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Effects of False yam (*Icacina oliviformis*) tuber compost manure on the growth performance of garden eggs (*Solanum aethiopicum l*)

Rosemond Boama AGYAPONG, Albert Kojo QUAINOO

Department of Biotechnology, Faculty of Biosciences, University for Development Studies
Correspondence emails: rosemond.agyapong@uds.edu.gh, aquainoo@uds.edu.gh

ABSTRACT

This study sought to explore the effects of a twelve week old-decomposed false yam (Icacina oliviformis) tuber on the growth performance of garden eggs (Solanum aethiopicum L.). Freshly harvested false yam tubers were processed and decomposed for twelve weeks. The decomposed tuber was mixed with topsoil in the ratios 1:2, 2:1 (false yam:topsoil ratio (FYTS)); 1:1 (false yam compost:decomposed cow dung ratio (FYCD)); with decomposed tuber (FY-100), and top soil (TS-100) as controls. Garden eggs (test crop) seeds were nursed and transplanted onto each treatment after five weeks. Data were taken on plant growth and productivity parameters. The study revealed that false yam tuber compost is ideal for plant growth and provides a better physical medium to support plant growth when added to topsoil. Results indicated that FYTS (2:1) had the highest plant and leaf area. Also, FYTS (1:2) recorded the highest plant girth and number of leaves. The highest crop yield was recorded from plants grown in topsoil followed by plants grown in the FYTS (1:2) growth medium. Although the study revealed that false yam tuber compost supports plant growth, yield characteristics were not significantly different among treatments.

Keywords: *Compost; False yam tuber; Icacina oliviformis; Manure; Solanum aethiopicum; Top soil*

INTRODUCTION

Continuous cultivation of crops on land without soil amendment and allowing for fallow depletes soil nutrients. To amend soil nutrition, chemical fertilizers, animal manure and compost are often used. While chemical fertilizers increase soil nutrients for plant use, several harmful effects of their use have been recorded. Some of the harms chemical fertilizers cause include waterway pollution, chemical burn to crops, increased air pollution, acidification of the soil, and mineral depletion of the soil (Peyvast et al, 2008).

Over the years, composts have been used to supplement soil nutrients since they contain the main plant nutrients; nitrogen (N), phosphorus (P), and potassium (K), needed for growth and development (Fallis, 2013). Composts are made from animal wastes and plants through a decomposition process. Composts add needed organic matter, sequester carbon, reduces reliance on chemical pesticides and fertilizers, and help prevent nutrient runoff and erosion (Platt & Goldstein, 2014).

False yam (*Icacina oliviformis*) is an underutilized tuber crop which belongs to the family *icacinaceae*. It is a small drought-tolerant shrub that grows best in tropical climates like the West and Central African savannas (Fay, 1993). The seeds and tubers contain gum resins identified as terpenes. Due to this, studies on false yam have been carried out to effectively process both seed and tuber and used as livestock feed, against agricultural pest, and as soil amendment (Dei, Bacho, Adeti, & Rose, 2011; Sowley, Kankam, & Nsarko, 2019; Umoh & Iwe, 2014). Proximate composition of false yam tuber contains a range of 3.01-60.30% protein, 1.77-5.76% lipid, 85.50-93.31% carbohydrate, 2.80% ash while concentration of potassium, sodium, calcium and iron (among others) ranged between 20.83 and 31.51 mg/l, 2.40 and 18.89 mg/l, 90.25 and 112.55 mg/l to 0.77 and 2.84 mg/l respectively (Umoh & Iwe, 2014). As the tuber is decomposed, these nutrients are released into forms that plants can use. Quainoo and Asaviansa (2015) reports that maize growth performance increases when portions of decomposed false yam tuber is added to soil to serve as soil amendment. It is therefore essential to further assess the effects of a twelve-week old decomposed false yam tuber on the growth performance of other crops and their fruit yields.

The aim of this study was to assess the growth performance and yield of garden eggs (*Solanum aethiopium L.*) on soil amended with false yam tuber compost.

MATERIALS AND METHODS

Study Area

The experiment was carried out at the Agricultural Mechanization field and the plant house of the University for Development Studies, Nyankpala Campus in the Tolon district of Northern Ghana. The location lies on latitude 9°25^{i}45^{i}N and longitude 0°58^{i}42^{i}N at altitude 182 m above sea level (SARI, 2001) characterized as a hot dry savannah zone. The pattern of rainfall in this area is mono-modal which occurs in April to October followed by a dry season which sets in from November to March (Quianoo and Asaviansa, 2015). The temperature of the area ranges between 19°C (minimum) and 42°C (maximum) with an average annual rainfall of 1060 mm (SARI, 1998).

