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Effect of Composting Waste on the agronomic parameters of Young Hevea plants (*Hevea brasiliensis* Muell. Arg.) In West of cote d'ivoire

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Abstract
An agronomic trial lasting four Months was carried out in a peasant environment in order to study the effect of compost made from Chicken Manure, Whether or not combined with urea on the Vegetative Growth of Rubber plants (*Hevea brasiliensis* Müll Arg.) in bagged nursery. The trial was set up using a Randomized complete block device (BCR) with six treatments which are: T1 (Soil only, absolute control); T2 (Potting soil + 1.30 g of urea (relative control); T3 (0.5 kg of compost mixed with potting soil); T4 (1 kg of compost mixed with potting soil); T5 (0.5 kg of compost mixed with potting soil + 0.65 g of urea) and T6 (1 kg of compost mixed with potting soil + 0.325 g of urea). Data on growth unit, scion diameter (mm) and plant height (mm) were collected monthly from the start of the trial. Plant vigor was also determined. Four months after setting up the experiment, the results showed that adding compost significantly improved the vegetative growth of the plants. These contributions have; therefore, induces a very good vigor of the plants. The T3 treatment (plant having received 0.5 kg of compost mixed with potting soil) gave the best results. This shows that the recovery of waste as a source of organic matter could be a practice to be encouraged among peasants, in particular, rubber tree nurserymen.

Keywords: Compost made from chicken manure, vegetative growth, *Hevea brasiliensis*, Ivory Coast

1. Introduction

Rubber cultivation in Côte d'Ivoire is an important factor in poverty reduction policy, due to the monthly income it provides (Toguila *et al.* 2016) [14]. From 100 tonnes in 1960, Ivorian natural rubber production rose to 256,000 tonnes in 2013, then to 350,000 tonnes in 2015, over a geo-localized area of 298,975 hectares (APROMAC, 2017). This remarkable development was possible thanks to the improved prices and the subsidy of plant production by the Hévéa Development Fund (FDH), in support of research through clonal selection and improvement of technologies for harvesting latex from clones (Eschbach and Tonnelier, 1984; Prévôt *et al*., 1986, Lacrotte, 1991; Obouayeba, 2005). Despite the investigations undertaken and the high yields, concerns remain, including pest and land pressures, the aging of the orchard and the low level of adoption of the technical routes recommended by the research. Also, it should be added that in terms of prospects, the national master plan for the development of the rubber industry, foresees, with the 2025 objective, to increase its production to 600,000 tonnes of natural rubber. This natural rubber production objective can only be achieved by increasing the areas planted with high-performance plant material, adapted to the pedoclimatic conditions of the environment. The expansion of this rubber area necessarily starts from nurseries which provide the seedlings allowing the creation of new plantations. Unfortunately, the strong demand for rubber planting material which contrasts with the availability of seedlings has shown the need to shorten the production time of seedlings in the nursery, including, in these new cultivation areas (Elabo *et al*., 2014). All these constraints can be overcome if the conditions for the production of vigorous plants, from land preparation to transplanting in the field, are well defined; in particular, the sustainable management of soil fertility. This management of soil fertility involves the rational use of chemical or organic fertilizers or a combination of the two types of fertilizers. Organic waste, such as crop residues, chicken manure, pig and cattle droppings can, through the technique of composting, make a decisive contribution to ensuring the maintenance of the fertility of cultivated soils (Mahli *et al.* 2006; Djéké *et al.* 2011). This study is part of the recovery of organic waste by the technique of composting in pits and aims to enrich knowledge on the beneficial effects of composts on plant growth and improvement of soil quality. More specifically, this work aims to evaluate the effects of compost made from chicken manure on the vegetative growth of rubber trees in bagged nurseries. To conduct such a study, a trial was set up in a farming environment.

