

# Influence of Turmeric (*Curcuma longa* .L.) Extract on Fruiting and Nutritional Content of Egg Plant (*Solanum melongena* .L.)

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**Abstract**— This experiment was conducted during planting season of 2016 at Teaching and Research Farm of Faculty of Agriculture and Veterinary Medicine to study the effect of foliar application with turmeric extracts on growth, yield and nutritional status of eggplant (*Solanum melongena* L.). The experiment was laid out in a Randomized Completely Block Design with three replications. Various concentrations (0, 1%, 2% and 3%) formed the treatment levels. Parameters such as plant heights, number of leaves, leaf area, stem girth, leaf area index and yield were measured. Statistically, the aqueous turmeric extract significantly ( $P < 0.05$ ) improved the above mentioned growth parameters than ethanol extract. The nutritional content was significantly improved upon by turmeric extract application. 300ml gave the highest yield (302.80kg/ha) from plots treated with aqueous extract. The obtained results showed that spraying aqueous turmeric extract at 3% improve the growth parameters of fruiting and fruit nutritional content. Therefore, turmeric extract and investigated two methods of extraction could be safely recommended as a natural bio-stimulants application improving the yield and fruit quality of *Solanum melongena*.

**Keywords**— Growth, yield, nutritional status, turmeric extract and *Solanum melongena*.

## I. INTRODUCTION

Eggplant belongs to the family *Solanaceae*. It is a very large and important genus of the family *Solanaceae*. *Solanum melongena* L. is an important vegetable in Central, Southern and Southeastern Asia and in a number of African countries especially Nigeria (Behera *et al.*, 2006). Egg plants are cultivated in all the agroecological zones of Nigeria and there are many varieties of egg plant. Each variety is peculiar to the locality where it is cultivated (Ubani and Okonkwo, 2011). The egg plant is characterized by variation in morphology, physiology and biochemical features such as bitterness of fruit (Daunay *et al.*, 2001).

Although the egg plant has been identified to be an important vegetable crop which list of importance include both nutritional and medicinal values. The fruits are claimed to alleviate liver ailments and it is a fruit of choice by diabetic patients (Lawande and Chavan, 1998).

Egg plant deterioration starts within two to three days after harvest, especially when the stalk and calyx are removed and fruits are exposed to warm temperatures (Ubani and Okonkwo, 2011). The problem of low yield and quality of fruits during the peak season is enormous due to poor soil fertility. The use of inorganic fertilizer is no longer an

encouraging source of nutrient due to its unfriendly nature to agricultural soil. There is need to use plant extract as source of nutrient supply since the can be easily degraded in the plant and soil. Turmeric (*Curcuma longa*), is an erect perennial herbaceous plant grown as an annual crop for its rhizome. It belongs to the family *Zingiberaceous*. It is rich in carbohydrate, arabinogalacton, potassium salt, essential oils and pigments. Proximate analysis of turmeric rhizomes indicated that turmeric contains: moisture 8.67%, crude protein 14%, crude fiber 8.63%, fat 3.82%, total ash 6.97% and starch 57%. It is known for its anti-oxidant, anti-inflammatory, anti-carcinogenic, anti-viral, anti-parasitic, bio-protective, chemo-protective and anti-microbial properties (Nwokocha, C.C. and Ekwe, K. C., 2010). The present study is therefore aimed at investigating the effect of Turmeric extracts as growth enhancer on Egg plant

## II. MATERIALS AND METHODS

### Location

This study was conducted in the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri. Owerri lies between the latitudes 5°10'N and 6°0'N and longitudes 6°35'E and 7°0'E with an altitude of 91.0m within the Southeast rain forest agricultural zone of Nigeria. The area maintains an average annual rainfall of 2,500 mm, mean minimum and maximum temperature of 23.5°C and 32.1°C respectively, with relative humidity ranging from 70-85% and the annual evapotranspiration is 1450 mm (NIMET, 2010).

### Source of Materials

Plant materials that was used in this study will be collected from Imo State University Teaching and Research Farm, while reagents that was used for extraction was purchased from the local market. Egg plant seeds was sourced from Imo ADP. Other materials include, a piece of land measuring 15m x 18m, turmeric rhizomes. Blender, weighing scale. Also 12 air tight plastic containers were used for storage.

### Preparation of Turmeric Extract

Dried turmeric was kept in a plastic zip bag at room temperature before extraction. Two extraction methods were used as follows: (1) Turmeric extract with Ethanol. (2) Turmeric extract with Water.

1. Turmeric extract with Ethanol. Firstly, 300g of dried turmeric was soaked in 600 ml of 95% ethanol for 24h at ambient temperature (32°C). After maceration, the mixtures were then be filtered with white sheet, 1 liter of distilled water was added to dilute the extracts in different concentration and was kept in a dark bottle at 4°C until use.
2. Turmeric extract with Water. 300g of dry turmeric was soaked in 600ml of distilled water for 24h at ambient room temperature (32°C). After maceration, the mixture was filtered with white sheet; 1liter of distilled water was added to dilute the extracts in different concentration and was kept in a dark bottle at 4°C until use.

