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ASSESSMENT OF DECOMPOSED FALSE YAM (*ICACINA OLIVIFORMIS*) TUBER AS PLANT GROWTH MEDIUM

Albert K. Quainoo and Andrew Asaviansa

Department of Biotechnology, Faculty of Agriculture, University for Development Studies, P.o. Box 1882, Tamale, Ghana

Corresponding author email: *aquainoo@googlemail.com*

Abstract

The study was carried out in attempt to use false yam tuber as soil amendment for plant growth. False yam tubers were harvested, processed into smaller pieces and decomposed for six different weeks (2, 4, 6, 8, 10 and 12 weeks). Decomposed false yam tubers from the various treatments were mixed with top soil in the ratio 1:1, 1:2 and 2:1 (false yam: sand ratio) with soil as control. Maize seed was used as test crop with germination percentage, plant height, number of leaves, plant girth and leaf area index as growth parameters. The study revealed that decomposed false yam tuber has better physical capacity to support seed germination when added to soil. Results indicated that treatment 1:2 had the highest plant height, number of leaves and plant girth followed by the control, treatment 1:1 and then treatment 2:1 at week 10 and 12 of false yam decomposition. Also treatment 1:2 had the highest leaf area index followed by treatment 1:1, control and then treatment 2:1 at week 12 of false yam decomposition. The study revealed that decomposed false yam tuber has the ability to support plant growth and development when added to soil in a ratio of 1:2.When the quantity of decomposed false yam becomes higher than the soil,or sand the media become injurious to plant growth and development and may be due to too much moisture absorption leading to anaerobic condition in the medium. Further decomposition of the false yam tuber into compose may establish its usefulness as plant growth media.

Keywords: False yam, decomposition, Icacinaceae, Terpenes, Monomodal, Anaerobic, Chronic

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INTRODUCTION

Decomposition is the process by which organic matter in thesoil is converted into progressively smaller pieces and eventually inorganic compounds (Wetterstedt, 2010). Through the decomposition process, nutrients in organic materials are converted to forms which are readily available for uptake by plants (Roberts, 2011).

There are both abiotic and biotic factors involved in the decomposition process. Abiotic factors include, type and number of organisms involved, pH, oxygen, substrate type and size, moisture and temperature. Bacteria and fungi decomposers are responsible for more than 95% of biotic part of organic matter decomposition (Persson *et al*., 1980). Baker and his associates (2001) noted that micro and macro invertebrate, bacterial, and fungi communities depend on these organic resources for food and that decomposition of organic materials into basic nutrients materials represents a critical control on vegetation productivity.

False yam (*Icacinaoliviformis*(Poiret) J. Raynal syn. *Icacinasenegalensis*A. Juss) is a tuber crop belonging to the family icacinaceae. The plant is a small drought – tolerantshrub forming dense stands in the West and Central African savannas (Fay, 1993). It consists of aerial stem which are large green and may reach about one meter in height (Dalziel, 1948). However both the seeds and tubers contain toxic substance called gum resins, which are identified as terpenes (Vanhaele *et al*., 1986). The toxic substance limits their utilization as food for man and feed for animals.

Report by RELC (2005) indicates that poor soils that results in low crop yields in Northern Ghana is negatively affecting the development of agriculture().

Chemical fertilizer is the most important contributor to theincrease in world agricultural productivity over the past decades (Smil, 2001) but its negative effects on soil and environment limits its usage insustainable agricultural systems (Peyvast et al., 2008).

False yam tuber is noted to contain favourable agronomic and nutritional characteristicsthat are similar to that of soil (Maurice et al., 1977). It is also noted to contain other useful nutrients uptake from the soil such as protein, calcium, iron and others which can support plant growth. Bosomtwe (2013) reported that false yam tuber when processed into substrate (growth medium) can support the growth of plants in his attempt to use false yam tuber as a soil amendment. It is therefore essential to find means of transformingthis neglected underexploited agricultural product into a useful form to improve soil nutrients to crop growth and development.

The aim of this research is to attempt to use false yam as soil amendment for crop growth. The objective of the study is to determine the effects of different decomposing periods of false yam tuber on the growth of plant.

MATERIALS AND METHODS

Study Area

The experiment was carried out at the plant house of the University for Development Studies, Nyankpala campus, Tamale. The location lies on latitude 9^o 25^i 45^i N and longitude $0^o 58^i$ 42^i N at latitude 183m above sea level (SARI, 2001) which is generally described as a hot dry savannah zone. Rainfall is monomodal which occurs in April to October with the dry season setting in from November to March. The temperature of the area ranges between 19^o C (minimum) and 42^o C (maximum). Average annual rainfall is 1060mm (SARI, 1998).

