# STUDY CONCERNING INFLUENCE OF MANURE AND GREEN MANURE ON MAIN PHYSICAL PROPERTIES OF ERODED SOILS FROM NORTH-WESTERN PART OF ROMANIA

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***Abstract***

*The researches efectuated at Agricultural Research and Development Station Oradea in an experience set in 1999 highlited the influence of six types of green manure, pure culture and mixed, and 2 doses of manure on macro-structural hidrostability, bulk density, porosity, strength pentetration and hydraulic conductivity, specific physical indices determinants in achieving favorable conditions for growing of crops.In all variants organic fertilized the compaction degree decreasing, bulk density values being 2.1% - 10.8% lower than in the unfertilized variant. The biggest differences were registered in variants with manure and in variants with mixture green manure bulk density values were lower than in variants with pure green manure crop. As a result, total porsity values increased in all variants organically fertilized. Mixture of green manure determined the obtaining of better values of hydraulic conductivity compared with green manure pure culture.*

**Key words:** eroded soils, manure, green manure, bulk density, porosity, hydraulic conductivity

## INTRODUCTION

Plowing in a culture of green plants, usually a legume crop is known since the time of Ancient Greece and the Roman Empire. Farmer's ancient world recognized this method a means of revitalizing the soil, increase its fertility and, simultaneously, the yield obtained (Budoi, Penescu, 1996; Moţoc et al., 1975; Neamţu, 1996; Samuel et al., 2006).

Research in the second half of the twentieth century (Norman Broadbent, Hallam and Bartholomew, Stotzky and Martensen, Domsch, quoted by Eliade et al., 1983; Ciobanu, Domuţa, 2003; Domuţa, 2006; Domuţa et al., 2012; Sârca, Goia, 2002; Neamţu, 1996) have reported some issues which would restrict the use of green manure (legumes). They showed that by incorporating green manure, especially if the plants are younger (and therefore is characterized by a small C/N) are release microbiological processes explosive likely to increase the stable humus mineralization of soil, and finally we are witnessing to decreasing of reserves of humus in soils fertilized with green manure. Eliade et al., (1983) provide another explanation of the phenomenon of enhanced mineralization of stable humus in the soil, considering that the stronger mineralization of humus is due less soluble compounds resulting from the decomposition of fertilizers in the soil and stimulates multiplication of microorganisms specialized in metabolization of original humus in soil (strong polymerized).

Roger (1976), quoted by Eliade et al. (1983), a researcher belonging to biological agriculture, believes that failures using green fertilizer are due to use pure vegetable crops, sufficiently rich in cellulose. It is recommended to work with mixtures of plants having the optimum ratio of mono- / cellulose / nitrogen system (Bîlteanu, 2003; Domuţa, Domuţa, 2010). The same researcher believes that the composition of the seed mixture to take account of previous crop; after an experience of over 50 years of biological agriculture, Roger recommends mixture:

- vetch: 30-40 kg/ha;
- oat : 80 kg/ha;
- ryegrass etalon: 0-10 kg/ha.

The quoted author recommends a significant proportion of rye if the soil is infested with couch, replacement with a mixture 80 kg of rye and 40 kg rye and 50 kg oats, where the land is infested with thistles; if prevailing mustard or oilseed rape will use 50 kg rye seed and of 5 -10 kg rape seed. Technology of green fertilizers in Romania, both on flat or on slopes land involves using pure cultures (Jelev, Brejea, 2006; Brejea, 2011, 2014; Sârca, Goia, 2002) with the disadvantages mentioned above in terms of humification. Based on the conclusions of Roger (1976) Domuţa C., since 1988, and in 1990 in Pocola at Beius, uses mixtures: *Lupinus angustifolius* + millet + oat; *Lupinus angustifolius* + rye + rape, results were published in 2000, 2001 and 2002, 2003.

It was envisaged that lupins is a green fertilizer known in Romania, and that vetch – leguminoes plant from green fertilizers recommended by Roger - known in Romania (and not only) as part of fodder and change this perception it is hard to realise (Nistor et al., 1979; Guș et al., 2004).

**MATERIAL AND METHOD**

The research was carried on erosioned soil with slope of 10% at Agricultural Research and Development Station Oradea. Soil profile is as follows: Ap = 24 cm; El= 24-34 cm; $Bt_1$=34-54 cm; $Bt_2$= 54-78 cm; Bt/c= 78-95 cm; C= 95-145 cm. On sown field was determine available mineral nitrogen content (N-NH + NO3) of 3.86 ppm, 6.0 ppm, and 88.5 ppm phosphorus content, potassium mobile content, pH value is 5,5. Wilting point had a medium value on 0-75 cm depth and a great value below this depth. Field capacity is medium on the entire depth and water use capacity is high on depth of 0-50 cm and medium on depth of 50-150 cm. Physical properties of the soil were analyzed using the characterization of Canarache (1990).