*Experimental Design*

The experiment was laid out in a Randomized Complete Block Design in a split plot fashion. The extraction methods formed the main plots while the rate/concentration of application (1%, 2% and 3%) constitutes the subplots. The setup was replicated three times

*Agronomic Practices and Treatment Application*

The experimental plot was cleared with cutlass and low beds were made for nursery and also for planting. Seedlings were sown after 4weeks in the nursery. Eggplant seedlings were planted at a depth of 4-6cm with a spacing of 1mx1m.

The treatments was applied as specified at two weeks after transplanting, immediately after weeding and repeated at 4, 6, 8, 10 and 12weeks at the rate of 20ml per plant of different concentration. The field was kept weed free throughout the study period.

*Data Collection and Analysis*

The following parameters were monitored and data was collected and recorded for analysis:

*Plant height (cm):* The height of 1 selected plant from each treatment level was taken from the base of the plant to the tip in cm and the average was determined and recorded. This began at 2weeks after transplanting and repeated at 4, 6, 8, 10 and 12weeks after transplanting.

*Stem girth (cm):* The girth of 1 selected plant was taken from 3 cm mark using a veneer-caliper. The average was determined and recorded. This began at 2weeks after transplanting and repeated at 4, 6, 8, 10 and 12weeks after transplanting.

*Number of leaves/plant:* The visual count of number of leaves per plant was done on 1 selected plant from each treatment level and the average was determined and recorded. This began at 2weeks after transplanting and repeated at 4, 6, 8, 10 and 12weeks after transplanting.

*Leaf area (cm<sup>2</sup>):* The leaf area was measured and calculated using the formula  $1.06+0.4731L^2$  (Ogoke *et al.*, 2015).

*Number of fruits/plant:* Visual count of number of fruits per plant per harvest was taken and recorded. The average was determined at the end of the study and recorded for analysis.

*Leaf area Index:* The leaf area index of 1 selected plant from each treatment level was taken. The average was determined

and recorded, this began at 2 weeks after transplanting and repeated at 4, 6, 8, 10, and 12 weeks after transplanting.

*Fruit yield (Kg/ha):* The fruit yield was weighed and calculated using the formula (Umar Musa Tanko, 2015)

$$\frac{\text{Fresh Weight}}{\text{Land Area}} \times \frac{10,000}{1}$$

*Proximate Analysis:* This was conducted to determine the nutritional contents as influenced by the treatments.

III. DATA COLLECTION

Data collected will be subjected to statistical analysis, using the analysis of variance (ANOVA) of the SAS software 17.0 version. Means separation was done using the Least Significant Difference (LSD) method as described by Onuh and Igwemma (2007).

*Plant height as influenced by turmeric extract application*

The application of different rates of ethanol and aqueous turmeric extract on plant heights as shown in table 1a-b, where found improved the plant heights at sampling periods of 2, 4, 6, 8, 10 and 12 WAP compared to the control.

In Table 1a, it was observed that there was progressive increase in the growth from seedling stage to maturity stage. However among the treatments levels, T<sub>4</sub> was observed to recorded the plant heights of 11.33cm, 13.66cm, 26.00cm, 53.00cm, 80.66cm and 90.33cm respectively at 2, 4, 6, 8, 10 and 12 WAP respectively, which was not statistically different (P<0.05) to lower values (7.66cm, 10.33cm, 16.66cm, 29.33cm, 60.00cm and 73.00cm respectively) recorded from control plots. It also noticed that T<sub>2</sub> and T<sub>4</sub> plots performed better than T<sub>3</sub> and T<sub>1</sub>.

In Table 1: it was observed that at early stages of growth (2, 4 WAP) plot treated with T<sub>4</sub> and T<sub>2</sub> recorded highest plant heights of 12.33cm and 15.66cm which was not statistically different (P<0.05) compared to 7.66cm and 10.33cm respectively recorded from T<sub>1</sub>. While at maturity stage, (12 WAP) T<sub>3</sub> plots recorded the highest plant heights of 97cm compared to the plant heights (68.33cm, 94cm and 96cm respectively) recorded from plots in T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub> respectively. Comparatively, aqueous turmeric extracts enhanced plant heights more in *Solanum melogena* than ethanol turmeric extract.

TABLE 1. Plant height as influenced by turmeric extract application.  
TABLE 1a. (Ethanol Turmeric Extract Response).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	7.66 <sup>a</sup>	10.33 <sup>a</sup>	16.66 <sup>a</sup>	29.33 <sup>a</sup>	60.00 <sup>a</sup>	73.00 <sup>a</sup>
T <sub>2</sub>	8.00 <sup>a</sup>	12.00 <sup>a</sup>	24.33 <sup>a</sup>	46.66 <sup>a</sup>	69.66 <sup>a</sup>	76.66 <sup>a</sup>
T <sub>3</sub>	9.33 <sup>a</sup>	11.33 <sup>a</sup>	14.66 <sup>a</sup>	32.00 <sup>a</sup>	65.33 <sup>a</sup>	75.33 <sup>a</sup>
T <sub>4</sub>	11.33 <sup>a</sup>	13.66 <sup>a</sup>	26.00 <sup>a</sup>	53.00 <sup>a</sup>	80.66 <sup>a</sup>	90.33 <sup>a</sup>

TABLE 1b. (Aqueous Turmeric Extract Response).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	7.00 <sup>a</sup>	8.66 <sup>a</sup>	18.33 <sup>a</sup>	26.66 <sup>b</sup>	56.66 <sup>b</sup>	68.33 <sup>a</sup>
T <sub>2</sub>	10.00 <sup>a</sup>	15.66 <sup>a</sup>	34.33 <sup>a</sup>	70.00 <sup>a</sup>	90.66 <sup>a</sup>	96.00 <sup>a</sup>
T <sub>3</sub>	11.33 <sup>a</sup>	15.33 <sup>a</sup>	29.00 <sup>a</sup>	63.33 <sup>a</sup>	92.00 <sup>a</sup>	97.00 <sup>a</sup>
T <sub>4</sub>	12.33 <sup>a</sup>	15.66 <sup>a</sup>	29.66 <sup>a</sup>	67.66 <sup>a</sup>	90.00 <sup>a</sup>	94.00 <sup>a</sup>

Means in the same column, having the same letter according to LSD are not significant (P<0.05).