Preparation of false yam tuber to serve as substrate

False yam tuber was harvested peeled, chopped into smaller pieces and dried for seven to ten days.The dried samples were pounded into a powdery form,16kg of powdery false yam tuber was mixed with 3kg of soil and about 15-20 litres of water, the soil was just to ensure the inoculation of soil microbes, and the mixture was not too wet or too dry (damp but not soggy). The mixture was kept in a big black polyethylene bag and subjected to temperature of 33^0 C and above for decomposition for two, four, six, eight, ten and twelve weeks respectively to form substrates. The mixture was turned every week to ensure air circulation and water was added to it when necessary to ensure steady decomposition.

Source and preparation of pest crop

Aburohemaa was the maize (*Zea mays*) variety used as test crop. Seeds were obtained from Savannah Agriculture Research Institute (SARI) at Tamale in the Northern region of Ghana. The seeds were screened to remove any infested and very small seeds.

Experimental design and analysis

Completely randomized design (CRD) was used for the experiment. Six treatments were obtained from the decomposed false yam tuber and top soil only served as a control making seven treatments each replicated three times.

False yam substrate obtained from different decomposing durations were mixed with the same quantity of top soil but in three different ratios 1:1, 2:1 and 1:2 (false yam: topsoil) for T1 to T6 for planting.

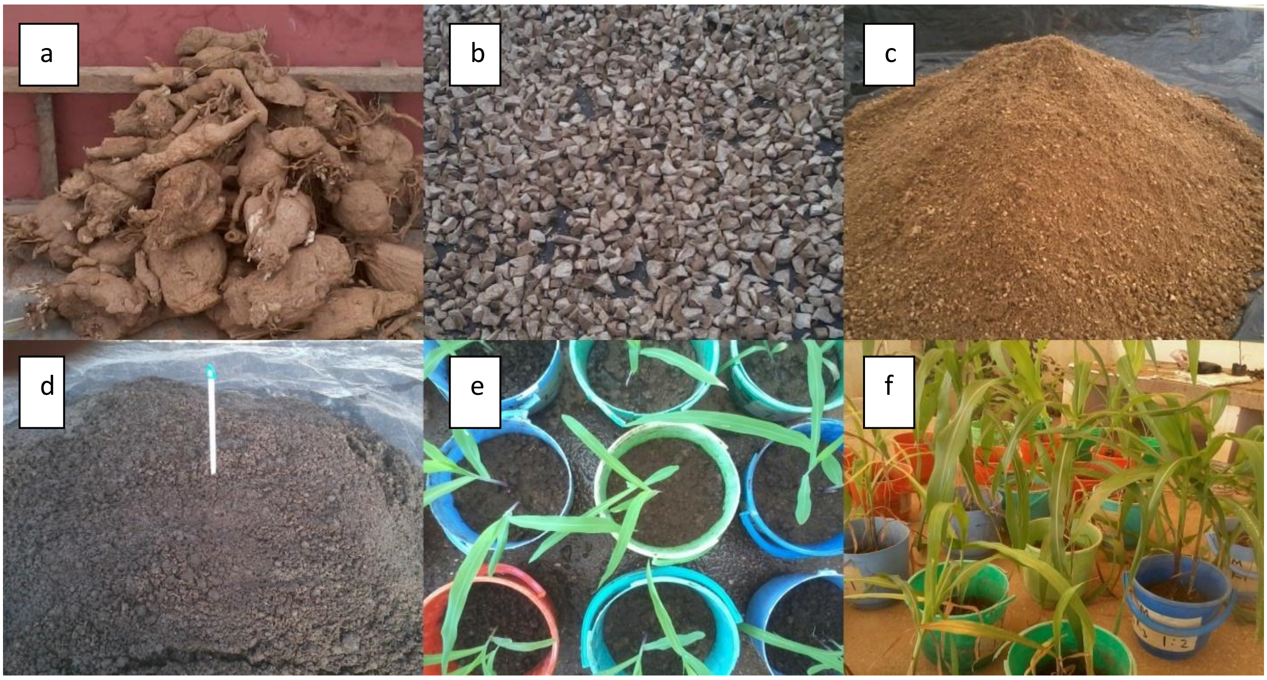

Plate 1: Different stages of processing false yam tuber into a growth medium.
a: Harvested false yam tuber.
b: Chopped false yam tuber.
c: Pounded false yam tuber.
d: Decomposed false yam tuber.
e: Germination of maize seeds on false yam tuber substrate.
f: Ten weeks old maize plant on false yam tuber substrate.

