



EFFECTS OF LIQUID MANURE FROM "*Lantana camara*", COMFREY "*Symphytum officinale*", AND FARM, ON THE PRODUCTIVITY OF CARROT "*Dacus carotta*" Var. Nantes IN THE REGION OF VATOVAVY FITOVINANY IN MADAGASCAR

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Article Received on 15/02/2020

Article Revised on 05/03/2020

Article Accepted on 26/03/2020

ABSTRACT

This study aims to improve the productivity of carrot "*Dacus carota*" in "Vatovavy Fitovinany" region, in the southeastern part of Madagascar. Liquid manure from: "*Lantana camara*", comfrey "*Symphytum officinale*", farm, *Lantana* mixed with comfrey and *Lantana* mixed with farm, were used as fertilizer. They were watered at the foot of each carrot plant, at a rate of 0.5 liters repeated 3 times a week, on an experimental surface of 5 random blocks, each of which consists of 6 elementary plots of 3 m x 2.60 m. Mixed liquid manure from *Lantana*, comfrey and farm was more favorable for the growth in length of the leaves on the average of 48 cm. The highest average leaf weights were obtained with liquid manure from *Lantana*, comfrey and farm unmixed at the respective weight of 212 g, 211 g, 246 g compared to 46 g for the control. The different types of manure have significant effects on the average root weight. The carrot roots obtained after fertilization with comfrey manure have the highest average weight of 311 g compared to the control which is 48 g. Carrot root yield is almost six times higher when the crop was treated with these different manures. The best yield of 14.34 t / ha was obtained in plots fertilized with comfrey liquid manure, while for non-treated control plants, the yield was only 2.22t / ha.

KEYWORDS: *Comfrey*, *Dacus carota*, fertilization, *Lantana camara*, liquid manure, Madagascar.

INTRODUCTION

Madagascar is recognized as an agricultural country. In recent years, vegetable crops are growing in quantitative importance in agriculture in Madagascar. The existence of favorable natural conditions and the willingness of producers to the diversification lead to a progressive integration of these crops into production systems. In addition, vegetables are an important source of vitamins and allow diet. They also constitute, even on small surfaces, a cash crop for farmers (http: 1).

Unfortunately, the country is facing high rates of food insecurity especially in the South, Southeast, and Vatovavy Fitovinany regions (http:2). In rural areas, people live on subsistence agriculture, and almost 80% of them suffer from poverty (http: 3). Regional profile of the FCC (Food Consumption Score) shows that the level of food consumption limit of 47% of households is very high in the region Vatovavy Fitovinany (Benjamin B. et al., 2013).

According to the agro-ecological map of Madagascar, the Vatovavy Fitovinany region is subject to a tropical

rainy climate, in which the soil becomes increasingly degraded (GSDM, 2017).

This results in loss of nutrients, to which is added the lack and / or inadequacy of techniques for improving and managing soil fertility. Furthermore, the slash-and-burn method and the absence of external fertilizer supply led a negative effect on soil fertility (Laura Van Schöll, 1998). Thus, farmers suffer and fertilizer use remains essential to have satisfactory production. The existence of suitable organic fertilizer is essential and, adopting simple technologies accessible to all farmers remains imperative.

The main objective of this study is to improve the productivity of the "*Dacus carota*" in the Vatovavy Fitovinany region in the southeast of Madagascar. The specific objective is to highlight the effects of liquid manure of "*Lantana camara*", of comfrey "*Symphytum officinale*" and of farm, alone or in combination, on the productivity of carrot roots.

MATERIAL AND METHOD

Study area

The study was conducted on the field of the Farm-School named "Fihaonana", Urban Commune of Vohipeno, Vatovavy Fitovinany region, southeastern part of Madagascar. This Farm-School is located 5 km North of Vohipeno. It was created in 1983 and covers an area of 30 ha. The experimental site is bounded by the geographic coordinates: 22 ° 20 '01.3' 'at Latitude South and 047 ° 51' 43.7'' at Longitude East. It is located at the top of the hill with a low slope of 4% and the soil has a pH = 5.98

II.2 Biological material and method

« *Dacus carota* »

The starting plant material consists of carrot seeds produced by the Seed Multiplier Center (CMS) at Laniera in Antananarivo. "*Dacus carota*" is belonging to Apiaceae Family, and it has an edible fleshy taproot (Chaux. Cl., Foury. Cl., 1994). It is classified in moderately demanding in crops in terms of fertilization and living biological soil. The culture period ranges from 2.5 to 6 months. The variety used in this experiment is Nantes type.