The research was conducted in the following experimental device:

**Organic fertilization**

$V_1$: control
$V_2$: *Lupinus angustifolius*
$V_3$: vetch + oat + raigrass
$V_4$: *Lupinus angustifolius* + oat + rape
$V_5$: *Lupinus angustifolius* + oat
$V_6$: *Lupinus angustifolius* + rape
$V_7$: *Lupinus angustifolius* + millet
$V_8$: manure 25t/ha
$V_9$: manure 50 t/ha

Measurements of soil physics were carried out in our own laboratory and included: soil structure - as determined through Cseratzki method, bulk density (DA), hydraulic conductivity (k) and penetration resistance (RP) detertminate according to the methodology of the Research Institute for Soil Science and Agrochemistry Bucharest. The total porosity (TP) was determined according to the formula: TP = 1 - BD / D; where BD = bulk density, D = density 2.65 g / $cm^3$.

## RESULTS AND DISSCUSION

### The influence of green manure and manure on soil structure

After determining the two experimental cycles, it appears that in the variant fertilized with lupine pure culture, total values of soil hydrostable agregates (54.3%) is close to that of the unfertilized control. Using *Lupinus angustifolius* mixed with oats or oat and rape increased the macro-structure of hidrostability 11.5% and 12.3%; a value close (10.6%) was obtained in the variant with mixture vetch + oats + ryegrass, this option is recommended for biological school (Roger, 1976 quoted by Eliade et al., 1983). In the variant with rape value of hidrostability of macro structure is close to the value obtained in the variant with *Lupinus angustifolius* and control; rape mixed with oat determined an increase of 7.6% compared to the control variant. The highest values of macro-structural hidrostability were obtained in variants fertilized with manure 25t / ha (66.1%) and 50 t / ha (69.4%) (Table 1).

*Table 1*

The influence of green manure and manure on macrostructure hidrostability of sloping land in Oradea, 2016

| **Variant** | Diameter of aggregates, mm | | | | **Total agregate >0,25 mm** | |
|---|---|---|---|---|---|---|
| | **>5,0** | **2,1-5,0** | **1,1-2,0** | **0,25-1,0** | **%** | **%** |
| 1. Control | 4,20 | 8,36 | 6,70 | 35,4 | 54,6 | 100 |
| 2. *Lupinus angustifolius* | 4,06 | 7,94 | 6,50 | 35,8 | 54,3 | 99,5 |
| 3. Vetch+oat+ryegrass | 6,32 | 8,60 | 7,26 | 38,22 | 60,4 | 110,6 |
| 4. *Lupinus angustifolius* + oat | 6,28 | 8,70 | 7,40 | 38,52 | 60,9 | 111,5 |
| 5. *Lupinus angustifolius* + oat + rape | 6,40 | 8,66 | 7,41 | 38,83 | 61,3 | 112,3 |
| 6. Rape | 5,30 | 8,26 | 6,80 | 34,54 | 54,9 | 100,5 |
| 7.Rape + oat | 5,38 | 8,40 | 6,92 | 38,10 | 58,8 | 107,6 |
| 8.Manure 25t/ha | 7,96 | 10,24 | 8,30 | 39,60 | 66,1 | 121,1 |
| 9. Manure 50 t/ha | 9,80 | 10,30 | 9,20 | 40,10 | 69,4 | 127,1 |

**The influence of green manure and manure on bulk density (BD)**

In all 8 versions of fertilizer, bulk density values decreased compared to the control, which means more favorable growing conditions for the crop plants. The biggest differences compared with control variant were registered in variants fertilized with manure, 10.8% in the variant with 50 t / ha and 6.1% in the variant with 25 t / ha. In variants with green manure were registered close values of bulk density, in mixed variants values of this parameter is slightly lower (Table 2).

*Table 2*

The influence of green manure and manure on values of bulk density (BD) of soil on slope from Oradea, 2016

| Variant | BD | | Difference % |
|---|---|---|---|
| | g/cm$^3$ | % | |
| 1. Control | 1,48 | 100 | - |
| 2. *Lupinus angustifolius* | 1,44 | 97,3 | -2,7 |
| 3. Vetch+oat+ryegrass | 1,41 | 95,3 | -4,7 |
| 4. *Lupinus angustifolius* + oat | 1,43 | 96,6 | -3,4 |
| 5. *Lupinus angustifolius* + oat + rape | 1,42 | 95,9 | -4,1 |
| 6. Rape | 1,45 | 97,9 | -2,1 |
| 7.Rape + oat | 1,44 | 97,3 | -2,7 |
| 8.Manure 25t/ha | 1,39 | 93,9 | -6,1 |
| 9. Manure 50 t/ha | 1,32 | 89,2 | -10,8 |

**The influence of green manure and manure on the total porosity (PT)**

Total porosity values have improved compared to control in all variants studied. The biggest differences, 13.6% and 7.7%, were registered in variants with manure, the differences registered in variants with green manure ranging from 2.5% (rape) and 5.9% (vetch + oat + ryegrass) (Table 3).

