

# Valorisation of Compost from Cattle Manure in Forage Plant Cultures

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## Abstract

Two successive agricultural years was investigated the effect of fertilizer on forage production of compost from cattle manure aerobic fermentation. For this, were experienced two types of compost with cellulosic support coming from: the stalks chopped sunflower and triticale straw. The type of compost from the two studied recipes did not affect the production of green mass. The fertilizer effect was influenced by the dose of compost administered per unit area, production growth being of 14 t green mass·ha<sup>-1</sup> at a dose of 50 t compost·ha<sup>-1</sup> and 10 t green mass·ha<sup>-1</sup> at a dose of 30 t compost·ha<sup>-1</sup>. Following the fertilization repeated in the second year, production growth was low, being higher by just 1.7–3% on plots fertilized with 30 t compost·ha<sup>-1</sup>, respectively, 1.1–1.3% on plots fertilized with 50 t compost·ha<sup>-1</sup>.

**Keywords:** cattle manure, compost, green mass production.

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## 1. Introduction

Due to the high content of nitrogen, phosphorus and potassium, a rich organic matter and the absence of heavy metals, animal manure is a very attractive feedstock for the production of compost for soil fertilization of crops [1-4]. Numerous studies have shown that through composting organo-mineral elements from residues that ecologically recirculate through the natural biogeochemical circuits from the soil are reused [5-10].

For farmers, composting is a way of clean stabilization of waste or crop residues, especially manure from livestock, because a clean organic product, without contaminants, and good fertilizing value is resulting. In case they do not have enough farmland to distribute "in situ" semi-liquid manure, composting is one method of treatment and neutralization of manure pollutant

potential under maximum environmental protection.

In addition to supplying nutrients, compost is the best natural soil amendment. After its integration into the soil improvement of soil structure, improvement of texture, increased aeration and water storage capacity record and soil fertility increases and root system of plants is stimulated. The organic matter in compost provides food for soil specific microorganisms, resulting in important edaphic sanogenesis factor [9-12].

Cultivated forages are classified into two groups: grasses and legumes, annuals and perennials. Through the quality of the nutrients they contain current forage species selected and cultivated by modern agricultural technologies determine in animals an intensive growth, close to the maximum production potential [13]. In an efficient agricultural management fodder mixtures with a good scientifically structure that provide the farm animals with a rich and balanced nutritional principles can be organized. These forage mixtures must include in their structure both grasses and legumes group, annual or perennial [13].

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Our paper presents the results of testing the productive effect of cattle manure compost on the production of a forage mixture. Composting cellulosic substrate was provided by strains of sunflower and triticale straw.

## 2. Materials and methods

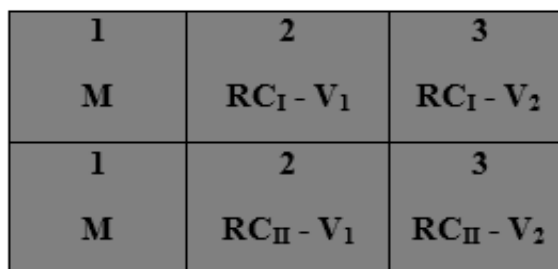
We have used two types of compost: C1-compost made from cattle manure aerobic biodegradation on a cellulose support made from sunflower stalks and C2-compost made from cattle manure aerobic

biodegradation on a cellulose support made from triticale straws. The characteristics of the two types of compost are shown in Table 1.

We have used a feed mixture with the following structure: *Lolium perenne*–45%, *Festuca pratensis*–45% and *Trifolium repens*–10%. Cultivation of forage mixture was achieved after following agro-technical works: plant debris removal and plowing to a depth of 18-20 cm. Then the experimental plots with an area of 4 m<sup>2</sup> per lot were formed. A block of six experimental plots resulted (Figure 1).

**Table 1.** The chemical composition of the two types of compost

| Compost type | pH   | C (%) | Ca+Mg (g/100g) | P (%) | K (%) | Total Nitrogen (%) | C:N report |
|--------------|------|-------|----------------|-------|-------|--------------------|------------|
| C1           | 8.55 | 29.51 | 46.5           | 0.372 | 0.330 | 1.88               | 15.69      |
| C2           | 8.69 | 26.35 | 36.0           | 0.342 | 0.290 | 1.66               | 15.87      |



### Legend:

RC<sub>I</sub> - compost I recipe  
 RC<sub>II</sub> - compost II recipe  
 M - blank plot  
 V<sub>1</sub> - 30 t / ha  
 V<sub>2</sub> - 50 t / ha

**Figure 1.** Experimental scheme of the research fields

Fertilization using compost was carried out manually by incorporation into the soil at a depth of approx. 10-12 cm. Sowing experimental plots was done with a quantity of seeds resulted from the mixture of the three participating factions to the feed mixture of the three species of forage plants. Considering the density per hectare, hectoliter weight, purity and germination of seeds resulted in the following doses: 20.89 kg·ha<sup>-1</sup> (45%) in *Lolium perenne*, 29.99 kg·ha<sup>-1</sup> (45%) in *Festuca pratensis* and 2.1 kg·ha<sup>-1</sup> (10%) in *Trifolium repens*. From the seed mixture thus prepared was used the amount of 21 g for each

experimental plot. Sowing was done on 30 March of the years under study. Crop care consisted of weed control works by weeding and providing moisture by watering during drought. Aspects of seedbed preparation and development of forage plant growth are shown in Figure 2.