Farm manure

The liquid manure originally meant liquid waste produced by farm animals, mainly urine. Previously, each farm had its manure pit, smelly, but useful for crop fertilization in particular especially by its nitrogen supply (https:4). The farm liquid manure used was from a manure pit derived from a barn on the farm of the experimental site.

Plant manure

The liquid manures used in this experiment are liquid prepared from plants of *Lantana camara*, and comfrey. The method was as follows: 10 kg of fresh leaves of *Lantana camara* or comfrey were macerated in 100 liters of water. The mixture was stirred every day for two weeks, and plant manure was obtained after filtering (http:5).

Each carrot plant was watered with liquid manure diluted to 10%. For fifteen days after germination, 0.25 liters of liquid manure was applied 3 times a week. Afterwards, the amount of liquid manure was increased by 0.5 liters repeated 3 times a week.

Chemical analysis of liquid manure

The analysis were carried out at the Radio Isotope laboratory in Antananarivo; to assess the rates of the 3 major nutrients "N, P and K" as well as the two secondary elements "Ca and Mg" in the liquid manure.

Experimental plan

Experimentation occupies a total area of 307.50 m² (20.50 m x 15 m) and which was divided into 5 blocks.

Each block is constituted of 6 elementary plots of 3 m x 2.60 m, separated from each other by a path of 0.50 m. Each of these elementary plots consisted of 3 ridges (3 m x 0.70 m). Each sowing line is separated from each other by a 0.25 m. The experimental plan adopted is a complete random block type device, with 6 treatments and 5 repetitions.

Experimentation

The experiment was conducted during the vegetable growing season from March to October, which is a favorable period for the cultivation of carrot (BIMTT, 2010). The carrot seeds were sown at an amount of 1.2 g in each elementary plot, which is 7.2 g for each block; and in total of 36 g.

The method of fertilization is as follows: 5 plots fertilized with Lantana manure; 5 plots fertilized with comfrey manure; 5 plots fertilized with farm manure; 5 plots fertilized with Lantana manure combined with comfrey manure; 5 plots fertilized with Lantana manure combined with farm manure. And five (5) unfertilized plots are the control plots.

The harvest took place 4.5 months after sowing. At harvest, 25 samples of each treatment, (5 plants per elementary plot), were collected for measurements of the parameters studied. The data obtained were statistically processed.

Parameters studied

The parameters taken into account to assess the effects of liquid manure (alone or in combination) are: the length and weight of leaves, the length and weight of root, and the yield.

Data analysis

Analysis of the results according to the different modalities was performed by analysis of variance (ANOVA). The means resulting from ANOVA were thereafter separated into homogeneous groups and compared with the Newman-Keuls test, at the probability threshold of 5%. These statistical analyzes were performed using the software XLSTAT.

RESULTS

Chemical properties of manure

The results of analyzes carried out at the laboratory of Radio Isotope in Antananarivo concerning the nutritive elements consisting of N, P, K, Ca and Mg contained in the 3 liquid manures (Lantana; comfrey and farm) are illustrated in Table 1 below.

Table 1: Results of chemical analysis of liquid manure.

Liquid manure	N tot (mg/L)	P tot (mg/L)	K tot (mg/L)	Ca tot mg/L)	Mg tot (mg/L)
Lantana	77.67	0.035	0.368	0.308	0.097
Consoude	198.81	0.045	0.383	0.274	0.034
Ferme	155.00	0.030	0.399	0.107	0.031

N= Nitrogen, P = Phosphorus, K = Potassium, Ca: Calcium, Mg: Magnesium, tot: total

Particularly, the elements N, P and K are the basic elements of fertilizers, especially in the most popular chemical fertilizer everywhere in Madagascar. These three elements are most likely to be missing in the soil. Regarding nitrogen and phosphorus, comfrey manure is the richest in these elements, followed those from farm and *Lantana camara*. In addition, *Lantana camara* manure contains a higher amount of calcium and Magnesium compared to the other two.

Effect of liquid manure on the length and weight of carrot leaves

Figure 1a shows that different types of liquid manure have significant effects on leaf length. Four and a half months after sowing corresponding to the harvest period, the mixed liquid manures seem more favorable for the length growth of carrot leaves. The plants fertilized with manures mixture of *Lantana* and comfrey as well as of

Lantana and farm have longer leaves with an average length of 48 cm. Treatment with unmixed manures of farm, *Lantana*, and comfrey produced leaves with an average length of 46 cm, 44 cm, 43cm respectively. Control plants have shorter leaves with an average of 41 cm.

