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Growth and Yield Response of Cayenne Pepper Plant Grown in Different Substrates Culture of Drip Hydroponic Farming Method

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Abstract: The soilless farming techniques of growing crops most especially vegetables has increased tremendously in developed countries while it is still new in developing countries such as Nigeria. The research determined the effect of substrates on optimum growth, yield and nutrient composition of cayenne pepper plant so as to form an effective basis for selection of substrates to be used as plant support in soilless farming methods. This research was carried out at Agricultural and Environmental Engineering experimental farm, Federal University of Technology, Akure.The experiment was carried out in a completely randomized design with three treatments (sawdust, rice husks and soil) and replicated three times. The vegetative growth, yield, biomass weight, water and nutrient, proximate and mineral composition were measured. The results showed that rice husk gave the highest plant height of 29.91 cm, number of leaves of 39.60 and stem girth of 0.3414 cm respectively while sawdust gave the lowest plant height of 17.83 cm and soil gave the lowest number of leaves of 29.36 and stem girth of 0.3059 cm. Higher yields were also recorded from rice husk for cayenne pepper plant while the soil has the least yield. The physiological appearance of the crop and the yields were significantly ($P<0.05$) affected by the various treatments due to effects of the substrates and the planting methods. The proximate and mineral compositions of the pepper were higher in the pepper from rice husk and least in the pepper from the soil. These were significantly ($P<0.05$) affected by the treatments effects as a result of its physicochemical features.With the outcome of this research, it is advisable that soilless farming should be embraced by farmers in areas where there is limitations of land for agricultural activities. Also, federal and state ministry of agriculture should give necessary support for soilless farming in Nigeria.

Keywords: Hydroponic, Substrate, Growth, Yield, Quality, Cayenne pepper,

INTRODUCTION

Expert experience over the last few years has shown the need to embark on agricultural production with effective technology for better economic prosperity of any nation (OECD, 2001; UNDP, 2012) The present high cost of foodstuff in Nigeria is because of failed agricultural practices over the years (Okuneye, 2002; Obayelu, 2010; Olukunle, 2013). If Nigeria has to be rated among the economically powerful countries in the world, our agricultural productivity has to measure up to those countries that are presently rated as economic giant of the world. Hence, the agricultural sector of our economy will need a new and effective technology with ideas that will continually improve the productivity, profitability and sustainability of our country major farming practices (Sanusi, 2010; Plumecocq *et al.*, 2018). Therefore, among these technologies and ideas is the greenhouse technology, soilless farming, irrigation, specific crops nutrient and water requirements, etc. Soil is usually the most available growing medium for plants. It provides anchorage, nutrients, air, water, etc. for plant growth (Aatif *et al.*, 2014). It can be defined in many ways to suit different purposes, but to agriculturist, soil is the medium for crop growth, anchorage for plants, it contains nutrients, water and air on which plants depend (Ibiyoye, 2006; Pawlson *et al.*, 2013). However, these soils do pose serious limitations for plant growth often. Some of them are presence of disease causing organisms and nematodes, unsuitable soil reaction, unfavourable soil compaction, poor drainage, degradation due to erosion, etc (Aatif *et al*., 2014). In addition, open field agriculture is difficult as it involves large space, lot of labour and large volume of water. In most urban and industrial areas, soil is less available for crop growing, or in some areas, there is scarcity of fertile, cultivable arable lands due to their unfavourable geographical or topographical conditions (Aatif *et al*., 2014). Under such circumstances as stated above, soilless farming method can be introduced successfully (Butler and Oebker, 2006).

Soilless farming method is the technique of growing plants in soilless condition with their roots immersed in nutrient solution (Maharana and Koul, 2011). Soilless farming methods of cultivation can be classified according to the techniques employed. It is generally classified into substrate and water culture. Substrate culture is the cultivation of crops in a solid, inert or non-inert medium instead of soil while water culture is the cultivation of plants directly in nutrient solution circulated with or without any substrate. Soilless farming methods supply fresh vegetables in countries or region of countries with limited arable land as well as in small countries with large populations. It could be useful to provide sufficient fresh vegetables for the indigenous population. In soilless culture, some cultural practices like soil cultivation and weed control are avoided, and land not suitable for soil cultivation can be used (Polycarpou *et al*., 2005). Plants grown by soilless methods had consistently superior quality, high yield, rapid harvest, and high nutrient content (Silberbush and Ben-Asher, 2001). This system will also help to face the challenges of climate change and also, it helps in the production system management for efficient utilization of natural resources and mitigating malnutrition (Butler and Oebker, 2006). Soilless farming can provide important requirements for plant growth with equal growth and yield results compared to field soil (Aatif *et al*., 2014). Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium. When the mineral nutrients in the soil dissolve in water, plant roots are able to absorb them. When the required mineral nutrients are introduced into a plant's water supply artificially, soil is no longer required for the plant to thrive. The simplest and oldest method for farming is a vessel of water in which inorganic chemicals are dissolving to supply the nutrients that plants require. The retention of nutrients and water can be further improved with sphagnum peat, vermiculite, or bark chips. These are the most commonly used materials, but others such as rice husk, sugarcane refuse, sedge peat, and sawdust are used sometimes as constituents in soilless mixes. Straw bales have been used as growing medium in England and Canada and Rockwool (porous stone fibre) is used in Europe (Parameshwarareddy *et al*., 2017).