*Number of leaves as influenced by turmeric extract Application*

The results in table 2a shows that at 2, 4, 6, 8 and 10 WAP, the average leaf numbers were 6, 9, 16, 31.66 and 50 respectively recorded with plots that received treatment 4 which was not significantly different ( $P < 0.05$ ) compared to the average leaf numbers (4.06, 6.33, 12, 29.33 and 38.33 respectively) recorded from control plots. Among the treated plots, at 12 WAP plots in Treatment<sub>2</sub> recorded the highest leaf number (56.66) compared to 44.33, 48.33 and 55.66 respectively recorded from T<sub>3</sub>, T<sub>1</sub> and T<sub>4</sub>

In table 2b, at 2, 4, and 6 WAP, T<sub>3</sub> plots recorded the highest number of leaves (8.66, 14.66 and 31.66 respectively) compared to lower values (3.33, 6.33 and 12.26 respectively) recorded from control plots, whereas at 8WAP. There was significant difference ( $P < 0.05$ ) in the average number of leaves 42.66 recorded from T<sub>2</sub> plots compared to 25 recorded from control plots.

At 12 WAP, T<sub>4</sub> performed better than T<sub>3</sub>, T<sub>2</sub> and T<sub>1</sub> as shown in table 2b. Also it was observed that more leaf numbers were recorded towards maturity stage in aqueous turmeric extract application compared to ethanol extract except in T<sub>2</sub>.

TABLE 2. Number of leaves as influenced by turmeric extract Application.  
TABLE 2a: (Ethanol Turmeric Extract).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	4.06 <sup>a</sup>	6.33 <sup>a</sup>	12.00 <sup>a</sup>	29.33 <sup>a</sup>	38.33 <sup>a</sup>	48.33 <sup>a</sup>
T <sub>2</sub>	5.00 <sup>a</sup>	8.33 <sup>a</sup>	15.00 <sup>a</sup>	30.66 <sup>a</sup>	48.33 <sup>a</sup>	56.66 <sup>a</sup>
T <sub>3</sub>	3.33 <sup>a</sup>	5.00 <sup>a</sup>	10.66 <sup>a</sup>	25.33 <sup>a</sup>	35.00 <sup>a</sup>	44.33 <sup>a</sup>
T <sub>4</sub>	6.00 <sup>a</sup>	9.00 <sup>a</sup>	16.00 <sup>a</sup>	31.66 <sup>a</sup>	50.33 <sup>a</sup>	55.66 <sup>a</sup>

TABLE 2b. (Aqueous Turmeric Extract).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	3.33 <sup>a</sup>	6.33 <sup>a</sup>	12.33 <sup>a</sup>	25.00 <sup>a</sup>	5.00 <sup>a</sup>	44.66 <sup>a</sup>
T <sub>2</sub>	6.33 <sup>a</sup>	11.00 <sup>a</sup>	20.33 <sup>a</sup>	42.66 <sup>a</sup>	56.66 <sup>a</sup>	52.33 <sup>a</sup>
T <sub>3</sub>	8.66 <sup>a</sup>	14.66 <sup>a</sup>	31.66 <sup>a</sup>	36.00 <sup>ab</sup>	53.33 <sup>a</sup>	54.33 <sup>a</sup>
T <sub>4</sub>	7.33 <sup>a</sup>	8.66 <sup>a</sup>	22.00 <sup>a</sup>	34.66 <sup>ab</sup>	50.00 <sup>a</sup>	55.00 <sup>a</sup>

Means in the same column, having the same letter according to LSD are not significant ( $P < 0.05$ )

*Stem Girth (cm) as influenced by turmeric extract application*

Table 3a shows the effect of ethanol turmeric extract on the stem girth of *Solanum melogena*. Ethanol turmeric extract was found to increase the stem girth of eggplant (*Solanum melogena*). At 4 and 6 WAP, maximum stem girth of 1.66cm and 2.33cm respectively were recorded from T<sub>2</sub> and T<sub>4</sub> respectively compared to the lower values of 1.50cm and 1.76cm respectively compared to the lowest (2.33cm, 2.90cm and 3.6cm) recorded from T<sub>3</sub> which was statistically not different ( $P < 0.05$ ).

In table 3b, application aqueous turmeric extract significantly ( $P < 0.05$ ) influenced the stem girth at 4, 8, 10 and 12 WAP.

