

RESEARCH REGARDING THE IMPACT OF COMPOST OBTAINED FROM MANURE AND DELUVIAL SOIL ON THE FERTILITY OF MODERATELY ERODED ORDINARY CHERNOZEM

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Abstract

Currently, the total area of land subjected to erosion in the Republic of Moldova is of about 863,000 ha or 25% of the total surface (Rozloga Iu., 2010). The chernozems that occupy 788,000 ha (91% of the eroded surface) are most affected by erosion. The damage to the national economy caused by erosion is huge and is estimated at U.S. \$ 200 million. Annually, an average of 30 tons of fertile soil is lost per hectare, or 26 million tons from the whole eroded surface of the Republic of Moldova. The areas affected by erosion continue to expand. The compost made from manure and deluvial soil can serve as an important source for the restoration of eroded arable soil fertility. The present paper attempts to highlight these opportunities.

Key words: compost, deluvial soil, erosion, manure, ordinary chernozem.

INTRODUCTION

The soil is the main natural wealth of the Republic of Moldova on which its food security, economic potential and people's welfare is based. Regretfully, the soil is lately being subjected to strong degrading pressure, the main factor being the erosion caused by water (Krupenikov, 2004). In the past 25 years, the amount of organic fertilizers was reduced by 65 times and constitutes 0.1 t/ha; the surface planted with alfalfa decreased by 4-5 times, the vegetal wastes are burned on large surfaces. As consequence, the amount of humus in soil is negative: minus 1.1 t/ha. According to the latest estimates, 2.4 million tons of humus are annually lost from the agricultural lands. Forecast calculations show that, given the present situation, the quantity of humus in the soils from Moldova will decrease to the critical level of 2.5/2.8% by the year 2025 (Andrieş et. al., 2008).

The issue of restoring the fertility of soil affected by erosion, in the current management, can be partially solved by exploiting the local organic fertilizers on a well-set anti-erosion background.

The composts obtained from manure and deluvial soil present interest in this context (Figure 1).



Figure 1. Compost preparation

Besides the fact that they contain all nutrients necessary for the plants, when used as fertilizers, the composts also contribute to the restoration of soil fertility, which, in essence, means increasing the organic matter content of the soil (Lixandru, 2006).

MATERIALS AND METHODS

In order to test the efficiency of compost as fertilizer (manure, 80%, + deluvial soil, 20%), a long-term experimentation was founded at the experimental station of the Institute of Pedology, Agrochemistry and Soil Protection named after "Nicolae Dimo" in the village

Lebedenco, Cahul district in 1996, situated on land with an inclination of 5-6° to the northeast (Figure 2).



Figure 2. Experimental field

The soil is moderately eroded ordinary chernozem. The chemical and physical properties of the soil are presented in Tables 1 and 2.

Table 1. Agro-chemical indicators of moderately eroded ordinary chernozem

| Horizon and depth | pH (H ₂ O) | CaCO ₃ | Humus | P ₂ O ₅ | K ₂ O |
|-------------------|-----------------------|-------------------|-------|-------------------------------|------------------|
| | | mg/100 g soil | | | |
| Bhkp1 0-10 | 7.8 | 6.9 | 2.36 | 1.63 | 17.0 |
| Bhkp1 10-22 | 7.9 | 7.0 | 2.16 | 1.32 | 16.0 |

Table 2. Physical properties of moderately eroded ordinary chernozem

| Horizon and depth | Clay (<0.001 mm) | Physical clay (<0.01 mm) | Density | Bulk density | Porosity (%) |
|-------------------|------------------|--------------------------|----------------------|--------------|--------------|
| | % | | (g/cm ³) | | |
| Bhkp1 0-10 | 25.8 | 45.0 | 2.58 | 1.21 | 53.1 |
| Bhkp1 10-22 | 25.9 | 45.9 | 2.60 | 1.29 | 50.4 |

The experimentation was done in three repetitions. The plots are rectangles placed in a single line across the slope (6 m x 40 m = 240 m²). The long sides of the plots are oriented along the slope. Before founding the experiment, initial soil samples were collected from each plot. The preparation and incorporation of the compost was done according to the recommendations and instructions in force (Țurcan et al., 1993; Banaru, 2001).

The chemical properties of the compost used in the experiment are presented in Table 3.

Table 3. Chemical composition of the compost obtained from manure and deluvial soil

| Compost index | Dry substance | Organic matter | Nitrogen | Phosphorus | Potassium |
|----------------------------------|---------------|----------------|----------|------------|-----------|
| Manure, 80% + deluvial soil, 20% | 43.2 | 18.4 | 0.58 | 0.26 | 1.24 |

RESULTS AND DISCUSSIONS

In the Republic of Moldova, deluvial soils, formed as a result of erosion, are common and it represents an important reserve for the restoration of the eroded soils fertility. Therefore the most effective way of using them would be composting them with nutrient-rich and microbiologically active ingredients. In this sense, animal manure is a very suitable material. Research has found that fertilization with compost made from manure, 80%, and deluvial soil, 20%, on moderately eroded ordinary chernozem led to a significant increase in the humus content (Table 4).