Preparation of false yam tuber for decomposition

False yam tuber were harvested from the naturally growing false yam fields in the Nyankpala Campus of the University for Development Studies. The tubers were cut into smaller pieces and buried in a compost pit measuring 0.65 m x 0.75 m x 1.40 m a day after harvest. The pits were covered with black polythene sheets and the pieces of tubers were allowed to decompose for twelve weeks. The compost was turned over weekly to ensure adequate air circulation and water was added when necessary to ensure the decomposition process and also keep the pile's temperature regulated.

Test Crop, growth medium, and growth parameters

Garden Egg was the test crop used for the experiment. The seeds were screened to remove small and shriveled ones and were nursed for five weeks. The decomposed tuber was mixed with topsoil in the ratio 1:2, 2:1 (false yam:topsoil ratio (FYTS)); 1:1 (false yam compost:decomposed cow dung ratio (FYCD)); with decomposed tuber (FY-100), and topsoil (TS-100) as controls. Twenty pots, each of volume 0.0455 m^3 were filled with 0.0303 m^3 growth media (soil-compost combination) and arranged randomly in a plant house with transplanted seedlings. Data were taken on plant growth parameters: plant height, leaf area, number of leaves and plant girth, and productivity parameters: days-to-flowering, number and weight of fruits, and fruit yield per treatment. A foot rule and a micrometer screw gauge were used to measure the plant height and girth, respectively while the number of leaves were counted. The leaf area of the test crop was estimated using the Hinnah et al (2014) model. The number of days to flowering was computed as the number of days from seedling transplant to visible flower opening while a weighing balance was used to measure the weight of fruits harvested.

Experimental design and Analysis

The experiment was carried out using Completely Randomized Design (CRD). Three treatments were obtained from the decomposed false yam tuber, and false yam tuber compost only and topsoil served as controls. This made five treatments, each replicated four times.

False yam tuber compost was mixed with topsoil in two different ratios: 1:2 and 2:1 (false yam tuber compost:topsoil) and false yam tuber compost mixed with decomposed cow dung in the ratio 1:1 for planting. Analysis of Variance (ANOVA) test was used to obtain *p*-values on data collected using GENSTATS Statistical Software Edition.

FIGURE1. **Processing of false yam tuber to serve as soil amendment**

a. Harvested false yam tuber
b. False yam tuber in decomposition pits
c. False yam tuber compost
d. Twelve weeks old eggplant bearing fruit

RESULTS AND DISCUSSION

Plant Height

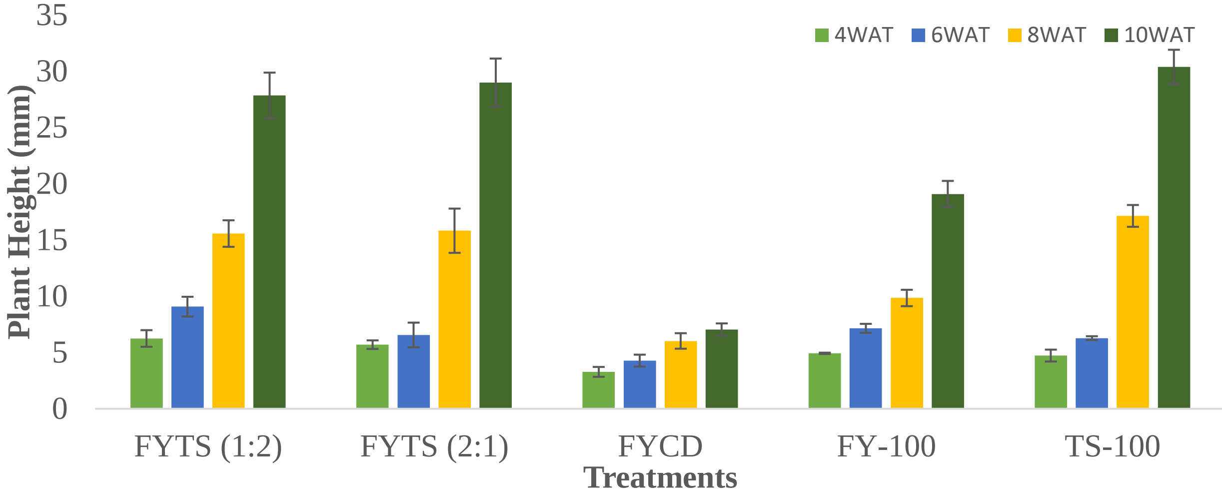

FIGURE 2. **Plant height of garden eggs transplanted onto growing media (soil–compost combination). The bars represent standard error of means (SEM).**