2. Material and Method

2.1 Plant Material

Since the choice of rootstock is an important element in successful grafting (Penot, 2004), the plant material used consists of rubber seedlings of the GT 1 clone, about one month old. Currently, the GT 1 clone is considered the best rootstock. It was selected in Indonesia in the region of Gondang Tapen from which it takes its name. GT 1 is the benchmark clone in Côte d'Ivoire.

2.2 Fertilizer material: Compost and chemical fertilizers (urea)

The compost used was obtained by recycling chicken manure and dry straw from Panicum maximum in the pit; wood ash and urea.

3 Work Methodology

3.1 Preparing the ground and making the gauges

The plot was manually cleared and cleared of plant debris, before picketing, over an area of 300 m2 (20 m × 15 m).
Staking was done on two parallel borders and then inside the plot. Then, eight (8) trenches or gauges were opened, according to the following dimensions:

- width of a trench: 0.2 m;
- length of a trench: 4 m
- distance between 2 trenches: 1 m;
- depth of a trench: 0.2 m.

During the digging of the trenches, the earth was placed on the same side of the trench and was subsequently used for filling the bags after mixing with or without the compost.

3.2 Filling and arrangement of bags

By gradually settling, the polyethylene bags were filled with potting soil mixed with or without the compost produced. These bags, buried at 2/3 of their height, were placed in the trenches in discontinuous tetrahedra.

3.3 Collecting the seeds and setting up the germinator

The germinator is the place where the seeds are put to germinate before their transfer to the nursery or the field. It was made up of one (1) square meter flower beds at each test site. This one-square-meter strip can hold up to 1000 seeds. These bands were formed by a light medium about 5 to 10 centimeters thick of sand and were covered by a shade made of oil palm stems. The so-called illegitimate seeds (seeds of which only the maternal origin is known) were those of the GT 1 clone.

3.4 Experimental set-up and treatments

The trial of the application of organic manure in rubber tree nurseries was carried out in a peasant environment. The factor studied in this experiment was the fertilization of the soil with different doses of compost from chicken manure. In total, six (6) treatments were considered. To this end, we have two control treatments (absolute control T1: without input of fertilizer and relative control T2: input of urea) and four other composition treatments resulting from the compost produced combined with or without mineral manure. Each treatment, repeated three times, consists of 40 plants. The total number of plants per nursery was 720 and the compound treatments are as follows:

- T1: Soil alone (absolute control)
- T2: Soil + 1.30 g of urea (relative control)
- T3: 0.5 kg of compost mixed with potting soil
- T4: 1 kg of compost mixed with potting soil
- T5: 0.5 kg of compost mixed with potting soil + 0.65 g of urea
- T6: 1 kg of compost mixed with potting soil + 0.325 g of urea.

The urea was applied in two applications inside the sachets. The first application was made from the second leaf stage, one month after transplanting the seedlings and the second, two months after the first pass. The urea was dissolved in the irrigation water (50 ml of water per plant) and supplied to the plants. However, the compost applications were made in one go (when filling the bags).

3.5 Nursery maintenance

- **Irrigation**

The water requirements of young rubber plants in the nursery are estimated at 120 mm of water per month. We therefore made two contributions of 15 mm per week, in addition to the rainfall, at the cooler hours of the day (early morning, then late afternoon).

- **Weeding**

Weeding the nursery was done manually with a daba and a machete, at each regrowth after transplanting.

3.6 data collection

Plant growth measurements were performed to assess the effect of applying chicken manure compost on the vegetative growth of rubber trees in the nursery.
These measurements were made every month (from November 2018 to February 2019), from transplanting before grafting the plants. The parameters measured are as follows:

- the total height H (mm) of the plant, measured using a ruler graduated in centimeters;
- the diameter DC (mm) from the stem to the root collar (soil) of the plant, measured using a millimeter caliper;
- the number of leaf stages or growth units (CU) that have appeared;
- the homogeneity and vegetative vigor of the plants within the treatment:

We know that the potential vegetative vigor of the rootstock does not a priori have a direct influence on the growth and future production of the scion, ie the tree. But, for agronomic reasons, it is advisable to select the most vigorous rootstocks in the nursery to ensure good subsequent vegetative development (Ferrand, 1944).
The vegetative vigor of the plants was assessed by determining the vigor index (IV). This index makes it possible to highlight the development of the plant at a young

age (Berchoux and Lecoustre, 1986). It was determined from the circumference or diameter at the neck and the height of the plant according to the following expression:

C: circumference (mm) at the neck; H: height (mm) of the plant and ft: constant 3.14.

$$\mathbf{IV}\,(\mathbf{p.c.}) = \log\left(\frac{H \times C^2}{pi \times 4}\right)$$

3.7 Data processing

The data relating to the vegetative growth of the plants in the nursery were entered and processed using an Excel spreadsheet. One-way analysis of variance (ANOVA) was used to assess the effects of application of the compost produced on the vegetative growth parameters of the plants. Mean values were classified using Fisher's least significant difference method (ppds = Lsd). The probabilities were evaluated at the threshold of $\alpha = 0.05$. All these results have been represented in the form of graphs.

4. Results and Discussion

4.1 Results

Physical and chemical characteristics of the compost produced: The evaluation of a compost must take into account its fertilizing value, but also its health quality and its organic amendment properties. Its fertilizing value can vary greatly depending on the nature of the litter and the fertilization of the crops that provide this litter. As part of this study, we determined the granulometric composition (fraction of 10, 5, 2 mm) of the compost produced as well as its chemical characteristics (carbon, nitrogen, phosphorus, magnesium and calcium contents).

4.1.1 Particle size composition of the compost produced

The average values of the different particle size fractions (Figure 1) of the compost are as follows:

- 4.46% for particles having a size greater than 10 mm;
- 24.86% for those whose size is between 5 and 10 mm;
- 13.39%. for those of size between 2 and 5 mm;
- 57.29% for particles having a size less than or equal to 2 mm.

The compost thus obtained has the highest proportion of fine elements (particles of size less than 10 mm), ie a rate of 95.54%. This compost has a structure whose particles are smaller and fairly homogeneous (95.54%) and whose texture is similar to that of soil. The high proportions of fine elements in the compost testify to the good quality of the composts, although the refusal is around 5%.

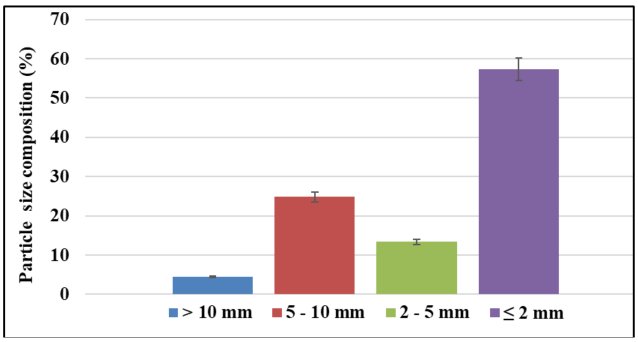

Fig 1: Particle size composition (bw) of the compost obtained

4.1.2 Chemical characteristics of the compost produced

Table 1 shows the chemical characteristics of the compost produced in a farming environment (Man region). According to the analysis, the content of organic matter (OM = 32.42%), total nitrogen (N = 1.43%); phosphorus (P = 0.48%); potassium (K = 0.22%); in calcium (Ca = 2.58%) and in Magnesium (Mg = 0.21%) is of a good to very good level according to the AFNOR standard (Association Française de Normalization). The C / N ratio between 10 - 15 corresponds to a mature compost.