Regarding the weight of leaves (Figure 1b), significant effects of different liquid manures were noted. Unlike their effects on the growth in length of leaves, simple manures of *Lantana*, comfrey and farm produced the highest leaf weight of 212 g, 211 g, 246 g, respectively. Relatively low weight was obtained after treatment with combined manures of *Lantana* and comfrey (163g) and with those of *Lantana* and farm (153g). The average weight of plant leaves Controls is the lowest, 46 g on average.

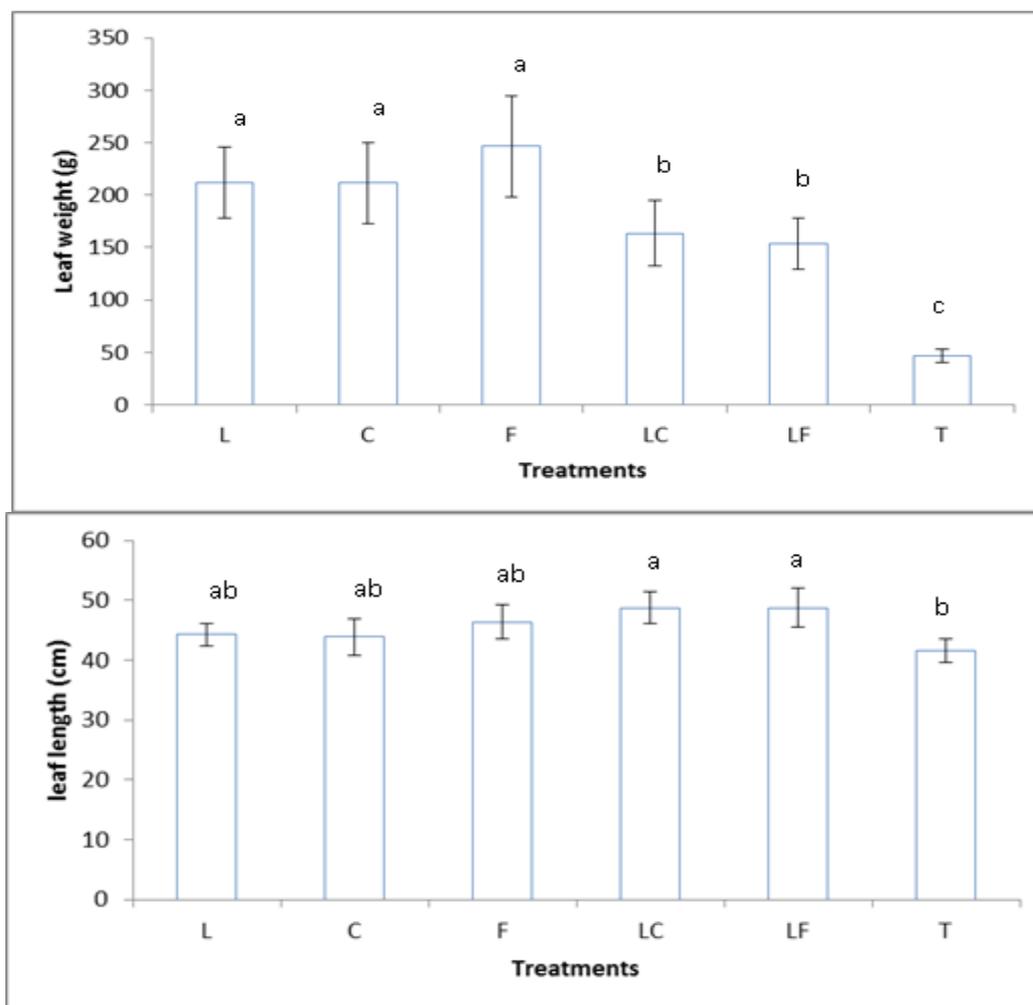


Figure 1: (a) Average leaf length; (b) average leaf weight according to different treatments.

L : *Lantana* liquid manure, *C* : *comfrey* liquid manure, *F* : *Farm* liquid manure, *LC* : *Lantana* + *comfrey*, *LF* : *Lantana* + *Farm*, *T* : *Contrôl*

Effects of liquid manure on the root

According to Figures 2a, whatever the treatments with manure, alone or combined, their effects on root growth are identical. The average root length ranged from 23 cm to 26 cm, which is greater than that of the control plants (16 cm on average). The different types of liquid manure have significant effects on the average weight of carrot root (Figure 2b). Carrot roots obtained after treatment with *comfrey* manure have the highest average weight of

311 g. Treatment with farm manure, with manure combined of *Lantana* and *comfrey* as well as with *Lantana* and farm produced roots whose average weights are quite high respectively of 297 g, 294 g, et 292 g. Treatment with *Lantana* manure alone produced enough lightweight roots compared to those obtained by other treatments. Control plants have roots of lower weight, reaching only 48 g on average.

