization included the variants: control, *Lupinus angustifolius*; vetch+oat+ryegrass; *Lupinus angustifolius* + oat; *Lupinus angustifolius*+oat+rape; rape; rape+oat; manure 25 t/hectare and manure 50 t/hectare. Annual fertilization included the graduations: N<sub>0</sub>P<sub>0</sub>, N<sub>120</sub>P<sub>90</sub>. Number of repetition used: 4; the plot surface: 100 m<sup>2</sup>; the experiments surface: 7200 m<sup>2</sup>.

The green manures, were sowed like 2<sup>nd</sup> crop in the 15<sup>th</sup> July. The seed rates used were: *Lupinus angustifolius* in pure crop, 200 kg/hectare; *Lupinus angustifolius* in mixture, 100 kg/hectare; vetch, 40 kg/hectare; oat, 80 kg/hectare; ryegrass, 10 kg/hectare; rape 20 kg/hectare in pure crop and 10 kg/hectare in mixture crop.

Green manures harvesting were manure at the flowering of the *Lupinus angustifolius*; the green manures were maintained on the soil surface 15 days and after that a plough land was made.

Crop rotation used: wheat-maize. Soil sample was prelevated in 2011 on 0-30 cm depth in four repetition from wheat. Soil structure were determined by Cseratzki method and bulk density, penetration rezistance and hydraulic conductivity were determined by usually method in the laboratory of the Agricultural Research and Development Station Oradea.

## 3. Results and discussions

### Green manure and manure influence on soil structure

Macrostructure hydrostability included the aggregates with diameter bigger than 0.25 mm. The total structure degree in the control was of 55.8%. In the variants with mixture of green manure the total structure degree increased in comparison with the control with 2.3% (rape+oat), 6.7% (vetch+oat+rape), 7.6% (lupin+oat+rape) but the differences are insignificant statistically; a few increase was registered in the variant with rape and in the variant with lupin like pure crop a few smaller value of the total structure degree was registered (55.72%) in comparison with manure (15.3% and 22.4%) are significant and distingue significant statistically (table 1).

### Green manure and manure influence on bulk density and total porosity

The soil from the research field has a colloid clay content in the Ap horizon of 32.0% and a value of bulk density bigger than 1.47 g/cm<sup>3</sup> characterizes a very

settled soil and a very big value of the bulk density. All the organic fertilizers used determined the improve of the bulk density.

**Table 1.** Green manure and manure influence on macroaggregates hydrostability of the eroded soil from Oradea, 2011

| Variant            | Diameter of aggregates, mm |           |           |            | Total > 0.25 mm |       |
|--------------------|----------------------------|-----------|-----------|------------|-----------------|-------|
|                    | > 5                        | 3.1 – 5.0 | 1.1 – 5.0 | 0.25 – 1.0 | %               | %     |
| Control            | 4.28                       | 7.20      | 7.40      | 36.9       | 55.80           | 100   |
| Lupin              | 4.02                       | 6.65      | 7.55      | 37.5       | 55.72           | 99.8  |
| Vetch+oat+ryegrass | 5.80                       | 7.90      | 8.02      | 37.8       | 59.52           | 106.7 |
| Lupin+oat          | 5.82                       | 8.00      | 7.30      | 38.9       | 60.02           | 107.6 |
| Lupin+oat+rape     | 5.90                       | 8.02      | 7.20      | 39.5       | 60.62           | 108.6 |
| Rape               | 4.30                       | 6.70      | 7.25      | 38.6       | 56.85           | 101.9 |
| Rape+oat           | 4.36                       | 7.15      | 7.40      | 38.2       | 57.11           | 102.3 |
| Manure 25 t/ha     | 7.93                       | 10.65     | 8.24      | 37.9       | 64.32           | 115.3 |
| Manure 50 t/ha     | 9.71                       | 9.53      | 10.31     | 38.19      | 68.30           | 122.4 |
|                    | LSD <sub>5%</sub>          | 1.50      | 1.60      | 1.90       | 1.70            | 7.8   |
|                    | LSD <sub>1%</sub>          | 2.30      | 2.90      | 3.30       | 2.60            | 11.6  |
|                    | LSD <sub>0.1%</sub>        | 3.80      | 4.35      | 5.10       | 4.20            | 19.6  |

The differences in comparison with the control were significant statistically and included the values of the bulk density in the class “big” with the soils “moderate settled”. The differences registered in the variants with manure are distinguishable significant but the value determined in the variant with 50 t/ha belongs “the median” class with the soils a “few settled” (table 2).

