IMPROVEMENT OF THE COMPOSTING TECHNIQUE BY FORCED OXYGENATION DURING THE THERMOPHILIC PHASE

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ABSTRACT

This subject is part of the framework of studies concerning the production of organic fertilizers, in particular compost. This is to improve the composting technique by adjusting a parameter which is the forced supply of oxygen in the compost heaps. Contribution made especially during the thermophilic phase to improve the living conditions of decomposing microorganisms, in particular their respiration. To do this, a simple manual forge blower was used. The method adopted is to vary the frequencies of forced addition of oxygen: every 2 days for heap n ° 3, every 4 days for heap n ° 2 and without addition for control heap n ° 1. After many follow-ups and interviews. The main result is the net acceleration of composting from 3 months to 1 month. 1 month for heap n ° 3 which underwent forced oxygenation every 2 days and 3 months for heap n ° 1 without additional input. The use of a simple manual blower enabled these results to be obtained, hence the interest of this study. Improving agricultural production requires the use of organic fertilizer available to farmers in addition to the quality of seeds and the availability of irrigation water.

Keywords: *composting, manual blower, forced oxygenation, thermophilic microorganisms, organic fertilizer*

1. INTRODUCTION

Madagascar is an agricultural country. 80% of its population practice agriculture. But agricultural production has not yet managed to meet the food needs of the Malagasy people, hence the need to develop agricultural production on all possible levels. Note that most Malagasy farmers do not have enough means to obtain chemical fertilizers or expensive equipment for agriculture. According to the study carried out in the district of Amparafaravola, only 12% of the households surveyed use compost in agriculture [1 ; 4]. One of the reasons for the poor practice of composting is due to the long duration of the latter, ranging from 3 to 6 months and consequently generating too much activity [11]. Hence the objective of this study, which is to use affordable materials to improve the composting technique.
Indeed, the hypothesis of this work is: the forced oxygenation of the compost heaps, using a manual blower, accelerates the activities of decomposing microorganisms, thus reducing the composting time.

2. MATERIALS AND METHODS

The main equipment used for forced oxygenation is a manual forge blower of about $ 10.
As aeration of the heap, most of the Malagasy farmers are satisfied only with insufficient weekly turnings for composting. This study differs from the usual methods by forced addition of air or forced oxygenation of the compost heap, especially during the thermophilic phase. Main phase during which, in the presence of oxygen, thermophilic microorganisms multiply and quickly break down properly moistened organic matter.

The composting process is as follows: first the acquisition of the raw materials, then the cutting of the plant material, the stockpiling, and then the treatment and periodic maintenance of the pile.
The comparative study undertaken is carried out using the three heaps. Efforts were made to keep the same composition of the 3 heaps to be studied.
The following table summarizes the comparative study. In addition to monitoring and controlling the temperatures and humidity of each heaps, the main study on forced oxygenation is shown in the following table1.

Table-1: summary of the comparative study

ACTIVITY	**Heap n° 1**	**Heap n° 2**	**Heap n° 3**
Forced oxygen supply	None	Every 4 days	Every 2 days
Retournement	Every 4 days	Every 4 days	Every 4 days

In general, the maintenance of the 3 composting heaps is the same, in particular the turnings every 4 days during the thermophilic phase, and once a week for the rest of the process [6 ; 8].
The major difference is the additional supply of oxygen from the air to different points of the heaps (every 10cm). This treatment was carried out using a manual blower in the deep holes made in the heaps, which are then plugged with compost. This addition of additional oxygen is our study parameter: every 2 days for heap n°3, every 4 days for the heap n°2 and without input for control heap n°1.
Mature compost is determined by a good woody smell. It is dark brown in color like potting soil. The various initial organic materials are unrecognizable and the value of the C/N ratio is approximately 10 according to the FAO [2 ; 7].

3. RESULTS AND DISCUSSIONS

3.1. Physico-chemical analyzes of the heaps at the start of composting

Physico-chemical analyzes of the composts obtained were made. The following table 2 shows the results of the essential physico-chemical analyzes of the compositions of the heaps at the start of composting.