The environment where soilless farming is conducted is tightly controlled and regulated wherein the essentials for a plant to successfully grow are amply provided; light, water, nutrition, temperature etc. (Mason, 1988; Jones, 2014a; Jones, 2014c). Therefore, soilless farming usually takes place in either a greenhouse, a modified warehouse or even inside an office building, a place where the environment can be regulated (Mason, 1988). The basic setup requires a few essential things: plant seeds, nutrient-enriched water, light and growing systems. Soilless farming heavily relies on water to function, it interestingly uses almost 90% less water when compared to conventional soil-farming; water in the systems is recycled until the crops are ready for harvest, instead of it washed in water run-offs (Baptista, 2014; Jones, 2014b). This research work aims to comparatively evaluate the potential of organic growing media (sawdust and rice husks) and soil on cayenne pepper and to examine its effects on yield and fruit quality using drip flow substrate technique hydroponic farming inside the greenhouse and conventional farming respectively.

MATERIALS AND METHOD

Study Area

This study was carried out at Agricultural and Environmental Engineering experimental farm site, Federal University of technology, Akure, Ondo State, Nigeria, (7.2995^0N, 5.1471^0E). As a tropical area, Akure has a high temperature throughout the year. The average daily temperature is 26°C with a range between 18^oC and 35^oC. Mean annual relative humidity of about 80% and relief is about 396 m above sea level (Odubanjo *et al*., 2011).

Field Experimental Procedure

Cayenne pepper seeds, bought from National Horticultural Research Institute, Ibadan, were sown on drip hydroponic structure using sawdust and rice husk as plant support under greenhouse conditions and conventional farming with soil to serve as control. Simultaneously, samples of sawdust and rice husks were randomly taken from sawmill and rice mill. Also, soil samples were randomly collected within the depths of 0-15 cm using a hand auger from the agricultural engineering experimental farm site where the conventional farming was carried out. Each sample was separately labeled, air-dried, crushed to pass through a 2 mm sieve, and taken to the laboratory for physicochemical analysis by standard methods prior to application of inorganic nutrients/solution and planting. Substrates were put in 3" drilled hole inserted with disposable empty water bottle and filled with sawdust and rice husk in a 4"•4"•72" PVC pipes were laid out in completely randomized design with three replicates. Treatments consist of two different substrates (sawdust and rice husk) in the drip hydroponic soilless structure as shown in Figure 1 and soil in conventional farming as control respectively to determine the growth and yield of the plants.

The experimental field for the open field farming was cleared, manually tilled prior to planting while the drip hydroponic soilless farming structure was being built. There were five observations of plants on each substrates and soil. The planting space is between 400 mm within row and 600 mm between rows. It was sown directly in the drip hydroponic planting structure and in the soil on the 13^{th} of March, 2017 at the rate of three seeds per hole and watered everyday. Drip hydroponic substrates culture supplied a standard nutrient solution to the plants. The nutrient solution that was used for this research contained: 0.76 g/l sodium nitrate, 0.24 g/l potassium sulphate, 0.25 g/l mono-calcium phosphate, 0.71 g/l magnesium sulphate, 0.27 g/l potassium nitrate, 0.76 g/l calcium nitrate and 0.03 g/l iron sulphate. The electrical conductivity of solution was maintained from 1.5 and 2.5 dS/m while the pH was maintained in the range of 5.8 and 6.5. The volume of nutrient solution applied varied from 1623 to 1949 ml for five observed plants in an experimental unit per week. The plants were irrigated 2 times a day with the same nutrient solution until the end of experiment. Irrigation frequency was based on solar radiation and stage of plant growth in greenhouse. Average day and night temperatures in the greenhouse were 31ºC and 22ºC respectively. The relative humidity varied between 52% and 75%. Data collection on plant height, number of leaves, stem girth began a week after planting and counting of number of flowers, number of fruits and continues every week at its stages. Total fruit yield of the crops and biomass yield were measured and evaluated.

