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Crop improvement of the vanilla tree, *Vanilla planifolia*, using organic fertilizer based on rice straw and manure in Mandritsara-Madagascar

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Abstract: Certain theoretical models have been proposed in this article such as in intensive agriculture which proposes agricultural systems based on a model where the dependence of farmers on agro-food industries in order to improve economic efficiency with the aim of increasing and improving the ecological efficiency. Madagascar vanilla is not only one of the main revenue products, but it is also the national pride of the big island. But currently, this vanilla sector finds itself in a delicate situation due to the lack of quality on world markets. Thus, the objective of this study is to improve the cultivation technique of vanilla using organic fertilizer based on rice straw and manure in order to determine its quality. The adopted methodology focuses on the making of organic fertilizers, cultural tests and laboratory analysis. According to the obtained results, the development of vanilla cultivation showed that intensive agriculture could mobilize certain services linked to good management of biodiversity, particularly at the agronomic level, and making it possible to better reconcile agricultural production and the preservation of nature biodiversity.

Keywords: Amelioration; Compost; Cultivation; Quality; Vanilla.

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1 Introduction

The vanilla tree is an orchid-type plant [10]. The vanilla tree is a climbing vine native to tropical America that can reach 15 m long and live 10 to 12 years. It has a woody stem with adventitious roots, oval leaves of 15 to 25 cm and greenish flowers [6]. It is cultivated in very different ways, from very extensive to very intensive methods. In general, in most producing countries, vanilla cultivation is carried out in semi-intensive mode on living stakes. Vanilla planting densities vary greatly, but typically plants are spaced 1.50 x 1.50 m apart, which gives 4,500 to 5,000 vanilla plants/ha. Reproduction is carried out by cuttings [9].

Madagascar vanilla, emblematic of the country, is currently in a delicate situation due to the competitive context. It must explore different original paths to gain a place corresponding to its historical reputation on international markets: one of the most promising approaches is the establishment of certifications of origins and/or qualities, which however require on the one hand reorganization and restructuring of the vanilla sector, and on the other hand an in-depth knowledge of the characteristic constituents of vanilla, and the determinants of their variability [7].

Pods harvested too early are vacuum-packed to artificially inflate their weight. A set of practices that leads to a progressive degradation of a quality once celebrated around the world [1]. The problems which damage the production of vanilla from Madagascar, in particular from Mandritsara are: the lack of competent technicians which raises many concerns about the future of this sector which is closely dependent on the quality of its production (high vanillin rate); lack of quality in global markets; and insufficient means to control and monitor the maturation of the product.

Thus, in this article we propose the theme: Cultural improvement of the vanilla tree, *Vanilla planifolia*, using organic fertilizer based on rice straw and manure in Mandritsara - Madagascar. The main objective of our research is to improve the cultivation technique of this variety of vanilla by using organic compost. Its specific objectives are to manufacture the best composts from agricultural waste, transmit the necessary knowledge to local farmers on the cultivation technique and packaging of vanilla and characterize the quality of vanilla pods.

2 Methodology

The used methods concern surveys with growers of the vanilla platform, manufacture of compost, analysis of the soil and the compost produced and then maintenance of the culture, sampling of the studied parameters and finally analysis of the vanillin level.

2.1 Method of making compost

2.1.1 Choice of raw materials

Raw materials were chosen because of their value in having indispensable mineral element, namely: rice straw (carbon-rich waste) and manure (nitrogen-rich waste).

2.1.2 Setting up windrows and mixing raw materials

Our windrow is located under a mango tree and next to a well. For the mixture, 50 % rice straw and 50 % manure were made. The different layers were respected in piles with a thickness of 40 cm for each type of waste until they reached a height of 1.5 m.

2.1.3 Watering and turning

Three turnings were made during the composting process during which we watered, so that the micro-organisms could do their work by decomposing the materials. The reversal is carried out with watering spaced 15 days apart. Turning allows the compost to aerate and mix the components.

2.1.4 Compost maturity test

To know the maturity of the compost, a biological test or germination test was carried out. The principle consists of sowing the plant seed in a small box filled with our compost. If the seed has not yet germinated after 24 or 48 hours, the compost is not yet mature. It is recommended to continue composting until maturity [10]. The pestai seed was sown in a plastic box filled with compost. After 24 hours of sowing, the seed has started to germinate: the compost is very ripe (Figure 1). The vanilla tree is planted by cuttings of 1 to 2 meters (m).

Figure 1. Seed germinated after 48 hours of sowing.

2.2 Soil analysis

Certain parameters which characterize the soil of our study site were considered. These parameters obviously depend on the nature of the soil to be cultivated. The determination of pH (Hydrogen Potential) and Organic Matter (OM) was made.

2.3 Compost analysis

The different parameters which characterize our compost have been determined, namely: dry matter, water pH, total nitrogen, organic matter and total phosphorus.

2.4 Parameter analysis

Twenty-six (26) vanilla plants were planted by dividing them into five lots, and each has six feet. For crop monitoring, the average height of growth and the average number of leaves on the plants of each batch were measured. For each cultivation maintenance, the compost was placed on each foot of the vanilla tree except for the last two feet serving as the control for our experiment.