Table 1: Chemical characteristics of the compost produced in a farming environment (man region)

Chemical characteristics	Compost produced	AFNOR quality standard
pH	7,7	-
C (%)	18,85	-
MO (%)	32,42	**> 5**
N (%)	1,43	**> 0,25**
C/N	13,18	**< 20**
P (% ms)	0,48	
K (% ms)	0,22	
Ca (% ms)	2,58	**> 1**
Mg (% ms)	0,21	

AFNOR: French Association for Standardization % ms: percentage of dry matter

4.2 Effect of different doses of compost on aerial vegetative growth of plants

Figures 2, 3, 4 and 5 show the effect of compost doses on aerial vegetative growth parameters such as height, growth unit, crown diameter and vigor index of rubber plants. in the nursery.

4.2.1 Effect of different doses of compost on the height (H) growth of rubber plants

Figure 2 shows the evolution of the height growth of rubber plants in the nursery over a period of 4 months, from November 2017 to February 2018. From the first two measurements taken (November and December 2017), we do not 'observed no significant difference in height measurements between treatments. The plants all evolved in the same order of magnitude. On the other hand, significant differences were observed from the 3rd and 4th measurements (January and February 2018). The T2 treatments (plants fertilized with chemical fertilizer) and T3 (plants fertilized with 0.5 kg of compost) gave the best results.

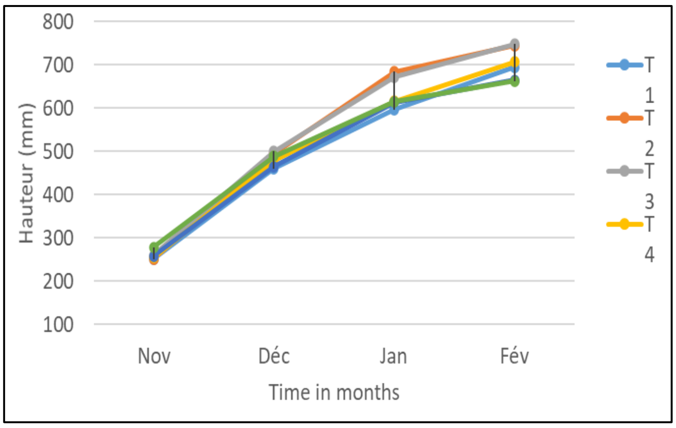

Fig 2: Evolution of the height of rubber trees in the nursery according to the treatments applied.

4.2.2 Effect of different doses of compost on a Growth unit (CU) of rubber plants

Figure 3 shows the evolution of the growth unit of rubber trees in the nursery over a period of 4 months. Analysis of this figure shows that the appearance of plant growth unit evolves in the same order of importance regardless of the treatment applied. The appearance of the growth unit could therefore not be related to the effect of fertilization, but rather to other conditions such as frequent watering.

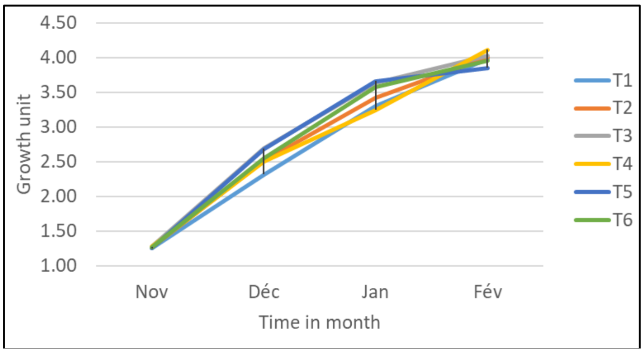

Fig 3: Evolution of the growth unit of rubber trees in the nursery according to the treatments applied

4.2.3 Effect of different doses of compost on the growth of crown diameter (DC) of rubber plants

The diameter at the neck and the vigor of the plants are the most determining parameters in the rest of the experiment. In fact, grafting, which is done in a dormant eye patch, therefore on the aerial part of the plant, is generally only carried out on vigorous plants. Because lack of vigor is one of the causes of high mortality of these plants after transfer to the field. The evolution of the diameter at the neck (mm) of the plants shown in the figure below, four months after transplanting, shows that it is the T3 treatment (plant having received 0.5 kg of compost mixed with potting soil) which displays good results, ie an average diameter greater than 9 mm. On the other hand, the lowest values of diameter at the neck were obtained with the T1 treatment (control without addition of fertilizer, Figure 4).