Table-2: composition of the heaps at the start of composting

ELEMENTS	**Heap N°1**	**Heap N° 2**	**Heap N°3**	**Average**
Humidity %	61	59	60	60
Organic Carbon **%**	73.75	73.77	73.76	73.76
Total Nitrogen %	2.58	2.56	2.57	2.57
Report C/N	28.5	28.9	28.7	28.7

According to this table, the value of the C/N ratio of around 28.7 is close to the 30 required by the chemical condition for good composting [2 ; 10].

3.2. Physico-chemical analyzes of ripe composts

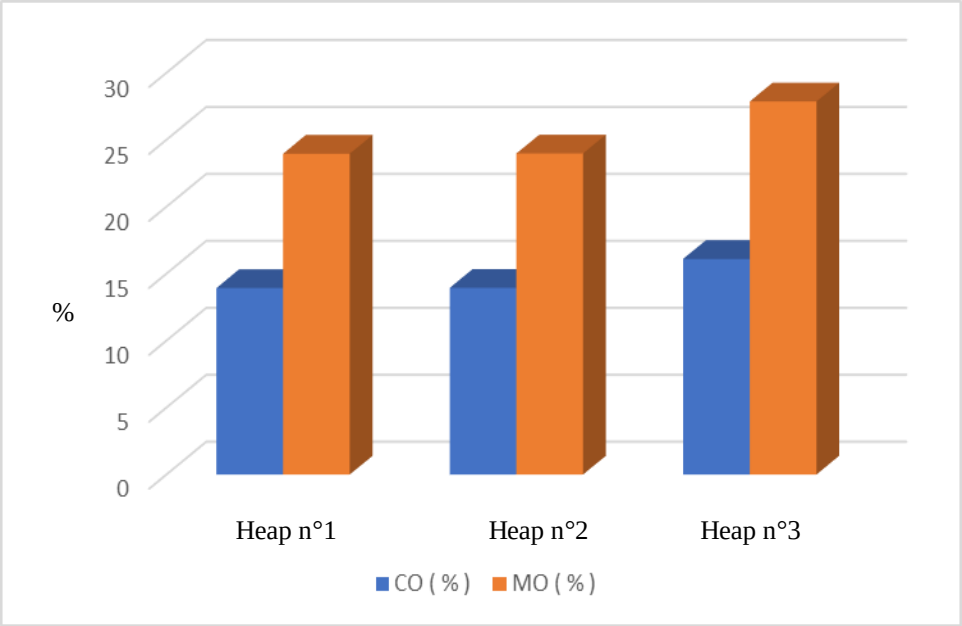

Fig-1: CO and MO contents of mature composts.

CO: Organic Carbon
MO: Organic Matter

The organic matter contents vary from 27.86% to 23.96% or 23.96% for heap n°1, 23.98% for heap n°2 and 27.86% for heap n°3. They are all greater than 20% according to the requirement of the NFU standard relating to organic amendments. Also, the composts obtained are called organic amendments. The organic carbon content makes it possible to evaluate the capacity of the compost to maintain the stock of organic matter in the soil. Under the action of microorganisms, the compost incorporated into the soil continues to be transformed into humus. The latter stores mineral elements and then releases them according to the plants' needs for their development. Thus, compared to chemical fertilizers, composts have properties to improve the biological properties of the soil and its fertility.