Figure 2 depicts significant differences in plant height measurements at weeks four (*p*-value = 0.029), six (*p*-value = 0.023), eight (*p*-value < 0.023), and ten (*p*-value < 0.001) after transplant (WAT) between each treatment and this may be attributed to the similarity in nutrient content and supply by all the treatment to the test crops. Similarities in plant height for treatments FYTS (1:2), FYTS (2:1), and TS-100 existed and may be associated to the same nutrient supply to the three treatments throughout the growth season of the test crop. Treatment FYCD had the highest water holding capacity often leading to waterlogging of the medium, retarding growth generally while treatment FY-100 had the least water holding capacity.

Leaf Area

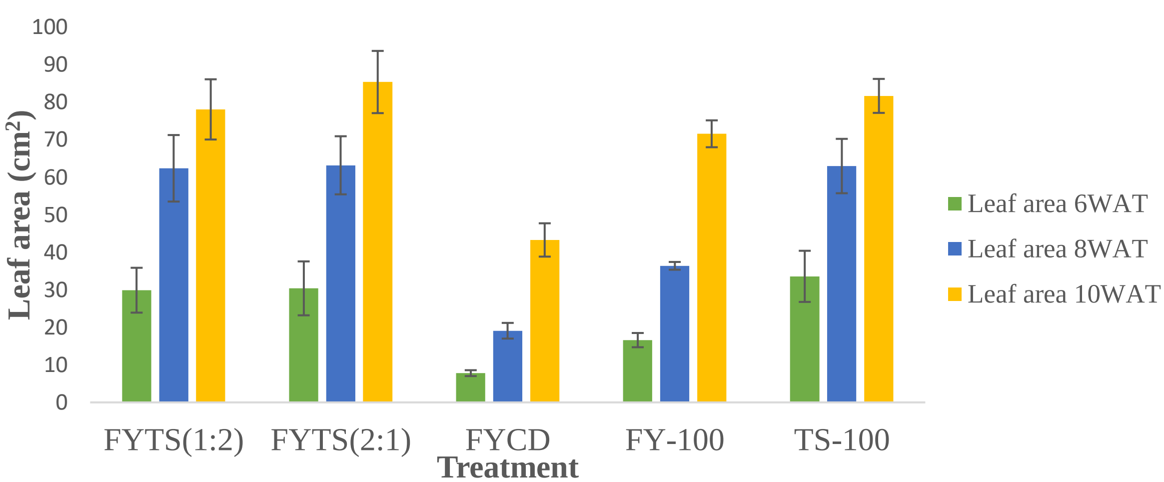

FIGURE 3. **Leaf area of garden eggs after transplant. The bars represent SEM.**

There was no statistical difference in the various treatment at four weeks after treatment (*p*-value = 0.260). This may be attributed to the same growth rate and nutrient availability to the test crop by the treatments. However, Figure 3 shows statistical differences in treatments in leaf area in subsequent weeks. These indications may be attributed to the physical conditions such as porosity and soil salinity of the media being similar at weeks four, six, eight, and ten after transplant. This agrees with Manuel, Machado and Serralheiro (2017) that soil environmental conditions such as soil salinity affect vegetable crop growth and subsequently leaf area as well as yield and general growth.