RESULTS AND DISCUSSION

Parameters measured included; substrate temperature, germination percentage (%), number of leaves per plant, plant girth, plant height and leaf area index

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Germination percentage

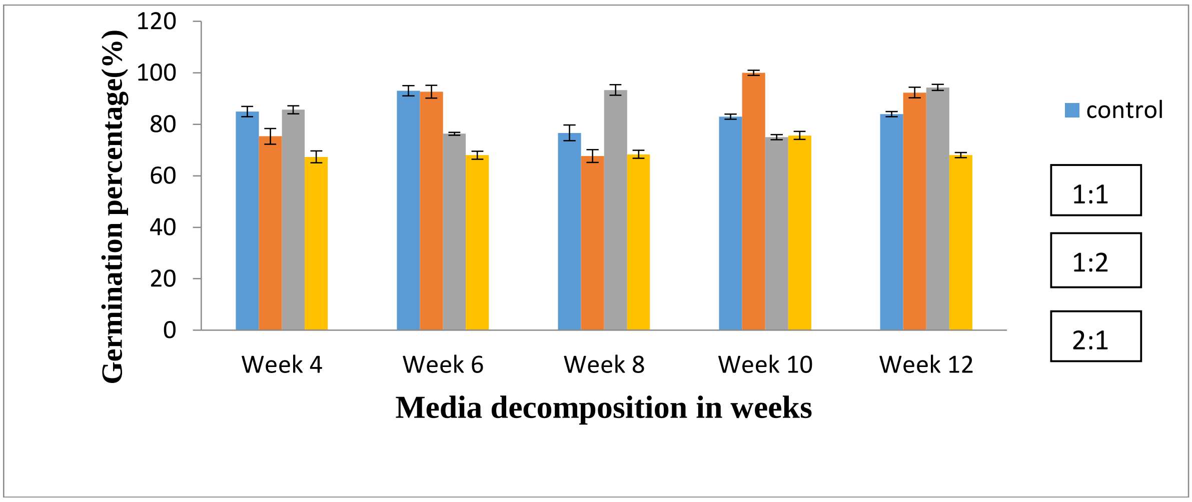

Figure 1. Germination percentage of maize planted on decomposed false yam. The bars represent standard errors of mean (SEM)

The study revealed significant difference $P<0.05$ in germination percentage in most of the treatments for all the weeks of media decomposition. However in the substrate combination ratios, treatment 1:2 and control did not differ significantly from each other at week 4. Treatment 1:1, the control did not differ significantly from the others at week 6. Treatment 1:1, 2:1 did not differed significantly from each other. Treatment 1:2, 2:1 showed no significant difference at week 10 and also treatment 1:1 and 1:2 showed no significant difference at week 12 after media decomposition (Figure 1). This confirmed the findings of Kontoh (2012) who supported that false yam tuber substrate has an effect on maize seeds germination and probably has superior physical ability to support seed germination in terms of the quantity of false yam tuber in the medium. This study showed that germination rate of maize seeds decreased with increasing quantity of decomposed false yam in the media mixture (Figure 1). This could be as attributed to the false yam tuber substrate having the ability to absorb excessive moisture leading to anaerobic condition in the medium affecting seed germination. This is in accordance with the findings of Zaidi and his associates (2012) reported that pre-germination anaerobic stress due to excessive moisture may inhibit seed germination by restricting the seed respiratory metabolic processes essential for germination