**Table 2.** Green manure and manure influence on bulk density (BD) of the eroded soil from Oradea, 2011

| Variant            | BD                |      | Difference<br>% | Statistically significant<br>% |
|--------------------|-------------------|------|-----------------|--------------------------------|
|                    | g/cm <sup>3</sup> | %    |                 |                                |
| Control            | 1.53              | 100  | -               | Control                        |
| Lupin              | 1.41              | 92.1 | -7.9            | o                              |
| Vetch+oat+ryegrass | 1.40              | 91.5 | -8.5            | o                              |
| Lupin+oat          | 1.39              | 90.8 | -9.2            | o                              |
| Lupin+oat+rape     | 1.38              | 90.1 | -9.9            | o                              |
| Rape               | 1.43              | 93.5 | -6.5            | o                              |
| Rape+oat           | 1.42              | 92.8 | -7.2            | o                              |
| Manure 25 t/ha     | 1.36              | 88.9 | -11.1           | oo                             |
| Manure 50 t/ha     | 1.34              | 87.6 | -12.4           | oo                             |

LSD<sub>5%</sub> = 0.10; LSD<sub>1%</sub> = 0.16; LSD<sub>0.1%</sub> = 0.30

The total porosity in the control (43%) is very small. Lupin pure crop and the mixture vetch+oat+ryegrass determined the increases significant statistically of the total porosity. The increases from variants with lupin+oat+rape, lupin+oat and

manure 25 t/ha were distinguished significant (12% and 13%); the increase from variant with manure 50 t/ha was very significant statistically only. (table 3)

**Table 3.** Green manure and manure influence on total porosity (TP) of the eroded soil from Oradea, 2011

| Variant            | TP |     | Difference<br>% | Statistically significant<br>% |
|--------------------|----|-----|-----------------|--------------------------------|
|                    | %  | %   |                 |                                |
| Control            | 43 | 100 | -               | Control                        |
| Lupin              | 47 | 109 | 9               | x                              |
| Vetch+oat+ryegrass | 47 | 109 | 9               | x                              |
| Lupin+oat          | 48 | 112 | 12              | xx                             |
| Lupin+oat+rape     | 48 | 112 | 12              | xx                             |
| Rape               | 46 | 107 | 7               | -                              |
| Rape+oat           | 46 | 107 | 7               | -                              |
| Manure 25 t/ha     | 49 | 113 | 13              | xx                             |
| Manure 50 t/ha     | 50 | 116 | 16              | xxx                            |

LSD<sub>5%</sub> = 7; LSD<sub>1%</sub> = 10; LSD<sub>0.1%</sub> = 15

### Green manure and manure influence on penetration resistance

The values of the penetration resistance determined in the studied variant include the soil in the class with small "values of the penetration resistance". In the variant with lupin, rape and rape+oat the values of the penetration resistance decreased significantly in comparison with the value (25.6 kgf/cm<sup>2</sup>) determined in the control. The decreases were distinguished significant in the variant with manure 25 t/ha, lupin+rape+oat and vetch+oat+ryegrass and very significant statistically in the variant with manure 25 t/ha (table 4).