Number of leaves

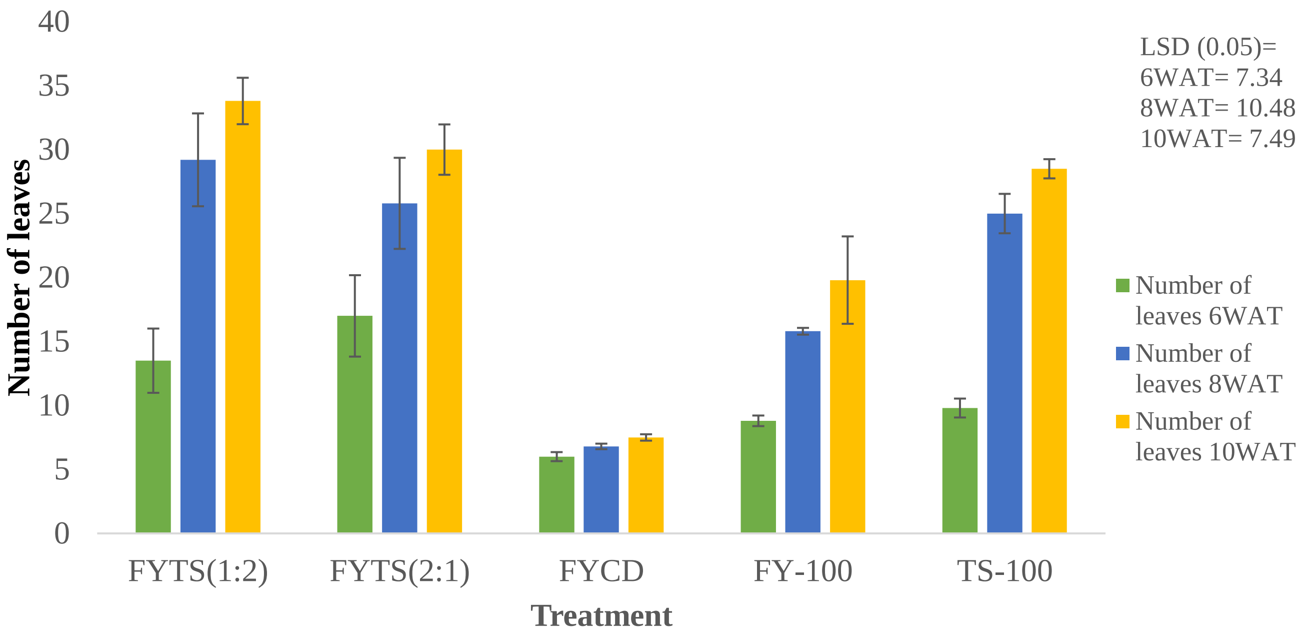

FIGURE 4. **Number of leaves on garden eggs plant after transplant. The bars represent SEM**.

No statistical significance between treatments at four WAT (*p*-value = 0.069) were observed. However, Figure 4 shows significant differences in the number of leaves of the test crop of each treatment at weeks six, eight, and ten after transplant.

These differences may be attributed to the supply of elemental nitrogen as plant nutrient by the treatments required for leaf development. As observed by Onasanya and Aiyelari (2009), number of leaves tend to increase when nitrogen content increases. The resemblance in growth of plants on diverse media indicates same nutrient availability for plant growth and development (Quainoo and Asaviansa, 2015) evident in treatments FYTS (2:1), FYTS (1:2) and TS-100.