Table 4. Modification of agro-chemical properties of moderately eroded ordinary chernozem in the 0-20 cm layer as result of fertilization with compost from manure and deluvial soil

| Variant | Humus | | P ₂ O ₅ | | K ₂ O | |
|---|---------|----------|-------------------------------|-------|------------------|------|
| | Content | Increase | mg/100 g soil | | | |
| mg/100 g soil | | | | | | |
| 1996 (before compost incorporation) | | | | | | |
| Control | 2.07 | - | 1.89 | - | 16.7 | - |
| Compost, 100 | 2.35 | - | 1.69 | - | 16.3 | - |
| 1997 (1 st year of experiment) | | | | | | |
| Control | 2.04 | -0.03 | 1.91 | 0.02 | 16.8 | 0.1 |
| Compost, 100 | 2.76 | 0.41 | 3.12 | 1.49 | 27.7 | 11.4 |
| 2001 (5 th year of experiment) | | | | | | |
| Control | 2.00 | -0.07 | 1.86 | -0.03 | 16.8 | 0.1 |
| Compost, 100 | 2.74 | 0.39 | 3.18 | 1.49 | 24.7 | 8.4 |
| 2005 (9 th year of experiment) | | | | | | |
| Control | 1.97 | -0.10 | 1.69 | -0.10 | 16.2 | -0.5 |
| Compost, 100 | 2.32 | 0.25 | 2.26 | 0.37 | 21.0 | 1.7 |

In the first year of experimentation, the humus content increased by 0.41% compared to the original one (before incorporating the compost). In the fifth year of experimentation, the same content of humus (0.39%) was observed. It should be noted that beginning with the sixth experimental year the value of the humus content is decreasing. The increase of the humus content constituted 0.25% in the ninth year of experimentation.

The content of mobile forms of phosphorus and potassium also increased in the variant fertilized with compost. The highest increase was observed in the 5th year of

experimentation. The increase of mobile phosphorus and potassium was of 1.49 mg/100 g and 8.4 mg/100 g of soil respectively. Fertilization with compost favourably influences on the physical properties of the moderately eroded ordinary chernozem (Table 5).

Table 5. Impact of compost obtained from manure and deluvial soil on the physical indicators of moderately eroded ordinary chernozem in the ploughed layer, 2005

| Variant | Fractions (%) | | Density (g/cm ³) | Bulk density (g/cm ³) | Porosity (%) | Resistance to penetration (kgF/cm ²) |
|-------------------|---------------|-------|------------------------------|-----------------------------------|--------------|--|
| | <0.001 | <0.01 | | | | |
| Control | 25.9 | 45.9 | 2.66 | 1.26 | 52.6 | 23.4 |
| Compost, 100 t/ha | 25.7 | 45.6 | 2.63 | 1.18 | 55.1 | 13.3 |
| DL 05% | 2.1 | 3.2 | 0.9 | 0.04 | 1.3 | 6.2 |

The increase of organic matter content in the variant fertilized with compost results in the reduced density and the bulk density of the soil. These modifications led to the increase of the lacunar space by 55%, a value that classifies the soil in the category 'high'. Fertilization with compost in the amount of 100 t/ha has a positive impact on the mechanical properties of the eroded soil. The researches reveal the fact that incorporating compost into the soil has reduced the resistance to penetration by about 10 kgF/cm² or by 43% compared to the original soil.

Table 6. Impact of fertilization with compost obtained from manure and diluvial soil on crops on moderately eroded ordinary chernozems at the station from Ursoaia, Cahul

| Culture and year | Control | Compost, 100 t/ha | DL 0.5% |
|--|---------|-------------------|---------|
| Yield for the control variant and the increase for the variant fertilized with compost, q/ha grain units | | | |
| Winter barley, 1997 | 29.6 | 6.2 | 5.4 |
| Maize, 1998 | 33.3 | 13.7 | 7.1 |
| Vetch (peas + oats), 1999 | 56.6 | 26.6 | 8.1 |
| Winter wheat, 2000 | 12.4 | 11.1 | 5.1 |
| Maize, 2001 | 31.7 | 7.2 | 5.0 |
| Winter barley, 2002 | 14.3 | 3.1 | 3.8 |
| Maize, 2003 | 34.2 | 5.8 | 5.9 |
| Sunflower, 2004 | 12.7 | 3.9 | 4.1 |
| Winter wheat, 2005 | 14.3 | 2.6 | 3.0 |
| Total yield increase for 9 years, grain units | 198.7 | 60.1 | - |

Consequently, optimal conditions for the growth and development of crop root system were provided.

All tested cultures exhibited significant increases in the yield (Table 6) as result of fertilization with compost over a period of five years (1997-2001).

Reduced yield of field crops in 2002-2005 demonstrates a decreased supply of nutritive elements for the plants.

The total increase for the period of nine years was of 60.1 g/ha grain units, or 6.7 g/ha annually.

CONCLUSIONS

The compost made from manure, 80%, and deluvial soil, 20% contains an average of 43.2% dry matter, 18.4% organic matter, 0.58% nitrogen, 0.26% phosphorus, 1.24% potassium.

Administration of compost on moderately eroded ordinary chernozem leads to significant increased values of humus content and of mobile forms of phosphorus and potassium for a period of five years, after which a decrease is observed. In the fifth year of experimentation the increase of the humus content was of 0.39%, of mobile phosphorus and potassium of 1.49 mg/100 g and 8.4 mg/100 g of soil respectively.

Fertilization with compost has a favorable impact on the physical properties of moderately eroded ordinary chernozem. The density and the bulk density of the soil were reduced, which led to the increase of the lacunar space by 55%. The value of the resistance to penetration decreased by 43%. Consequently, optimal conditions for the growth and development of crop root system were provided.

Using the compost as fertilizer on moderately eroded ordinary chernozem results in obtaining significant increases of crop yields for a period of five years, which is followed by decreases in the coming years. The overall increase for the period of nine years was of 60.1 q/ha grain units. The decrease of crop yield affirms the reduction of the plant supply with nutritive elements.

On slopes, it is recommended to apply the compost made from manure and deluvial soil simultaneously with the basic ploughing in a dosage of 50/100 t / ha every 4/5 years.

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