At 4 plot, that received Treatment<sub>2</sub> recorded maximum stem girth of 2cm which was significantly different ( $P < 0.05$ ) from stem girth (1.00cm) recorded from control. Also at 8 WAP, 10 and 12 WAP plots that received Treatment<sub>4</sub> recorded the maximum stem girth (3.83cm 5cm and 5.83 respectively) which was significantly different ( $P < 0.05$ ) from stem girths

(2.33cm, 2.93cm and 3.70cm respectively) recorded from control plots.

Comparatively, aqueous turmeric extract performed better than ethanol extract in enhancing the stem girth of eggplant in this study. Also, Treatment<sub>4</sub> plots performed well in both extraction methods compared to Treatment<sub>2</sub>, and Treatment<sub>3</sub>.

TABLE 3. Stem Girth (cm) as influenced by turmeric extract application.  
TABLE 3a. (Ethanol Turmeric Extract).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	1.33 <sup>a</sup>	1.50 <sup>a</sup>	1.83 <sup>a</sup>	2.83 <sup>a</sup>	3.33 <sup>a</sup>	3.83 <sup>a</sup>
T <sub>2</sub>	1.00 <sup>a</sup>	1.66 <sup>a</sup>	2.33 <sup>a</sup>	3.00 <sup>a</sup>	3.53 <sup>a</sup>	4.16 <sup>a</sup>
T <sub>3</sub>	1.10 <sup>a</sup>	1.50 <sup>a</sup>	1.76 <sup>a</sup>	2.33 <sup>a</sup>	2.90 <sup>a</sup>	3.60 <sup>a</sup>
T <sub>4</sub>	1.13 <sup>a</sup>	1.66 <sup>a</sup>	2.33 <sup>a</sup>	3.33 <sup>a</sup>	4.16 <sup>a</sup>	5.00 <sup>a</sup>

TABLE 3b. (Aqueous Turmeric Extract).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	0.90 <sup>a</sup>	1.00 <sup>a</sup>	2.00 <sup>a</sup>	2.33 <sup>b</sup>	2.93 <sup>b</sup>	3.70 <sup>b</sup>
T <sub>2</sub>	1.33 <sup>a</sup>	2.00 <sup>a</sup>	2.66 <sup>a</sup>	3.66 <sup>ab</sup>	4.83 <sup>a</sup>	5.50 <sup>ab</sup>
T <sub>3</sub>	1.16 <sup>a</sup>	1.66 <sup>a</sup>	2.50 <sup>a</sup>	3.33 <sup>ab</sup>	4.66 <sup>a</sup>	5.53 <sup>ab</sup>
T <sub>4</sub>	1.46 <sup>a</sup>	1.66 <sup>a</sup>	2.83 <sup>a</sup>	3.83 <sup>a</sup>	5.00 <sup>a</sup>	5.83 <sup>a</sup>

Means in the same column, having the same letter according to LSD are not significant ( $P < 0.05$ )

*Leaf Area (cm<sup>2</sup>) as influenced by Turmeric Extract Application*

Results presented in table 4 shows that turmeric extract at different concentration respectively, did not significantly enhanced the leaf area of eggplant as compared to control and differently treated plants.

In table 4a, the highest leaf area (435.6cm<sup>2</sup>, 714.33cm<sup>2</sup>, 896cm<sup>2</sup> and 971cm<sup>2</sup> respectively) was recorded from Treatment<sub>2</sub> at 6, 8, 10 and 10 WAP which was not significantly different ( $p < 0.05$ ) compared to leaf areas, 243.33cm<sup>2</sup>, 527.33cm<sup>2</sup>, 690cm<sup>2</sup> and 767.66cm<sup>2</sup> respectively from untreated plants. Similarly, at 2, 4, 6, 8, 10 and 12 WAP. T<sub>4</sub> plants recorded higher leaf area 46.16cm<sup>2</sup>, 137.33cm<sup>2</sup>, 400cm<sup>2</sup>, 693.33cm<sup>2</sup>, 829.66cm<sup>2</sup> and 944.33cm<sup>2</sup> respectively which was significantly different ( $P < 0.05$ ) as compared to leaf areas (41cm<sup>2</sup>, 108.66cm<sup>2</sup>, 229.66cm<sup>2</sup>, 577.33cm<sup>2</sup>, 710cm<sup>2</sup> and 826.33cm<sup>2</sup> respectively) recorded from T<sub>3</sub> at various sampling stages.

Results in table 4b shows that aqueous turmeric extract did not influence the leaf area significantly as compared to control. 6WAP, T<sub>4</sub> plots recorded a maximum leaf area of 702.66cm<sup>2</sup> which was significantly different ( $P < 0.05$ ) compares to minimum leaf area (251.66cm<sup>2</sup>) recorded from untreated plots. Also, T<sub>2</sub> plots at 8, 10 and 12 WAP (Maturity stage) recorded maximum leaf area (888.33cm<sup>2</sup>, 1034.66cm<sup>2</sup> and 1116.33cm<sup>2</sup> respectively) which was not significantly different ( $P < 0.05$ ) from minimum leaf area (490.33cm<sup>2</sup>, 683.00cm<sup>2</sup> and 818cm<sup>2</sup>) recorded from control plants.

However, it was observed that aqueous turmeric extract impacted more on leaf area than ethanol extract as shown in table 4a-b.

TABLE 4. Leaf Area (cm<sup>2</sup>) as influenced by turmeric extract application.