Indeed, the carrot crop fertilization with liquid manure improves root production, and liquid manure of *comfrey* seems the best compared to other.

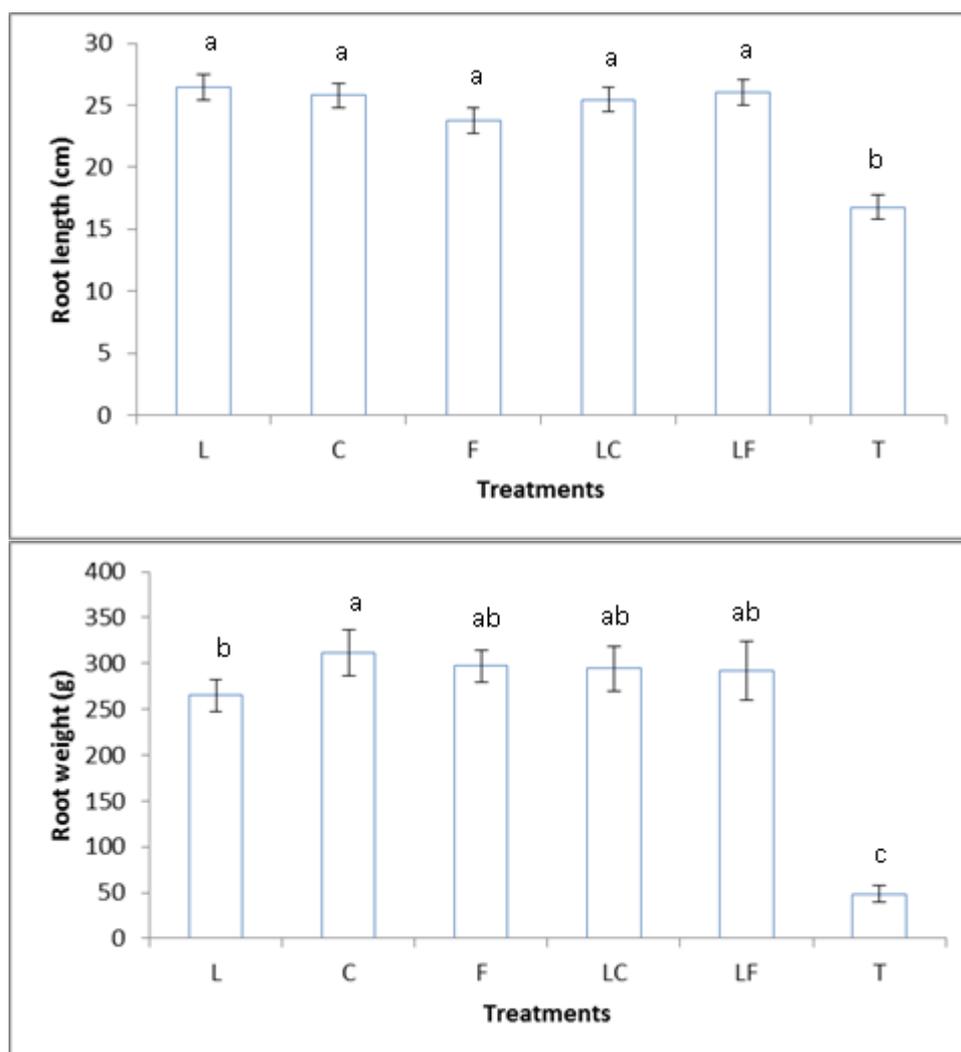


Figure 2: Average root length (a) ; Average fresh root weight (b) according to the different types of liquid manure.

L : *Lantana* liquid manure, *C* : *comfrey* liquid manure, *F* : *Farm* liquid manure, *LC* : *Lantana* + *comfrey*, *LF* : *Lantana* + *Farm*, *T* : *Contrôl*

Effects of different manures on yield

Table 2 below shows the carrot yields obtained at harvest after these different treatments with liquid manure. The fertilization of the carrot crop with these different manures significantly increased the yield. Control plants

have the lowest yield, which is an average of 2.22 t / ha, compared to those fertilized with liquid manure.

Fertilization with *comfrey* manure produced a better yield of 14.3 t / ha on average. Treatments with liquid farm manure, mixed manures of *Lantana* and *comfrey*, of *Lantana* and farm , as well as *Lantana* manure alone produced good yields of 13.69 t / ha, 13.57 t / ha, and 12.21 t/ha, respectively.