Productive effect of experimental compost was followed through two successive years, 2011 and 2012, on a soil with average fertility in the Șimleul Silvaniei town through the total production of green mass registration recorded on two successive mowing.



Figure 2. Aspects of experimental crops of forage mixture

### 3. Results and discussion

The fertilizing effect of the two compost recipes was determined by recording the green mass production in two successive mowing in 2011 and

2012.

The amount of green mass obtained from experimental groups is shown in Table 2 and the graphical representation in Figure 3.

Table 2. Green mass production analysis in 2011

| Compost recipes with quantitative variables |                                | Green mass quantity (t·ha <sup>-1</sup> ) | Relative production (%) | Difference (t·ha <sup>-1</sup> ) |
|---|--------------------------------|---|-------------------------|----------------------------------|
| RC <sub>I</sub>                             | M-V <sub>1</sub>               | 38.994-50.120                             | 77.80                   | +11.126                          |
|   | M-V <sub>2</sub>               | 38.994-54.496                             | 71.55                   | +15.502                          |
|   | V <sub>1</sub> -V <sub>2</sub> | 50.120-54.496                             | 91.97                   | +4.376                           |
| RC <sub>II</sub>                            | M-V <sub>1</sub>               | 38.985-49.735                             | 78.39                   | +10.750                          |
|   | M-V <sub>2</sub>               | 38.985-53.920                             | 72.30                   | +14.935                          |
|   | V <sub>1</sub> -V <sub>2</sub> | 49.735-53.920                             | 92.23                   | +4.185                           |

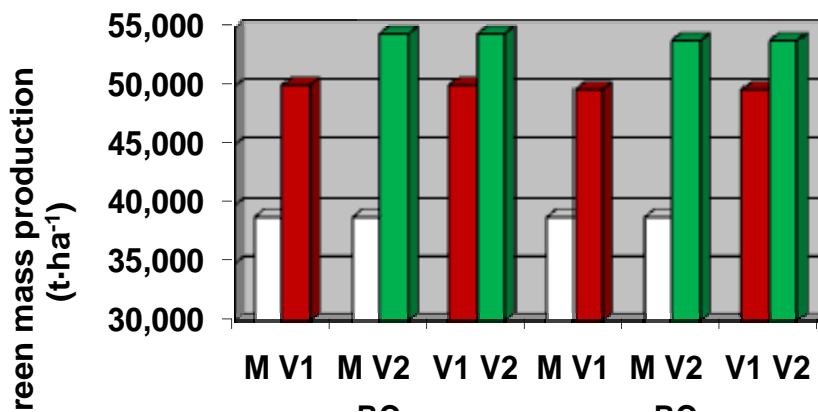


Figure 3. Graph of the total production of green mass obtained in 2011

From the data presented, there is a very favorable effect of fertilization with compost in both tested recipes. The highest yield of green mass is obtained when fertilizing with compost dose of 50 t·ha<sup>-1</sup> in the RC<sub>I</sub> recipe (54.496 t green mass), followed by the RC<sub>II</sub> recipe (53.920 t green mass). These values are higher by 39.7% and respectively 38.3% compared to the production of green mass harvested from the unfertilized plot. In the fertilization variant with 30 t compost·ha<sup>-1</sup> green mass production was higher by 28.5% for compost recipe RC<sub>I</sub> respectively 27.5% for RC<sub>II</sub> recipe.

The graph in Figure 3 is showing the amplitude of productive differences for variants fertilized with compost. They are most obvious in the case of V<sub>2</sub> quantitative variant histograms in both recipes of compost.

In conclusion, after fertilization by an amount exceeding 30 t·ha<sup>-1</sup> from both compost recipes, an increase forage production of green mass of 10-14 t·ha<sup>-1</sup> is resulting.

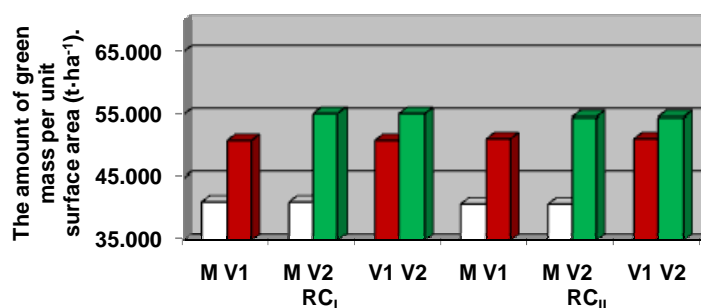
The average yield of green mass obtained in 2012 is shown in Table 3, and the graphic representation thereof in Figure 4.