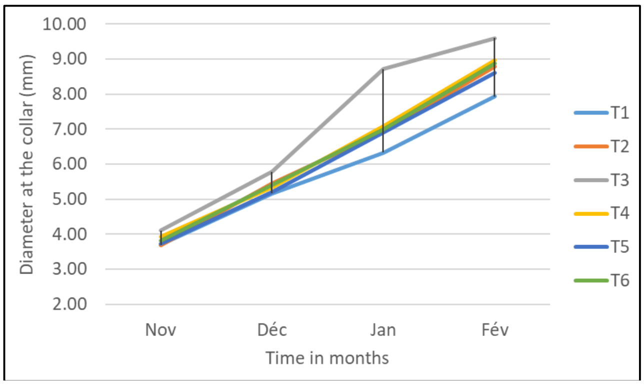

Fig 4: Evolution of the diameter at the crown of rubber trees in the nursery according to the treatments applied

4.2.4 Effect of doses of compost on the vigor of rubber trees in the nursery

The success rate of a grafting (Figure 5) of plants is generally conditioned by the vigor of the rootstocks, apart from parameters such as the influence of the grafter, of the clone; ecological conditions. The figure relating to the change in the vigor index of the plants shows that from transplanting to the 4th measurement of the plants, it is the T3 treatment (plant having received 0.5 kg of compost mixed with soil) which significantly improved the vigor of the plants.

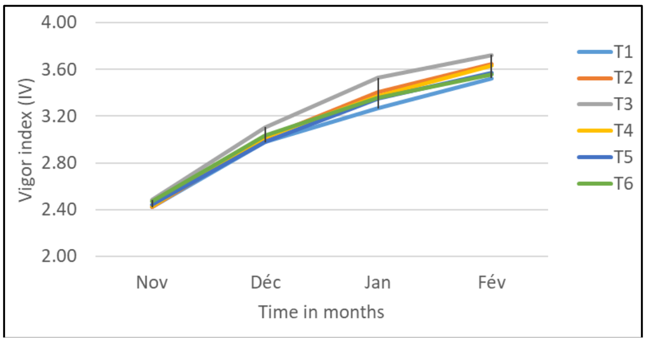

Fig 5: Evolution of the vigor index of rubber trees in the nursery according to the treatments applied

5. Discussion

In terms of growth of rubber trees in the nursery, the compost-based substrates performed better than the control substrate (S1), with statistically significant differences for the aerial vegetative growth parameters (height and diameter, rate of plants graftable and plant rate transferable to the field) and underground (length of the taproot and root biomass). The average values of the monthly increase in diameter at the root collar (ΔC), the most important parameter in the management of a rubber tree nursery, were significantly greater for the plants of compost-based substrates: 1.76; 1.86; 1.95 and 2 mm.month-1, respectively, for the substrates S6, S5, S4 and S3, against 1.57 mm.month-1 for the plants of the control substrate (S1), and even higher than that observed by Companion (1986), which is of the order of 1.5 mm.month-1 on average. In addition, the compost-based substrates made it possible to achieve significant growth gains ranging from 3.17 to 23.82 pc in height and from 12.34 to 27.88 pc in diameter, compared to the plants of the control substrate S1. This difference in growth observed with compost-based substrates is linked on the one hand to the maturity of the compost obtained and on the other hand to its richness in fertilizing elements. Nutrients from the mineralization of chicken manure (Biekré *et al*., 2018) and dry panicum straw must have enriched the soil and contributed favorably to the development of rubber plants, compared to plants produced from the substrate. control (S1) on these two sites. This confirms the observations made by Amadji *et al*. (2009) after using compost enriched with chicken manure for the production of cabbage on sandy soil and by Essehi *et al*. (2016) on the impact of organic fertilization on some soil characteristics and on the growth parameters of rubber trees during the establishment phase in Bonoua, in the south of Côte d'Ivoire. These results indicate that the nutrients, namely nitrogen, phosphorus and potassium, were more available in growing media based on compost than in other media (S1 and S2).