Plant height

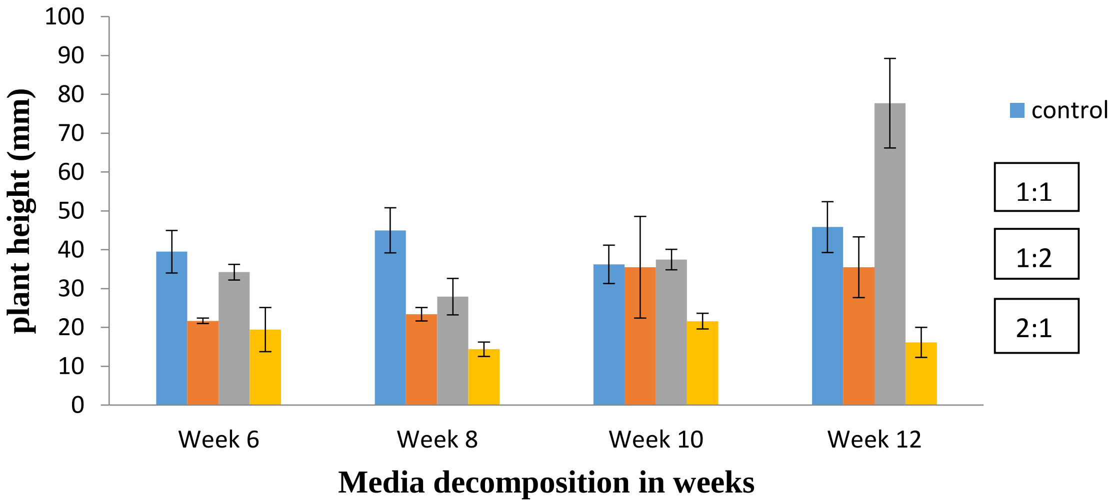

Figure 2. Plant height of test crop. The bars represent SEM

Plant height showed significant difference ($P<0.05$) for most of the treatment compared to the control for all the weeks with the exception of week 10 (Figure 2). However there was no significant difference between treatment ratios 1:1 2:1, 1:1 1:2 and 1:1 the control at weeks 4, 6 and 12 respectively after media decomposition also the highest performance in plant height was observed in week 12 across treatment after media decomposition. This variation in plant height may be attributed to the fact that there were differences in availability of nutrients from the decomposed false yam tuber specifically nitrogen and phosphorus for plant growth in terms of height. This conforms to the findings of Keskins *et al.*, (2005) and Salwa and Al-Shormiles (2005) who reported that increasing nitrogen level significantly increased plant height of corn plants. The longest period of decomposition in week 12 resulted in the release of nutrients for plant growth, which accounted for the best performance in plant height. The study also revealed that treatments with high amount of decomposed false yam tuber (2:1) resulted in poor performance, this may be attributed to too much moisture absorbed in the medium which prevented the roots access to oxygen. This result is similar to the findings of Kenelly *et al.*, (2012) who reported that excessive moisture can result in reduced oxygen availability to roots and in the case of chronic excess of water, plants appear stunted and have underdeveloped shoots.

Leave number of test crop

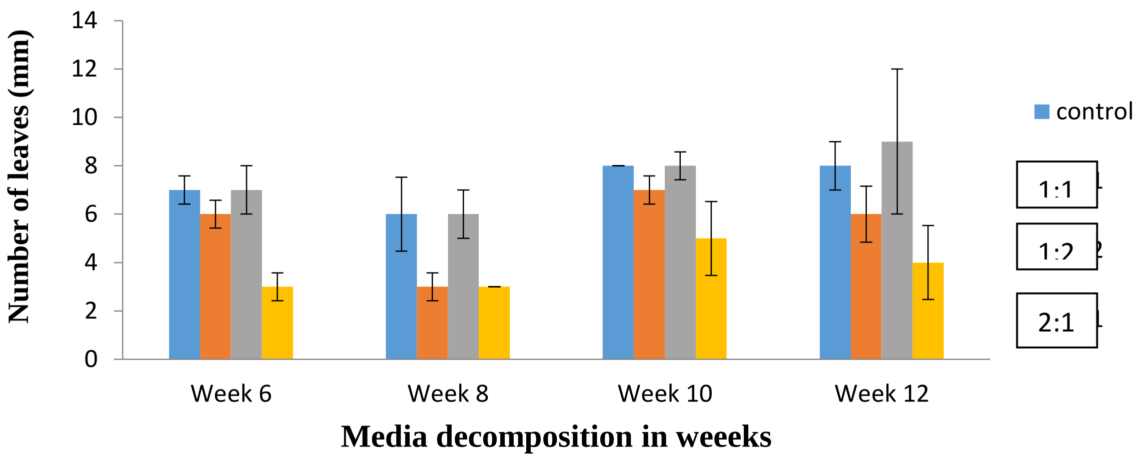

Figure 3. Number of leaves of test crop. The bars represent SEM

Treatment ratio1:1, 1:2 and the control did not differ significantly (P<0.05) from each other in number of leaves produced but with exception of treatment 2:1 in media decomposed for six and ten weeks(Figure 3). This may be attributed to the media having the same or similar quantities of nutrients, and this agrees with the findings of Tollenaar *et al.*, (1994) and Somasekhar *et al.*, (1998) who said that plants on diverse media exhibits similarities in organ growth and general development of plants when nutrients available to them are in one way or the other equal and functions in a sterile condition. However, significant difference was observed in the number of leaves for treatment 1:1, 2:1 compared to treatment 1:2 and the control in week 8 and 12. The highest number of leaves were recorded in treatment 1:2 at week 12, and this could be attributed to the fact that false yam tuber substrate was well decomposed at week twelve to make more nutrients readily available to the crop. This is in accordance with the work of Onasanya *et al.*, (2009) who indicated that number of leaves per plant tended to increase as nutrient (nitrogen) rate increased