Plant Girth

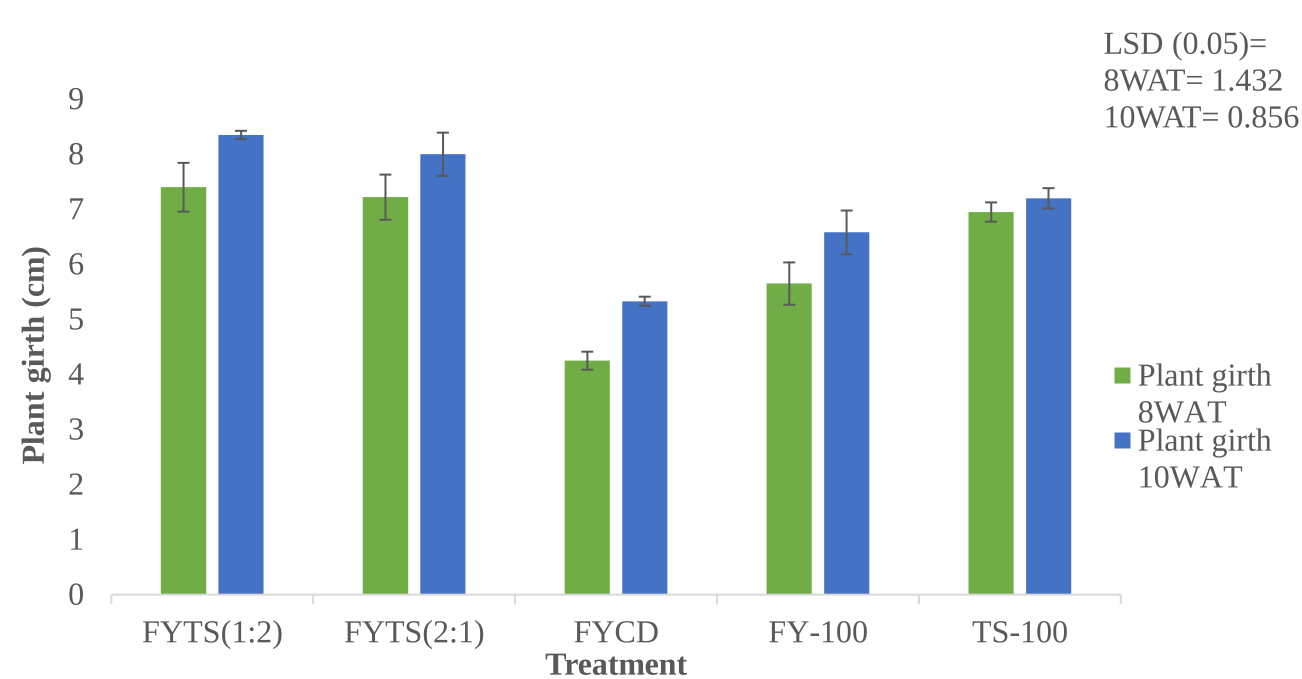

FIGURE 5. **Plant girth of transplanted garden eggs grown in soil amended with false yam tuber compost. The bars represent SEM.**

Significant differences (*p*-value < 0.05) in plant girth of the test crop was observed for eighth and tenth weeks after transplant as seen in Figure 5. This observation may be associated with an increase in nutrient availability for plant girth increment. However, similarities in plant girth at weeks four and six after transplant may be that nutrients supply to the test crop were the same during these weeks. Increase in plant girth at weeks eight and ten may be associated with an increase in soil carbon dioxide (Thompson, Gamage, Hirotsu, & Martin, 2017)

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Flowering of garden eggs

TABLE 1. **Number of days flower first appeared after transplant of test crop**

Treatment	Days to flowering
FYTS (1:2)	86.50 ± 0.83
FYTS (2:1)	89.00 ± 2.69
FYCD	111.00 ± 1.87
FY-100	95.50 ± 4.78
TS-100	88.75 ± 4.02
P-value	0.002
LSD	**10.61**

Table 1 shows significant difference in the number of days to flowering of the test crop in all the treatments. The delay in days to flowering of plants grown on FYCD treatment may be as a result of the lower vegetative growth as reflected on the growth parameters estimated. It may also be attributed to the supplies in nutrients by both sources of organic manures which agrees with Aminifard, Aroiee, Fatemi, & Ameri (2010) that excess nutrient supply delay anthesis in eggplant and tomato.

Fruit Yield

TABLE 2. **Fruit yield and mean weight of harvested fruits per treatment**

Treatment	**Number of fruits harvested**	**Weight of harvested fruits (g)**	**Mean weight of fruits**	**Fruit yield (%)**
FYTS (1:2)	4	144.0	36.0	33.3
FYTS (2:1)	2	37.0	18.5	16.7
FYCD	1	25	25	8.3
FY-100	-	-	-	-
TS-100	5	193	38	41.7
p-value	0.449			
LSD	1.581			

The lower yield recorded may be attributed to the excess nitrogen in the growth media as excess nitrogen favors foliage growth over flowering and fruiting or formation of storage organs such as tubers and roots (Johnson, 2012) as seen for treatments FYTS (1:2), FYTS (2:1), FYCD, and topsoil. Treatment FY-100 was observed to have a very low water-holding capacity and did not produce any fruit. This inability to produce fruits might be due to the leaching and run-off effects on the treatment which made nitrogen unavailable to plants grown in this treatment especially during fruits production which is in line with Olowoake, Ajayi, & Adeoye. (2013).

CONCLUSION

The results from the study revealed that false yam compost had a significant effect on the growth of garden eggs. Treatment FYTS (2:1), the combination of false yam tuber compost and topsoil in the ratio two is to one, had the highest plant height, and leaf area though not different from FYTS (1:2) and topsoil. Treatment FYTS (1:2), recorded the highest number of leaves and stem diameter. Plants grown in topsoil gave the highest yield while treatment FYTS (1:2) had the second greatest yield. Crop growth performance did not improve significantly when decomposed animal manure (cow dung) was added to false yam compost compared to false yam tuber compost only treatment.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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