Table 2: Carrot yield.

Treatment	L	C	F	C	LF	T
yield (t/ha)	12,21	14,34	13,69	13,57	13,47	2,22

L = *Lantana*, C = Comfrey, F = Farm, T = control.

DISCUSSIONS

Effects of liquid manure on the biomass production and roots:

Good quality and quantity of leaves and roots observed during the growing phase and harvest reflect the richness and balance of major mineral elements including nitrogen, phosphorus and potassium as well as magnesium and calcium nitrogen, phosphorus and potassium and magnesium and calcium in these manures used.

Carrot plants treated with liquid manure are vigorous, they have shown no signs of deficiency in their leaves, and they have produced large roots with high average weights compared to the plant control. The different results show that the nutrients provided by the different types of liquid manure promoted the growth and development of the plant and they have improved the production of carrot roots. These results corroborate those obtained by Ravoniarinjatovo M. A., (2016) on the study of the effects of comfrey and *Lantana* extracts on the in vitro growth and development of *Biophytum sp.* Furthermore, the work of Randrianarison M. L. (2001) on the culture of combava showed that the growth of plants treated with comfrey manure is higher up to 70.42% compared to plants control.

On the other hand, according to the soil analysis, although the pH = 5.98 is greater than 5.5 at which the soil is likely to cause mineral elements deficiencies (Chaux. Cl., Foury. Cl., 1994), the results observed on the control plants confirm the need for fertilization for this type of soil.

Effects of manure on yield

The evaluation of the carrot yield showed that fertilizing the crop with comfrey liquid manure gave a better yield of 14.34 t / ha.

This could be explained by the richness in nitrogen and potassium in comfrey manure. These mineral elements are essential for plant growth, for improving product quality, for root development and therefore for increasing crop yields. (Chaux Cl., Foury Cl., (1994); Projet Intrans/FAO, (2005); Andriamahery T. R., (2016). In addition, the liquid state of the manure allowed the dissolved nutrients to be more easily and quickly absorbed by the roots. (Madeleine I., et al. (2005) ; Ed Verhij, et Henk w.. (2008) ; https://3). This increase in productivity confirms that observed by Harinomenjanahary J. D., (2005), using comfrey manure on the culture of « *Brassica rapa subsp Pekinensis* », and by Andriamahery T. R., (2016) on *Brassica rapa subsp. Chinensis* culture.

\These results are in agreement with those reported by different authors. In 2002, the average world yield of fresh carrot roots was 21 t / ha; in Madagascar it was 5-8 t / ha and in tropical Africa it ranged from 8 to 12 t/ha (MAEP UPDR-Valy, 2004). In Europe and the United States, 30 to 120 t/ha of carrot root can be harvested depending on the cultivar and the method of cultivation. (Grubben G.J.H., et al, 2004).

CONCLUSION

In order to improve the productivity of "*Dacus carota*" in the Vatovavy Fitovinany region, southeastern part of Madagascar, the positive effects of fertilizing the carrot culture with comfrey and farmhouse manure and *Lantana* have been highlighted. Good growth and development, better yield of fresh carrot roots and good qualities were obtained in this experiment.

The nutrients provided by these different types of liquid manure promoted the growth in length and weight of the aerial biomass and root. Treatment with *Lantana* manure mixed with comfrey or farm liquid manure is more favorable for the growth in length of the leaves (48 cm on average). Besides, carrot plants treated with the unmixed liquid manure of farm, *Lantana*, and comfrey, produced quite long leaves of 46 cm 44 cm, 43 cm respectively. As for the leaf weights, unmixed liquid manure of *Lantana*, comfrey and farm promoted leaf production with the highest average weights of 212g, 211g and 246g respectively.

Liquid manure, alone or in combination, has positive effects on the development and production of carrot roots. Carrot plants fertilized with comfrey liquid manure have roots with the highest average weight of 311 g.

Regarding the yield, the treatment with comfrey, farm and *Lantana* liquid manure greatly increased the production compared to the control plants which received no treatment. The results show that the comfrey manure gave the best performance of 14.34 t / ha, followed by farm (13.69 t / ha) and the *Lantana* (12.21 t / ha). *Lantana* manure mixed with comfrey or farm manure improved carrot yields by 13.57 t / ha and 13.47 t / ha respectively. In this region of Vatovavy-Fitovinany where experimentation took place, it was noted that fertilization with these liquid manures has increased 6 times the yield of carrot.

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