After a month of planting, the first monitoring of the crop was done. The average growth and average number of leaves on the plants of each batch were analyzed. Two 5l buckets of compost were put on the first batch of six feet, then 1.5 buckets of 5l of compost on the second batch of six feet, then 1 bucket of 5l on the third batch of six feet and finally half 5l bucket of compost on the fourth batch of six feet. The last lot of the two feet serves as the control.

2.5 Culture monitoring after the interview

After one month of maintenance, the second follow-up of the culture was done. The average growth and average number of leaves on the plants of each batch were analyzed.

2.6 Laboratory analyzes of the vanillin level of products

Six (06) vanilla pods were analyzed in the laboratory. The sample analyzed by spectrophotometry was diluted 1/100 with the following formula:

$$\%\ \text{by mass of vanillin} = \frac{\text{t of vanillin of pure sample}}{\text{t pod of the pure sample}}\ x\ 100$$

with, t in vanillin of pure sample = t in vanillin x 100

t in vanillin = 2.52 mg / ml

$$\text{t pod of pure sample} = \frac{\text{mass of vanilla pods (mg)}}{\text{volume of volumetric flask (ml)}}$$

3 Results

3.1 Soil and compost analysis results

The results obtained from the soil characterization and the compost analysis are presented in Table 1. This table shows that our soil is low acidity and very low in organic matter. Our compost is very dry and it is acidified with a very low reserve with the presence of a fertilizing material.

Table 1. Soil and compost quality.

Settings	Soil	Compost
Water pH	5,41	6,34
KCl pH	4,92	-
Dry matter (%)	-	90,97
Organic material (%)	0,05	14,65
Total nitrogen (%)	-	9,6
Total phosphorus (%)	-	0,178

3.2 Growth and number of leaves

The results of the measurements of the average growth and number of leaves from the first monitoring after planting without compost are shown in Figure 2. It shows that the average growth in the last batch is higher, then in the second batch and finally in the first, third and fourth batch are almost the same. Regarding the average value of number of sheets, we see that the average number of sheets in the last batch and in the second batch are more numerous compared to the other batches.

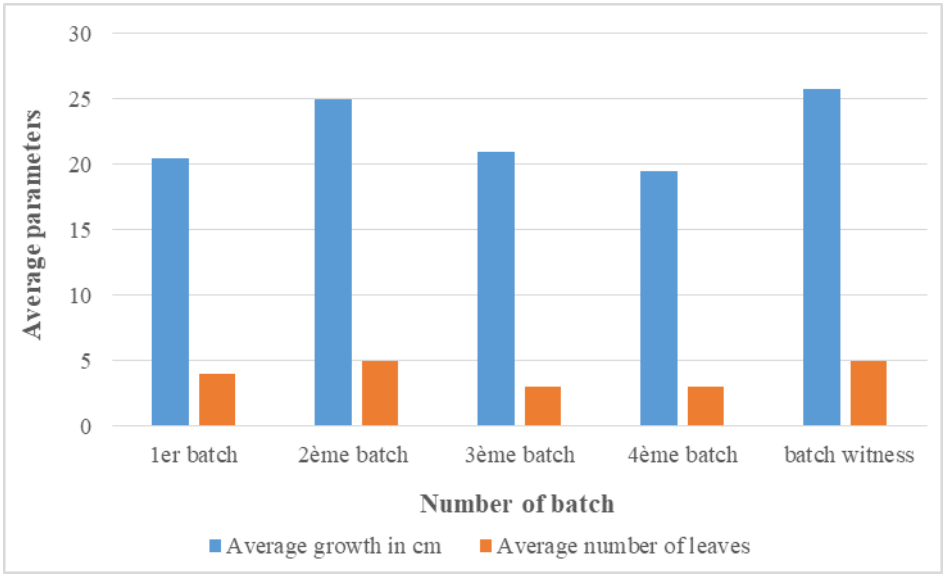

Figure 2. Average growth and number of leaves of vanilla without compost

The Figure 3 represents the result of the second monitoring of the culture after maintenance with compost. It shows that the average growth in the fourth batch is higher (100 cm), then in the second and third batch are almost the same height (92 and 93 cm) then in the first batch (83 cm) and finally in the control lot is shorter (65 cm). Regarding the average value of the number of sheets, we note respectively first batch: 8 sheets, second batch: 9 sheets, third batch: 10 sheets, fourth batch: 10 sheets and control batch: 8 sheets.