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Plant girth

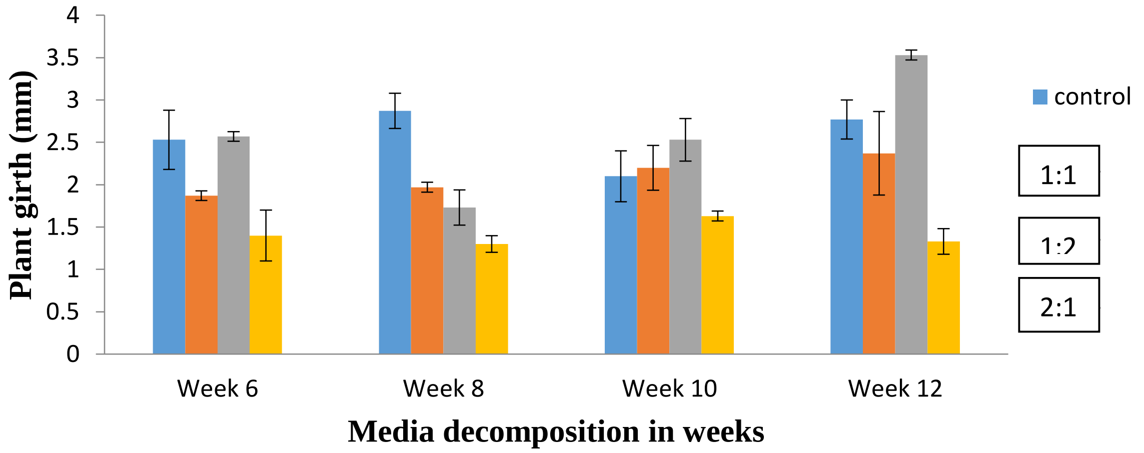

Figure 4. Plant girth of test crop. The bars represent SEM

Results in Figure 4 did not show significant difference (P<0.05) in plant girth at week 10 with the exception of treatment 2:1 after media decomposition. However there was significant difference in the control and our treatments at week 8. Also significant difference was recorded in plant girth in treatments 1:2, 2:1 compared to 1:1 and the control at week 12. Finally there was no significant difference between treatment 1:2 and the control but treatments 1:1 and 2:1

differed significantly from the control tweek 6 after media decomposition.

This similarities and differences may be attributed to the fact that some of the treatment had equal amount of nutrients availability and others did not. This finding is in accordance with the work of Beauchamp and Lathwell (1999) who stated that general plant or crop development (plant girth and others) are wholly determined by the nutrients available in the medium.

Table 1. Leaf area index of test crop after treatment

Treatment	Week 6	Week 8	Week 10	Week 10
1:1	63.1	62.2	63.7	147.8
1:2	117.3	48.0	112.6	213.5
2:1	36.2	31.6	42.4	26.1
Control	141.1	144.8	136.7	147.4
LSD	26.97	22.26	32.49	53.03

From table 1 significant differences ($P<0.05$) were recorded in leaf area index for most of the treatments compared to the control at all weeks after media decomposition. However, treatment 1:1 did not differ significantly for the control at week 12. The study revealed that treatment with the least amount of decomposed false yam tuber substrate had better leaf area development than those with the high amount of decomposed false yam tuber substrate including the control at the twelve week. This can be attributed to the fact that the decomposed false yam tuber substrate supplied additional nutrients to the plants when added in the medium to a certain level.This is in agreement with the findings of Cox *et al.*, (1993) who reported that higher rate of nutrient (nitrogen) promote leaf area index during vegetative development and also help maintain functional leaf area during the growth period. However, the treatment with the higher decomposed false yam tuber substrate had poor leaf area development and this may be due to the waterlogged nature of the treatments. Kenelly *et al.,* (2012) reported that excessive moisture can lead to reduced oxygen availability which can affect plant growth and consequently affect leaf development.

CONCLUSION

Analysis of the results showed that treatment 1:1 had the highest germination percentage at week 10 of decomposition and treatment 2:1 had the least germination percentage at week 4, 8 and 12 of decomposition. The highest growth performance (plant height, number of leaves, plant girth and leaf area index) was recorded in treatment 1:2 at week 12 of decomposition and the least growth performance was recorded in treatment 2:1 irrespective of the weeks of decomposition. In conclusion crop growth performance increased with decreasing proportion of decomposed false yam tuber when added to soil to serve as soil amendment.

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