TABLE 4a. (Ethanol Turmeric Extract).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	56.33 <sup>a</sup>	121.66 <sup>a</sup>	243.33 <sup>a</sup>	527.339 <sup>a</sup>	690.00 <sup>a</sup>	767.66 <sup>a</sup>
T <sub>2</sub>	60.66 <sup>a</sup>	122.33 <sup>a</sup>	435.66 <sup>a</sup>	714.33 <sup>a</sup>	896.00 <sup>a</sup>	971.00 <sup>a</sup>
T <sub>3</sub>	41.00 <sup>a</sup>	108.66 <sup>a</sup>	229.66 <sup>a</sup>	577.33 <sup>a</sup>	710.00 <sup>a</sup>	826.33 <sup>a</sup>
T <sub>4</sub>	46.66 <sup>a</sup>	137.33 <sup>a</sup>	400.00 <sup>a</sup>	693.33 <sup>a</sup>	829.66 <sup>a</sup>	944.33 <sup>a</sup>

TABLE 4b. (Aqueous Turmeric Extract).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	45.66 <sup>a</sup>	118.33 <sup>a</sup>	251.66 <sup>b</sup>	490.33 <sup>a</sup>	683.00 <sup>a</sup>	818.00 <sup>a</sup>
T <sub>2</sub>	73.33 <sup>a</sup>	247.00 <sup>a</sup>	693.66 <sup>a</sup>	888.33 <sup>a</sup>	1034.66 <sup>a</sup>	1116.33 <sup>a</sup>
T <sub>3</sub>	75.33 <sup>a</sup>	237.00 <sup>a</sup>	526.33 <sup>ab</sup>	672.00 <sup>a</sup>	853.66 <sup>a</sup>	1007.33 <sup>a</sup>
T <sub>4</sub>	72.66 <sup>a</sup>	246.00 <sup>a</sup>	702.66 <sup>a</sup>	878.00 <sup>a</sup>	987.33 <sup>a</sup>	1092.66 <sup>a</sup>
L.S.D	76.344	143.973	303.964	418.773	403.958	372.471

Means in the same column, having the same letter according to LSD are not significant (P<0.05).

*Leaf area Index as influenced by Turmeric Extract Application*

The result in table 5a indicated that during 6, 8 and 10 WAP. The maximum average leaf area index (17.66, 30.66 and 41 respectively) were recorded from treatment<sub>4</sub> plots which was not significantly different (P<0.05) from leaf area index (14.33, 22.44 and 34) recorded from control (T<sub>1</sub>). Also at 12 WAP it was observed that T<sub>3</sub> plants recorded highest leaf area index (46.33) compared to leaf area index (41.33, 42.66 and 45.60 respectively recorded from T<sub>2</sub>, T<sub>1</sub> and T<sub>4</sub>).

In table 5b: the result shows that turmeric extract at different concentration did not significantly enhance the leaf area index as compared to the untreated and differently treated plants. T<sub>4</sub> consistently improved the leaf area index at 2,4,6,8,10 and 12 WAP. Also, the highest leaf area index (12.33, 74.66, 27.33, 33.33, 50 and 55 respectively) was recorded from T<sub>4</sub> which was not significantly different from leaf area index (9.00, 11.00, 17.00, 23.00, 37.66 and 44.66) recorded from control. Also, it was observed that leaf area index was observed to increase across the sampling periods as rate of concentration increases.

Comparatively, aqueous turmeric extract enhanced leaf area index more than ethanol turmeric extract as shown in table 5a-b

TABLE 5. Leaf Area Index (LAI) as influenced but Turmeric Extract Application.

TABLE 5a. (Ethanol Turmeric Extract Response).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	9.83 <sup>a</sup>	11.33 <sup>a</sup>	14.33 <sup>a</sup>	22.66 <sup>a</sup>	34.00 <sup>a</sup>	42.66 <sup>a</sup>
T <sub>2</sub>	7.66 <sup>a</sup>	10.00 <sup>a</sup>	16.66 <sup>a</sup>	27.33 <sup>a</sup>	32.66 <sup>a</sup>	41.33 <sup>a</sup>
T <sub>3</sub>	5.83 <sup>a</sup>	8.00 <sup>a</sup>	13.33 <sup>a</sup>	21.33 <sup>a</sup>	34.00 <sup>a</sup>	46.33 <sup>a</sup>
T <sub>4</sub>	9.00 <sup>a</sup>	6.83 <sup>a</sup>	17.66 <sup>a</sup>	30.66 <sup>a</sup>	41.00 <sup>a</sup>	45.66 <sup>a</sup>
L.S.D	5.624	7.387	13.421	16.033	14.929	16.712

TABLE 5b. (Aqueous Turmeric Extract Response).

Treatments	2 WAP	4 WAP	6 WAP	8 WAP	10 WAP	12 WAP
T <sub>1</sub>	9.00 <sup>a</sup>	11.33 <sup>a</sup>	17.00 <sup>a</sup>	23.00 <sup>a</sup>	37.66 <sup>a</sup>	44.66 <sup>a</sup>
T <sub>2</sub>	9.66 <sup>a</sup>	11.66 <sup>a</sup>	23.66 <sup>a</sup>	31.66 <sup>a</sup>	46.66 <sup>a</sup>	52.33 <sup>a</sup>
T <sub>3</sub>	11.33 <sup>a</sup>	13.66 <sup>a</sup>	21.66 <sup>a</sup>	32.33 <sup>a</sup>	48.66 <sup>a</sup>	54.33 <sup>a</sup>
T <sub>4</sub>	12.33 <sup>a</sup>	14.66 <sup>a</sup>	27.33 <sup>a</sup>	33.33 <sup>a</sup>	50.00 <sup>a</sup>	55.00 <sup>a</sup>

Means in the same column, having the same letter according to LSD are not significant (P<0.05).