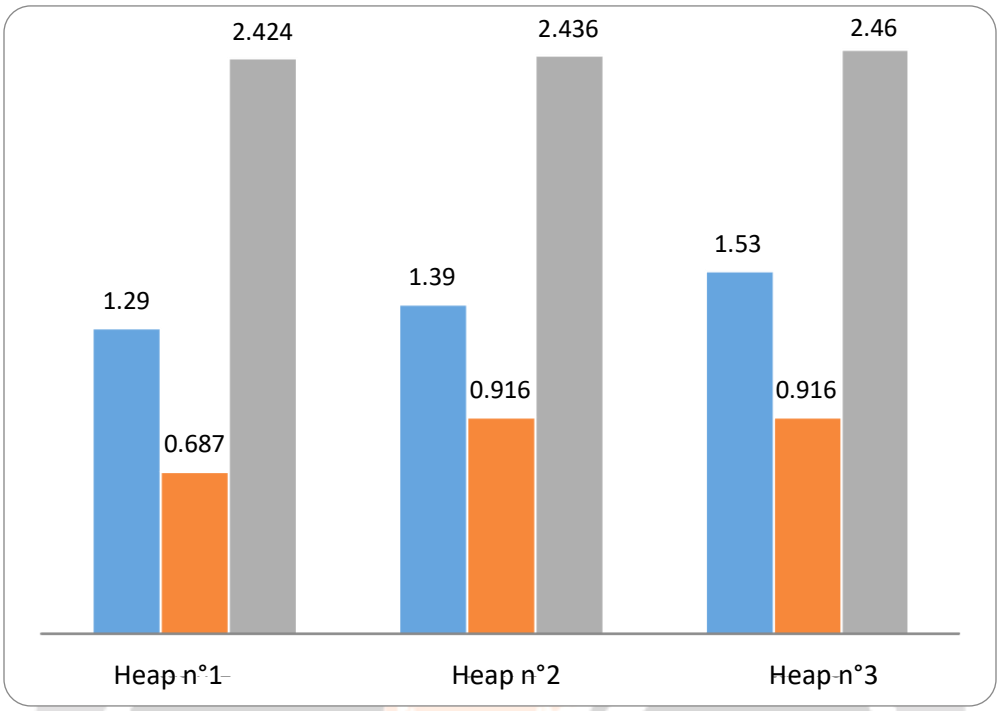

Fig-2: Contents of major elements N (Nitrogen), P (Phosphorus), and K (Potassium)

Bleu: Nitrogen (%)
Orange: Phosphorus (%)
Grey: Potassium (%)

The nitrogen contents of the 3 heaps are as follows: 1.29% for the heap n°1; 1.39% for the heap n°2 and 1.53% for the heap n°3. Nitrogen is the main factor in the growth and improvement of plant yields.
The heap n °1 has a low nitrogen content compared to the other two piles. This is explained by the loss of nitrogen in the heap n°1 during a long composting period of about 3 months. Hence the interest in shortening the duration of composting by forced oxygenation.

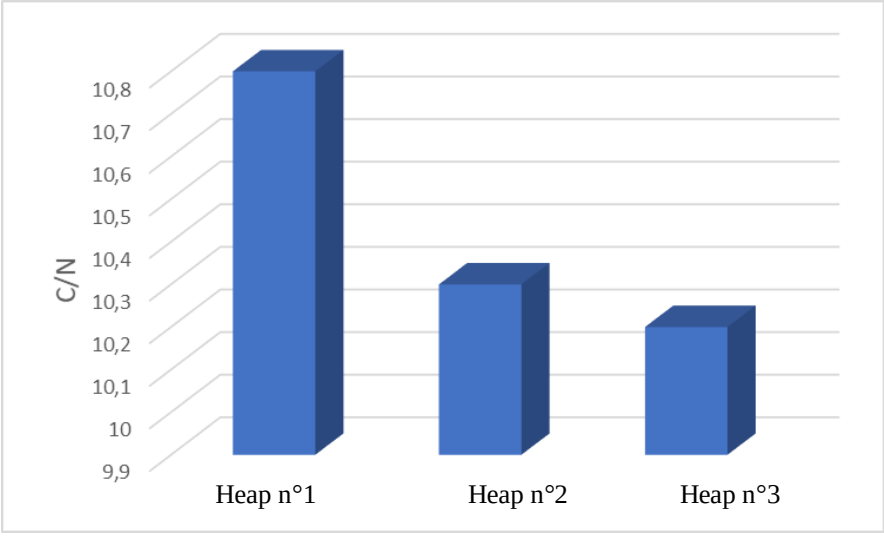

Fig-3: Value of the report C/N

For the C/N ratio, the heap n°1 has a value of 10.8; 10.3 for the heap n° 2 and 10.2 for the heap n° 3. The decrease in the initial values of the C/N ratio of about 30 to 10 indicates the maturity of the compost.
The composting times of the 3 heaps are shown in the following figure.