From these data, it appears that for dose of 50 t compost·ha<sup>-1</sup> an increase of over 33% green forage mass is obtained in both recipes. At the dose of 30 t compo·ha<sup>-1</sup>, production growth is lower, being 23.8% in RC<sub>I</sub> recipe and 25.5% in RC<sub>II</sub>.

The chart in Fig. 4 shows growing differences between variants, in particular in the case of histograms at a dose of 50 t·ha<sup>-1</sup> (variant V<sub>2</sub>) of both compost recipes.

**Table 3.** Green mass production analysis in 2012

| Compost recipes with quantitative variables |                                | Green mass quantity (t·ha <sup>-1</sup> ) | Relative production (%) | Difference (t·ha <sup>-1</sup> ) |
|---|--------------------------------|---|-------------------------|----------------------------------|
| RC <sub>I</sub>                             | M-V <sub>1</sub>               | 41.162-50.978                             | 80.74                   | +9.816                           |
|   | M-V <sub>2</sub>               | 41.162-55.112                             | 74.68                   | +13.950                          |
|   | V <sub>1</sub> -V <sub>2</sub> | 50.978-55.112                             | 92.49                   | +4.134                           |
| RC <sub>II</sub>                            | M-V <sub>1</sub>               | 40.836-51.245                             | 79.68                   | +10.409                          |
|   | M-V <sub>2</sub>               | 40.836-54.640                             | 74.73                   | +13.804                          |
|   | V <sub>1</sub> -V <sub>2</sub> | 51.245-54.640                             | 92.39                   | +3.395                           |



**Figure 4.** Graph of the total production of green mass obtained in 2012

Synthesis of the two-year cumulative research is presented in Table 4.

It is found that the average cumulative production increase in two years once again confirms the favorable effect on forage production grown on soils fertilized with composted manure. In the same compost recipe the dose makes difference. At a dosage of 50 t·ha<sup>-1</sup> for both compost recipes an increase of more than 14 t green mass·ha<sup>-1</sup> is obtained. The same favorable situation is recorded in dose of 30 t·ha<sup>-1</sup>, but production increase is

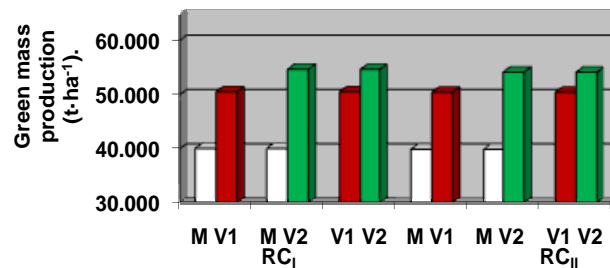
only 10 t·ha<sup>-1</sup>, regardless of compost recipe. Graph of average cumulative yields for two years (Figure 5) also highlights the differences in favor of forage plots fertilized with compost of two recipes, in both doses of fertilizer.

Comparing the production level of the second year to the first year of production, there was a slight increase in production for all variants, being 4.7-5.5% in group M, 1.7-3% in plots fertilized with 30 t compost·ha<sup>-1</sup> and 1.1-1.3% fertilized with 50 t·ha<sup>-1</sup>. We believe that this may be due to a more

favorable agro-meteorological context of that second year of production.

**Table 4.** Analysis of the cumulative average production of green mass in the two years of study

| Compost recipes with quantitative variants |                                | Green mass production (t·ha <sup>-1</sup> ) | Relative production (%) | Difference (t·ha <sup>-1</sup> ) |
|--|--------------------------------|---|-------------------------|----------------------------------|
| RC <sub>I</sub>                            | M-V <sub>1</sub>               | 40.078-50.553                               | 79.27                   | +10.475                          |
|  | M-V <sub>2</sub>               | 40.078-54.804                               | 73.13                   | +14.726                          |
|  | V <sub>1</sub> -V <sub>2</sub> | 50.553-54.804                               | 92.24                   | +4.251                           |
| RC <sub>II</sub>                           | M-V <sub>1</sub>               | 39.910-50.490                               | 79.05                   | +10.580                          |
|  | M-V <sub>2</sub>               | 39.910-54.280                               | 73.52                   | +14.370                          |
|  | V <sub>1</sub> -V <sub>2</sub> | 54.490-54.280                               | 93.01                   | +3.790                           |



**Figure 5.** Graph of average cumulative yields of green mass

#### 4. Conclusions

Type of compost in the two studied recipes did not affect the production of green mass.

Fertilizing effect was influenced by compost dose administered per unit area, production increase being 14 t green mass·ha<sup>-1</sup> at the dose of 50 t compost and 10 t green mass·ha<sup>-1</sup> at the dose of 30 t compost·ha<sup>-1</sup>.

Following fertilization repeated in the second year, production increase was low, being higher by only 1.7–3% of the plots fertilized with 30 t·ha<sup>-1</sup>, respectively, with 1.1–1.3% in plots fertilized with 50 t·ha<sup>-1</sup>.

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