*Table 3*

Influence of grren manure and manure on values of total porosity (TP) of soil from a slope land, Oradea 2016

| Variant | TP | | Difference |
|---|---|---|---|
| | g/cm$^3$ | % | % |
| 1. Control | 44,2 | 100 | - |
| 2. *Lupinus angustifolius* | 45,7 | 103,4 | 3,4 |
| 3. Vetch+oat+ryegrass | 46,8 | 105,9 | 5,9 |
| 4. *Lupinus angustifolius* + oat | 46,4 | 104,9 | 4,9 |
| 5. *Lupinus angustifolius* + oat + rape | 46,6 | 105,4 | 5,4 |
| 6. Rape | 45,3 | 102,5 | 2,5 |
| 7.Rape + oat | 45,7 | 103,4 | 3,4 |
| 8.Manure 25t/ha | 47,6 | 107,7 | 7,7 |
| 9. Manure 50 t/ha | 50,2 | 113,6 | 13,6 |

**Influence of green manure and manure on rezistance of penetration (PR)**

The higher value of penetration was registered in control variant, and the lower values were registered in the variant fertilized with manure 25 t/ha – 18.9 kgf/cm$^2$.

In the variant with mixture of green manure were registered lower values in the variant with green manure pure crop (Table 4).

*Table 4*

Influence of green manure and manure on values of penetration resistance (PR) of soil from a slope land, Oradea 2016

| Variant | PR | | Difference |
|---|---|---|---|
| | kgf/cm$^2$ | % | % |
| 1. Control | 26,8 | 100 | - |
| 2. *Lupinus angustifolius* | 20,9 | 77,9 | -22,1 |
| 3. Vetch+oat+ryegrass | 19,9 | 74,3 | -25,7 |
| 4. *Lupinus angustifolius* + oat | 20,1 | 75,0 | -25,0 |
| 5. *Lupinus angustifolius* + oat + rape | 19,9 | 74,3 | -25,7 |
| 6. Rape | 21,5 | 80,2 | -19,8 |
| 7.Rape + oat | 21,0 | 78,4 | -21,6 |
| 8.Manure 25t/ha | 18,9 | 70,5 | -29,5 |
| 9. Manure 50 t/ha | 15,8 | 58,9 | -41,1 |

**Influence of green manure and manure on hydraulic conductivity (K)**

The lowest value of hydraulic conductivity was registered in the variant without organic fertilization. Organic fertilization determined the increase of hydraulic conductivity with values between 24.4% (rape) and 67.2% (manure 50 t/ha).

Mixture of green manure determined the obtaining of better values of hydraulic conductivity compared with green manure pure culture (Table 5).

*Table 5*

Influence of green manure and manure on hydraulic conductivity values (K) of soils from sloping land, Oradea 2016

| Variant | K | | Difference |
|---|---|---|---|
| | mm/h | % | % |
| 1. Control | 12,62 | 100 | - |
| 2. *Lupinus angustifolius* | 15,84 | 125,5 | 25,5 |
| 3. Vetch+oat+ryegrass | 16,90 | 133,9 | 33,9 |
| 4. *Lupinus angustifolius* + oat | 16,80 | 133,1 | 33,1 |
| 5. *Lupinus angustifolius* + oat + rape | 17,00 | 134,7 | 34,7 |
| 6. Rape | 15,70 | 124,4 | 24,4 |
| 7.Rape + oat | 16,10 | 127,5 | 27,5 |
| 8.Manure 25t/ha | 17,96 | 142,3 | 42,3 |
| 9. Manure 50 t/ha | 21,10 | 167,2 | 67,2 |

**CONCLUSIONS**

One of the important measures to improve the parameters of fertility of sloping soil is the organic fertilization and the researches efectuated at Agricultural Research and Development Station Oradea in an experience set in 1999 highlited the influence of six types of green manure, pure culture and mixed, and 2 doses of manure on macro-structural hidrostability, bulk density, porosity, strength pentetration and hydraulic conductivity, specific physical indices determinants in achieving favorable conditions for growing of crops.

The highest values of macrostructural hidrostability were registered in variant with manure 50 t/ha, 69.4% difference from unfertilized variant being 27.1%. In variants with green manure mixture (Lupin + oats + rape, lupins + oats, vetch + oat + ryegrass, rape + oats) were obtained higher values of macrostructural hidrostability compared with values from variants fertilized with lupine or rape pure cultures.

In all variants organic fertilized the compaction degree decreasing, bulk density values being 2.1% - 10.8% lower than in the unfertilized variant.

The biggest differences were registered in variants with manure and in variants with mixture green manure bulk density values were lower than in

variants with pure green manure crop. As a result, total porsity values increased in all variants organically fertilized.

Penetration resistance decreased compared to the value determined in control variant (26.8 kgf/cm$^2$) values between 19.8% (rape) and 41.1% (manure 50 t/ha).

The lower value of hydraulic conductivity (12.62 mm/h) was recorded in the unfertilized variant, organic fertilization causing improve of this parameter with values between 24.4% (rape) and 67.2% (manure 50 t / ha).

The research highlights the importance of organic fertilizer to improve soil physical properties on a slope land and necesity of using green manure mixed and not pure culture.

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