6. Conclusion

At the end of our study on the effect of compost based on chicken manure combined or not with urea on the vegetative growth of rubber plants (*Hevea brasiliensis* Müll Arg.) In a bagged nursery. the growth unit, the diameter of the scion (mm) and the height (mm) of the plants were recorded monthly from the start of the test. Plant vigor was also determined. Four months after setting up the experiment, the results showed that adding compost significantly improved the vegetative growth of the plants. These contributions have; therefore, induces a very good vigor of the plants. The T3 treatment (plant having received 0.5 kg of compost mixed with potting soil) gave the best results. This shows that the recovery of waste as a source of organic matter could be a practice to be encouraged among peasants, in particular, rubber tree nurserymen.

7. References

1. Biekré AHT, Tié BT, Dogbo DO. Physico-chemical characteristics of composts made from farm by-products from Songon in Côte d'Ivoire, Int. J. Biol. Chem. Sci 2018;12(1):596-609.
2. Boa D. Modeling of the relationship between the weight rate and the volume rate of gravelly soils, Document ORSTOM, Adiopodoumé, 1988, 21.
3. Bouadou oi BF, Brahima K, Yao K, Yao-Kouamé A, Oikeh OS. Tropical Cambisol as Affected by Sugarcane (*Saccharum officinarum* L.) Foam and Inorganic Fertilizer. American Journal of Experimental Agriculture 2014;4(7):732-745.
4. Compaoré E, Nanéma LS, Bonkoungou S, Sedogo MP. Quality assessment of urban solid waste composts from the city of Bobo-Dioulasso, Burkina Faso for efficient use in agriculture, J. Appl. Biosci 2010;33:2076-2083.
5. Cooperband L. Building soil organic matter with organic amendments. Center for Integrated Agricultural Systems, University of Wisconsin-Madison, Madison, 2002, 1-16.
6. Coulibaly LF, Diarrassouba M, Obouayeba S, Yapi G CV, Ake S. Reverse bleeding exploitation system of the PB 235 clone of *Hevea brasiliensis* in Côte d'Ivoire. Journal of Animal & Plant Sciences 2011;9(2):1147-1160.
7. Culot M, Lebeau S. Composting, a little-known waste management practice, Information Bulletin AlGx 1999;5:11-19.
8. Dabin B. Study of a method of extracting humic matter from the soil. Soil Sciences 1971;1:47-63.
9. Déa GB, Keli ZJ, Eschbach JM, Omont H, Canh VT. Rubber tree (Hevea brasiliensis) behavior in marginal climatic zones of Cote d'Ivoire: Assessment of ten years of observations In: Symposium on Agronomy Aspects of the Cultivation of Natural Rubber, IRRDB, 5 - 6 November 1996, Beruwela, Sri Lanka 1997, 44-53.
10. De Pardillac R. The economic importance and future of natural rubber. In: Natural rubber. Coste R. ed., G. P. Maisonneuve and Larose, Paris 1986, 15-39.
11. Devi RR, Ali I, Maji TK. Chemical modification of rubber wood with styrene in combination with a cross linker: effect on dimensional stability and strength property Bio resource Technology 2003;88:185-188.
12. Diaz LF, Savage GM, Eggerth LL, Golueke CG. Composting and Recycling Municipal Solid Waste. Lewis Publishers, Michigan University, USA 1993, 296.
13. Disnar JR, Bruand A. Soil organic matter (SOM): a difficult but fruitful legacy. Geochronics 2007;104:20 - 21.
14. Toguila TB, N'diaye ON, Attobra A. Technical assistance mechanism for technology transfer to rubber planters in Côte d'Ivoire. IRRDB regional workshop, Yamoussoukro, Côte d'Ivoire 2016, 26.