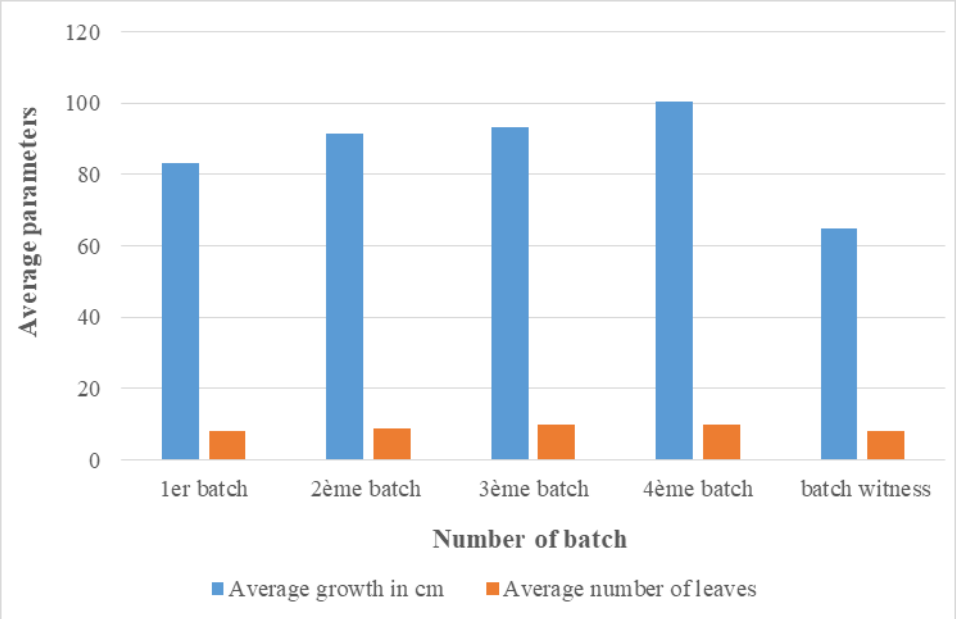

Figure 3. Average growth and number of leaves of vanilla with compost

3.3 Vanillin level

We can see that compost plays a very important role in the cultivation of vanilla. After using the compost, the growth of the vine is very rapid, 60 to 70 cm per month. The vanillin level of the pure sample is 252 mg/ml and the pod level of the pure sample is 72 mg/ml. Thus, the vanillin level of the pods is 3.5 %.

4 Discussion

Vanilla cultivation presents edaphic requirements. The soil must be well drained and rich in organic matter [3]. Mulching is a large operation and large quantities of mulch are required. Fertilizer inputs vary depending on the initial richness of the soil, but in general it is estimated that each vanilla plant needs 40 to 60 g of nitrogen, 20 to 30 g of phosphorus and 60 to 100 g of potassium. Vanilla responds well to organic fertilizers. For this purpose, a 1 % solution of NPK 17 -17- 17 is recommended [4].

According to our soil analysis, our soil is acidified in small quantities and it is also very poor. This is why we made organic compost from agricultural waste (straw and manure). The use of our compost in the cultivation of the vanilla variety, *Vanilla planifolia*, allowed us to conclude that a quantity of half a 5l bucket corresponds to rapid growth of 100 cm in height of the liana. The absence of compost in the control lot justifies the average liana growth value of 60 cm which is lower than the others. Concerning the average number of leaves on the vanilla plants, the use of our compost did not significantly influence the obtained results: almost the same number except in the control batch which is 10 leaves.

5 Conclusion

Improving the vanilla land is necessary for the good production of pods. The soil of the cultivation land in our experiment is an acidified soil with low reserves and organic matter, requiring fertilization with organic fertilizer (compost). Vanilla plants benefit more from the addition of organic matter from mulching, harvest residues or compost than from the addition of chemical fertilizer.

According to the result of our experiment, we can see that compost plays a very important role in the cultivation of vanilla. Using half a 5l bucket of compost is more effective compared to other dosages. The growth of lianas is very rapid, 60 to 70 cm per month. The vanilla pods that we analyzed have an acceptable mass percentage of vanillin because it is greater than 2 %.

REFERENCES

[1] In Madagascar, what future for vanilla? Available on: "www.entrevienseafrique.com" (accessed September 14, 2020).

[2] Andranomanana. S (2006). Semi-intensive system. Available on: "biblio.univ-antananarivo.mg" (accessed September 14, 2020), 86p.

[3] Vanilla cultivation. Available on: "www.mondevanille.com" (accessed April 5, 2021).

[4] Vanilla cultivation, fertilization, planting. Available on: "fr.agroneo.com" (accessed April 5, 2021).

[5] Vanilla sector: risk of a dizzying drop in prices. Available on: "www.mid-madagasikara.mg" (accessed April 5, 2021).

[6] The origin of vanilla-Bourbon vanilla from Madagascar. Available on: "www.vanigasy.fr" (accessed September 14, 2020).

[7] Rasoarahona. F (2013). Evolution of the aromatic constituents of vanilla during treatments. Available on: "www.fsp.parrur.irenala.edu.mg" (accessed April 10, 2021), 15p.

[8] Rasoavololoniaina. H (2014). Development of a yield forecasting model. Available on: "biblio.univ-antananarivo.mg" (accessed April 10, 2021), 79p.

[9] All about vanilla (Last update: December 5, 2005) [online]. Available on: "planet-vie ers.fr" (accessed April 10, 2021), 79p.

[10] Zafitody. C (2005). Strategic diagnosis of the vanilla sector. Available on: "http//: www.observatoire-foncier.mgdownloads" (accessed November 5, 2018).