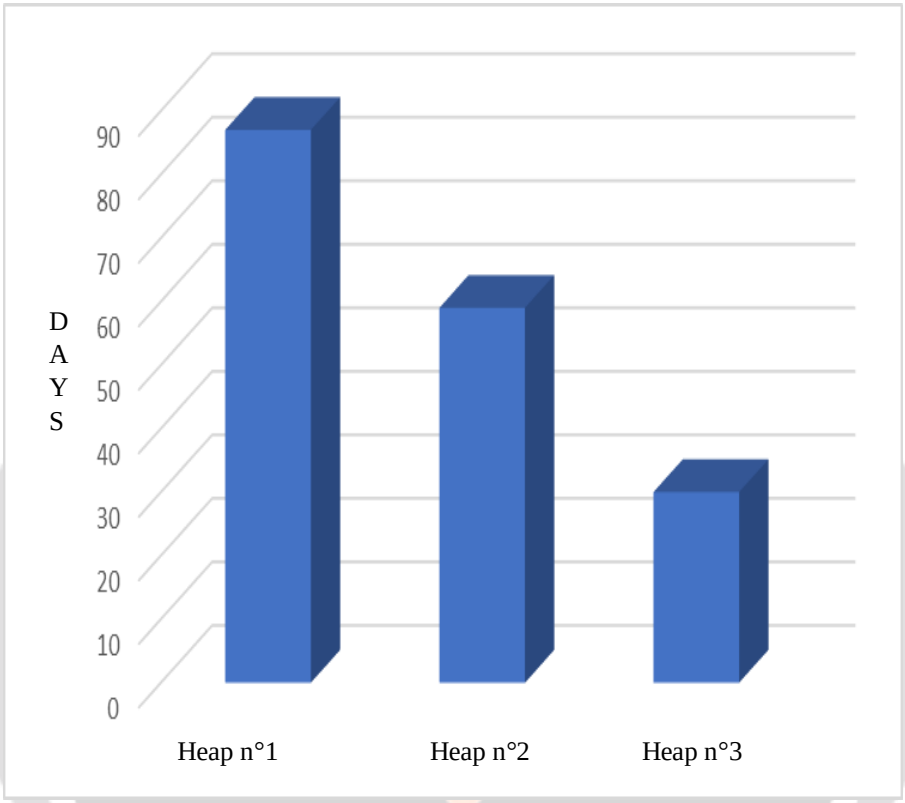

Fig-4: The composting times of the 3 heaps

The composting times for the heap n°3 piles show significant differences: only 1 month for the heap nº3 which received more oxygenation (every 2 days); 2 months for the heap n°2 (forced oxygenation every 4 days) and 3 months for control heap n°1 (no forced oxygenation). Using a manual blower activates the composting speed. This is a reinforcement of the ventilation of the pile in addition to the various turns. This method has modified the environment of decomposing microorganisms by improving their living conditions. These thermophilic microorganisms can breathe well, their multiplication and activity has shown to accelerate the decomposition of organic matter, hence reducing the composting time. Indeed, the acceleration of composting by forced oxygenation confirms the hypothesis.

4. CONCLUSION

According to the comparative study, the results obtained for the compost obtained from the heap nº 3 which received oxygenation were the best. The organic matter content is the highest, around 27.86%, the same for the nitrogen content of 1.53% and above all the shortest composting time of just one month. The forced supply of oxygen causes great changes in the life of microorganisms in the compost heaps. The living condition of decomposing microorganisms improves, and the composting time decreases considerably from 3 months to 1 month. Also, the activities of the peasants could be lightened during the preparation of compost in the future. Now, the working hypothesis is verified. The application of this study to farmers is highly desirable.

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