*Yield and Yield Components as influenced by Turmeric Extract Application*

*Number of Fruits*

The result in table 6a shows that increase in the concentration of treatment increased the mean number of fruits. It was observed that T<sub>4</sub> plants recorded the highest mean numbers (188) of fruits compared to the minimum number of fruits (61) recorded from control plants which was statistically not significant (P<0.05). whereas T<sub>3</sub> gave more mean number fruits (186.33) than 176 recorded from T<sub>2</sub> as shown in the table 6a.

In table 6b, the same trend was observed where T<sub>4</sub> recorded maximum mean number of fruits (222.66) compared to minimum number of fruits (62.33) recorded from control, which was not statistically different (P<0.05).

*Fresh Weight (g)*

In table 6a, maximum number of mean fresh weight (2070.43g) was recorded from Treatment<sub>4</sub> plots which was not statistically different (P<0.05) from mean fresh weight (622.36g) recorded from T<sub>1</sub>

Similarly, T<sub>4</sub> in table 6b obtained highest fresh weight (3304.03g) which was not significantly different from the fresh weights (656.86g, 1698.86g and 2492.80 respectively recorded from T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>).

*Yield (kg/ha)*

In both table 6a and 6b, yield showed increasing trend with increasing concentration of aqueous and ethanol turmeric extracts

The application of ethanol turmeric extract at Treatment<sub>3</sub> produced maximum yield (222.93kg/ha) compared to lowest yield (90.86kg/ha) recorded from control.

Whereas T<sub>4</sub> plants (table 6b) recorded highest mean yield (302.80kg/ha) which was not statistically different compared to the yield (87.86, 151.96kg/ha and 228.86kg/ha respectively recorded from control T<sub>2</sub> and T<sub>3</sub>).

It was observed that T<sub>4</sub> from aqueous extract plots produced highest number of fruits, fresh weight (2070.3g and yield (302.80kg/ha) compared to other treatments both ethanol extract and aqueous extract as indicated in the table 6a-b

TABLE 6. Yield (kg/ha) and yield components as influenced by turmeric extract application.

TABLE 6a. (Ethanol Turmeric Extract Response).

Treatments	Mean Number of fruits	Mean fresh weight (g)	Yield (kg/ha)
T <sub>1</sub>	61.00 <sup>a</sup>	622.36 <sup>a</sup>	90.86 <sup>a</sup>
T <sub>2</sub>	176.00 <sup>a</sup>	1848.50 <sup>a</sup>	172.33 <sup>a</sup>
T <sub>3</sub>	186.33 <sup>a</sup>	2048.43 <sup>a</sup>	222.93 <sup>a</sup>
T <sub>4</sub>	188.00 <sup>a</sup>	2070.43 <sup>a</sup>	191.70 <sup>a</sup>

TABLE 6b. (Aqueous Turmeric Extract Response).

Treatments	Mean Number of fruits	Mean fresh weight (g)	Yield (kg/ha)
T <sub>1</sub>	62.33 <sup>a</sup>	656.86 <sup>a</sup>	87.86 <sup>a</sup>
T <sub>2</sub>	183.33 <sup>a</sup>	1698.86 <sup>a</sup>	151.96 <sup>a</sup>
T <sub>3</sub>	210.33 <sup>a</sup>	2492.80 <sup>a</sup>	228.86 <sup>a</sup>
T <sub>4</sub>	222.66 <sup>a</sup>	3304.03 <sup>a</sup>	302.80 <sup>a</sup>

Means in the same column, having the same letter according to LSD are not significant (P<0.05)

*Proximate Analysis as Influenced by Turmeric Extract Application*

*Moisture Content*

The moisture content of the freshly harvested garden egg was observed to stand at 79.90% and 79.80% respectively from T4 plot treated with both ethanol and aqueous turmeric extract which was significantly different from moisture content (64.43) and 65.63 respectively) recorded from ethanol plots as shown in table 7a and b.

In table 7b, it was observed that increasing the content ration of aqueous extract increased the moisture content. ( $T_1 < T_2 < T_3 < T_4$ )

*Ash Content:*

Ash content in the freshly harvested garden egg fruit was 3.10% which recorded from plot T<sub>3</sub> was significantly different ( $P < 0.05$ ) from mean ash content recorded from control and other treated plants as indicated in table 7a, whereas in table 7. Control recorded a mean ash content (2.66%) which was significantly differently ( $P < 0.05$ ) from the Ash Content (1.83%) recorded from T<sub>1</sub> plots. Among the treated plants, T<sub>3</sub> performed better than T<sub>2</sub> and T<sub>4</sub> as shown in table 7b.