**Table 4.** Green manure and manure influence on penetration resistance (PR) of the eroded soil from Oradea, 2011

| Variant            | PR                  |      | Difference<br>% | Statistically significant<br>% |
|--------------------|---------------------|------|-----------------|--------------------------------|
|                    | Kgf/cm <sup>2</sup> | %    |                 |                                |
| Control            | 25.6                | 100  | -               | Control                        |
| Lupin              | 20.6                | 80.4 | -19.6           | oo                             |
| Vetch+oat+ryegrass | 20.1                | 78.5 | -21.5           | oo                             |
| Lupin+oat          | 20.5                | 79.9 | -20.1           | oo                             |
| Lupin+oat+rape     | 19.5                | 76.0 | -24.0           | o                              |
| Rape               | 21.7                | 84.7 | -15.3           | o                              |
| Rape+oat           | 21.5                | 83.9 | -16.1           | -                              |
| Manure 25 t/ha     | 17.6                | 68.6 | -31.7           | oo                             |
| Manure 50 t/ha     | 15.8                | 61.7 | -38.3           | ooo                            |

LSD<sub>5%</sub> = 3.02; LSD<sub>1%</sub> = 5.01; LSD<sub>0.1%</sub> = 9.7

### Green manure and manure influence on hydraulic conductivity

In comparison with hydraulic conductivity of the soil from the control in the all studied variant were determined the bigger values. The values of the hydraulic conductivity registered in the all variants indicate a soil with a big hydraulic

conductivity. The differences in comparison with the value (13.89 mm/h) from the control variant were insignificant statistically in the variants with rape and rape+oat, significant statistically in the other variant with green manure, distinguish significant in the variant with manure 25 t/ha and very significant statistically in the variant with manure 50 t/ha. (table 5)

**Table 5.** Green manure and manure influence on hydraulic conductivity (K) of the eroded soil from Oradea, 2011

| Variant            | K     |       | Difference<br>% | Statistically significant<br>% |
|--------------------|-------|-------|-----------------|--------------------------------|
|                    | mm/h  | %     |                 |                                |
| Control            | 13.89 | 100   | -               | Control                        |
| Lupin              | 15.97 | 114.9 | 14.9            | x                              |
| Vetch+oat+ryegrass | 16.19 | 116.5 | 116.5           | x                              |
| Lupin+oat          | 16.91 | 121.7 | 21.7            | x                              |
| Lupin+oat+rape     | 16.57 | 119.3 | 19.3            | x                              |
| Rape               | 14.32 | 103.1 | 3.1             | -                              |
| Rape+oat           | 14.36 | 103.4 | 3.4             | -                              |
| Manure 25 t/ha     | 18.61 | 133.9 | 33.9            | xx                             |
| Manure 50 t/ha     | 20.61 | 148.3 | 48.3            | xxx                            |

LSD<sub>5%</sub> = 2.0; LSD<sub>1%</sub> = 3.9; LSD<sub>0.1%</sub> = 5.02

## Conclusions

The researches were carried out in an experiment placed in the year 2000 on an eroded soil from Agricultural Research Development Station Oradea. The conclusions of the researches are the following:

(1) Soil structure was improved statistically assured in the variant with manure 25 t/ha and 50 t/ha. The pure crop for green manure of lupin didn't determine the increase of the total structure degree. The mixture lupin+oat+rape, lupin+oat and vetch+oat+ryegrass determined the increases of 8.6%, 7.6% and 6.7% but insignificant statistically; the mixture rape+oat determined a smaller difference (2.3%).

(2) All the variants with green manure determined the decrease of the bulk density values and the increase of the total porosity in comparison with the values (1.56 g/cm<sup>3</sup>; 43%) determined in the control. The biggest differences in comparison with the control were registered in the variant with the manure 50 t/ha (12.4%; 16%).

(3) The penetration resistance decreased in comparison with the control significant statistically in the variant with lupin, rape and rape+oat, distinguish significant in the variant with manure 25 t/ha, lupin+oat+rape, lupin+oat, vetch+oat+ryegrass and very significant statistically in the variant with manure 50 t/ha.

(4) In comparison with hydraulic conductivity from control (13.89 mm/h) in the variant with rape and rape+oat a bigger value was determined but the differences

are not significant statistically. In the other green manure variant the differences are significant statistically; in the variant with green manure the difference (33.9%) is significant statistically and in the variant with manure 50 t/ha, the difference (48.3%) is very significant statistically.

The results research emphasized the need of the green manure and manure for improve of the physical properties of te eroded soils and the use of the mixture lupin+oat+rape, lupin+oat like green manure.

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