*Fibre Content*

Fibre content as indicated in 7a, shows that control plots recorded highest fibre content (3.31%) which was significantly different ( $P < 0.05$ ) from fibre content (2.12% and 2.76% respectively) recorded from T<sub>2</sub> and T<sub>3</sub> plots. Also, T4 among the treated plots recorded highest fibre content (3.26%) which was significantly different ( $P < 0.05$ ) compared to fibre content (2.12% and 2.76% respectively) recorded from T<sub>2</sub> and T<sub>3</sub> plots (Table 7a)

Similarly in table 7b, control recorded mean fibre content (3.24%) which was significantly different from other treated plots. However, T<sub>3</sub> recorded the maximum fibre content (3.03%) which was significantly different from other treated plots but not statistically different compared to control. Comparatively, ethanol performed better than aqueous extract on fibre content

*Crude Protein*

The result in table 7a, shows that T<sub>3</sub> plots recorded highest protein content (2.26%) which was not significantly different ( $P < 0.05$ ) compared to the protein content recorded from treated plots and control.

In aqueous turmeric extract (7b), control plots recorded the highest protein content (2.10%) which was not statistically different from protein content obtained from treated plots

*Sugar content*

In ethanol turmeric extract response (table 7a), freshly harvested garden egg recorded maximum sugar content (1.20) which was significantly different ( $P < 0.05$ ) from sugar content (0.50) recorded from sugar content (1.01) recorded from T<sub>3</sub> plots.

In table 7b, it was observed that the same treatment<sub>2</sub> recorded maximum sugar content (1.40) which was significantly different ( $P < 0.05$ ) from sugar content (0.59, 0.60 and 1.160 respectively) recorded from T<sub>1</sub>, T<sub>4</sub> and T<sub>3</sub>

*Carbohydrate Content*

Carbohydrate content as shown in table 7a, showed that treated plots recorded more carbohydrate content than control. It was observed that fruits from T<sub>2</sub> plots recorded maximum carbohydrate content (3.32) which was not significantly different ( $P < 0.05$ ) from carbohydrate content obtained from control, T<sub>3</sub> and T<sub>4</sub> plots respectively.

In table 7b, it was 2% plot that recorded the highest carbohydrate content (3.00%) which was not statistically different from control, and other treated plots.

*Fat Content*

The result on fat content showed some level of significant as indicated on table 7a and b. fruits from control plots recorded the maximum fat content (2.71%) which was significantly different ( $P < 0.05$ ) compared to the fat contents (1.76, 2.11 and 2.12 respectively) obtained from T<sub>3</sub>, T<sub>4</sub> and T<sub>2</sub>

Similarly, the same trend was observed in aqueous turmeric extract application. Fat content was lower (1.50) in fruits from Treatment4 plots which was significantly different ( $P < 0.05$ ) from highest (2.36%) recorded from control.

*Vitamin C*

The result presented in table 7a, showed that fruits harvested from T<sub>3</sub> plots recorded highest mean Vitamin C (1.65) which was significantly different ( $P < 0.05$ ) compared to the Vitamin C content (1.02, 1.19 and 1.30 respectively) obtained from T<sub>4</sub>, T<sub>2</sub> and control plots

In the result shown in table 7b, fruits harvested T<sub>3</sub> plots recorded maximum Vitamin C (2.34) which was significantly different ( $P < 0.05$ ) from Vitamin C (1.24, 1.24 and 1.79 respectively) recorded from control, T<sub>4</sub> and T<sub>2</sub> plots

TABLE 7. Proximate Composition as influenced by Turmeric Extract Application.

TABLE 7a. (Ethanol Turmeric Extract Response).

Treatments	MC (%)	Ash (%)	Fibre (%)	Crude Protein	Sugar	Carbohydrate	Fat	Vit. C
T <sub>1</sub>	65.63 <sup>b</sup>	2.80 <sup>ab</sup>	3.31 <sup>a</sup>	2.20 <sup>a</sup>	0.50 <sup>c</sup>	2.43 <sup>a</sup>	2.71 <sup>a</sup>	1.30 <sup>ab</sup>
T <sub>2</sub>	64.56 <sup>b</sup>	2.17 <sup>ab</sup>	2.12 <sup>c</sup>	1.85 <sup>a</sup>	1.20 <sup>a</sup>	3.32 <sup>a</sup>	2.12 <sup>b</sup>	1.19 <sup>ab</sup>
T <sub>3</sub>	64.13 <sup>b</sup>	3.10 <sup>a</sup>	2.76 <sup>b</sup>	2.26 <sup>a</sup>	1.01 <sup>ab</sup>	2.95 <sup>a</sup>	1.76 <sup>b</sup>	1.65 <sup>a</sup>
T <sub>4</sub>	79.80 <sup>a</sup>	2.04 <sup>b</sup>	3.26 <sup>a</sup>	1.60 <sup>b</sup>	0.50 <sup>a</sup>	2.98 <sup>a</sup>	2.11 <sup>b</sup>	1.02 <sup>b</sup>
L.S.D	11.607	0.983	0.483	0.281	0.227	1.106	0.534	0.478

TABLE 7b. (Aqueous Turmeric Extract Response).

Treatments	MC (%)	Ash (%)	Fibre (%)	Crude Protein	Sugar	Carbohydrate	Fat	Vit. C
T <sub>1</sub>	64.43 <sup>b</sup>	2.66 <sup>a</sup>	3.24 <sup>a</sup>	2.10 <sup>a</sup>	0.60 <sup>c</sup>	2.70 <sup>a</sup>	2.36 <sup>a</sup>	1.24 <sup>b</sup>
T <sub>2</sub>	65.85 <sup>ab</sup>	1.83 <sup>b</sup>	2.45 <sup>b</sup>	1.94 <sup>a</sup>	1.40 <sup>a</sup>	2.89 <sup>a</sup>	1.79 <sup>b</sup>	1.79 <sup>ab</sup>
T <sub>3</sub>	68.76 <sup>ab</sup>	2.53 <sup>a</sup>	3.03 <sup>a</sup>	2.02 <sup>a</sup>	1.17 <sup>b</sup>	3.00 <sup>a</sup>	1.54 <sup>c</sup>	2.34 <sup>a</sup>
T <sub>4</sub>	79.90 <sup>a</sup>	2.13 <sup>a</sup>	1.95 <sup>c</sup>	1.61 <sup>b</sup>	0.59 <sup>c</sup>	2.99 <sup>a</sup>	1.50 <sup>c</sup>	1.24 <sup>b</sup>
L.S.D	14.900	0.808	0.317	0.218	0.205	0.653	0.152	0.783

Means in the same column having the same letter is not significant according to LSD ( $P < 0.05$ )

#### IV. DISCUSSION

Results of the experiment indicated that applications of the different concentration and methods of extraction significantly enhanced the growth parameters and proximate composition of garden egg (*Solanum melogena*) evaluated. Irrespective of the extraction method, plants height numbers of leaves, stem girth, leaf area and leaf area index were increased with increasing rates of application. The result also revealed variations among the extraction treatment type. The increase recorded in growth parameters from treated compared to control could be due to availability of and absorption of nutrients (Ca, K and P) contained in both aqueous and ethanol turmeric extract. This is in conformity with the work of Ahmed et al 2013 who reported that combined and single application of extract of Roselle, turmeric and seaweed effectively improved the leaf area, nutrients (N.P.K and Mg total Chlorophyll and Total carotenous) in leaves, yield quality & Valencia Orange trees.

The increase in stem girth and other growth parameters could be due to presence of Ca, Mg, P, K, contained in turmeric which is biosynthesis of cell wall materials and enhanced cell division which increase the stem girth. Turmeric have been found to contain, Ca, Mg, K and P and Curcumin which help to protect DNA damage in the plant. (Chawdhury et al., 2007, Karim and Tahim 2008, Ahmed et al, 2014).

It is evident from the data in table (6a-b) that yield expressed in weight and number of fruits for plant was enhanced in response to foliar application of turmeric at different rates compared to control. The promotion on yield was profound more with aqueous turmeric extract than from ethanol extract. The high number of fruits, fresh weights and yield recorded from treated plants are mainly attributed to positive action of aqueous and ethanol extract on enhancing vegetative growth and nutritional status of *Solanum melogena* (Eggplant) in favour of producing higher number of plants. These results is in agreement with those obtained by Ahmed et al. 2015 previous studies showed that application of plant extract was beneficial in improving yield, fruit quality and storability of fruit crops (Al-mahmodu et al., 2010, Abd El-Razek et al., 2011, Mohamed and Mohamed, 2013, Ahmed et al., 2013, Ahmed and Gad El-Kareem, 2014, Refaai, 2014, Abd El-Raham 2015 and Ahmed et al., 2015).

Results on nutritional status revealed that turmeric extract impacted more on Ash content, protein, sugar, carbohydrate and Vitamin C content of eggplant than untreated plants.

The treated plants recorded an improved nutritional status compared to other treated plots and control. This enhancement of nutritional content could be attributed to higher own contents of plant pigments, carbohydrate, oils volatile compounds, antioxidant, nutrients (such as (Ca, Mg, K, P and vitamins) Curcumin of turmeric extract. This is conformity with works of Obagwu et al., 1997, purohit 2000, Okigbo and Emoghene 2003, Chawdhury et al., 2007; Mohamed and Mohamed, 2013 and Ahmed et al., 2014) who reported plant extracts were found to enhance growth, nutritional status, yield and fruit quality of fruit crops.

In this study it could be inferred that enhancement of vegetative growth parameters such as plant heights, leaf area, number of leafs and leaf area index on application of turmeric extract is concomitant with improvement of yield and nutritional quality of freshly harvested garden egg. This is in agreement with work of Ahmed et al. 2014 and Ahmed et al. 2015. The beneficial effects of turmeric extracts on building plant pigments and organic foods certainly reflected on advancing maturity and enhancing fruit quality.

This is conformity with work of Ahmed et al. 2013. The variation in yield and growth parameter response to aqueous and ethanol turmeric extract could be due to chemical properties of the solvent and method of extraction. This agreed with Pinelo et al. 2004 and Javad and Somayeh (2016) who suggested that the chemical properties of solvent and method of extraction show distinct behavior.

In conclusion, these results show that spraying of turmeric extract (both aqueous and ethanol extract) has the potential to improved growth nutritional quality and yield of eggplant (*Solanum melogena*). Perhaps more importantly, results indicate that aqueous turmeric extract, enhanced nutritional status and yield at 300ml concentration than ethanol turmeric extract.

In this study the variation could be as a result of chemical properties of the solvent and method of extraction, and environmental factors (rainfall, temperature, humidity and soil nutritional status. The use of turmeric extract, is environmental friendly, simple technology application with cost effectiveness therefore can be recommended to local farmers as a source of bio stimulant.

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