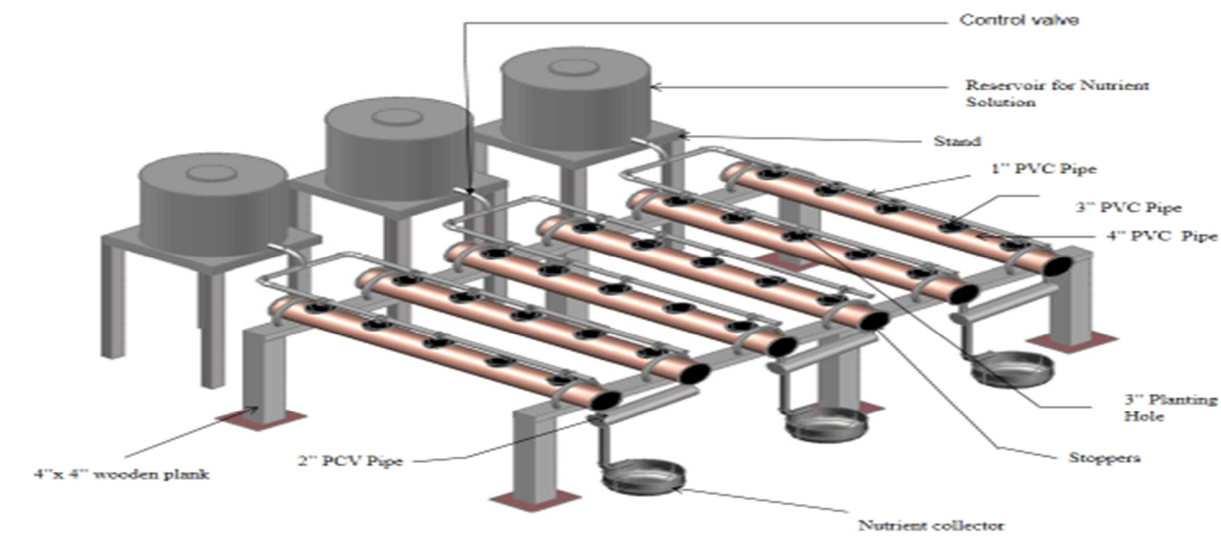

Figure1: Isometric View of Drip Hydroponic Soilless Structure

Proximate and Mineral Analysis of the Cayenne pepper

Samples of the pepper were plucked from each substrate and the soil and cleaned by rinsing it with deionized water. The samples were freshly blended and stored in the refrigerator (4-8^{0}C) for proximate and mineral analysis test in the laboratory. The proximate composition of the cayenne pepper was determined using AOAC (2000) procedure for the determination of moisture content, ash content, protein, crude fibre, fat and energy while the mineral elements comprising sodium, calcium, potassium, magnesium and iron were determined according to the method of Shahidi *et al.* (1999) and Nahapetian and Bassir (1975) with some modifications (Akubugwo *et al*., 2007).

Statistical Analyses

Analysis of variance was performed on the data of physiological responses of the cayenne pepper plant, its yield, proximate and mineral composition of its fruits. The means of significant treatment effects were separated with the Least Significance Difference test. All the tests of statistical significance were based on a 5% level of probability.

RESULTS AND DISCUSSION

Physical Properties of the Substrates and the Soil

Results of the sawdust, rice husk and soil samples used as substrates for plants support systems showed the physicochemical properties as shown in Table 1. The particle size analysis of the soil at the experimental farm is loamy sand in texture while sawdust and rice husk indicates no sample for particle size classification. A soil’s ability to hold and supply nutrients is related to the number of parking spaces for nutrients on substrates/soil particles. Since the result of the coefficient of permeability of the sawdust, rice husk and soil has been established to be low, very low and high respectively, it implies that less water/nutrient solution will move through the sawdust and rice husk which economized its use for the crops while the high permeability level of soil result to more water and nutrient been easily drained and not available to crops in the long run.

The soil is low in organic matter as reflected by the low content of organic matter (2.98 g/kg) which is very low compared to sawdust (9.53 g/kg) and rice husk (12.2 g/kg). Typical amount of organic matter in soil varies from <1% in ordinary soil to 90% in both peat soil and between 15 to 20% in mineral soils (Awofolu *et al*., 2005; McCauley *et al*., 2017). Organic matter obtained in both substrates and soil was within this range. The relevance of organic matters to this study is its influence on the mobility and flux of extractable bases and micronutrients. The normal range of organic matter obtained signified that metals in soil and substrates are bio-available since these metals are known to form complex with organic matter that influence their availability (Awofolu *et al*., 2005; Ashraf *et al*., 2012). The moisture content of the sawdust, rice husk and the soil are 12.1%, 18.8% and 8.70% respectively (Table 1). Moisture content is related to organic matter; it helps to improve the structures of the substrates as well as water and nutrient holding capacity, support soil microbes and protects soil and the substrates from.

Total nitrogen of soil is 0.14 g/kg compared to sawdust (0.5 g/kg) and rice husk (0.65 g/kg). Nitrogen is an important building block of proteins, nucleic acids and other cellular constituents that are essential for all forms of life. Soil pH is a measure of a soil solution's acidity and alkalinity that affects nutrient solubility and availability in the soil/substrates. The pH of soil is strongly acidic with a mean value of 5.3 while rice husk and sawdust has pH of 6.5 and 6.1 respectively. This is considered suitable and good for better performance of vegetables. Soil pH levels near 7 are optimal for overall nutrient availability, crop tolerance, and soil microorganism activity (Tindal, 1983; Pureseglove, 1991; McCauley *et al*., 2017). Soil pH can be modified by using chemical amendments which is considered in chemical composition of the nutrients used for the planting of this crops (McCauley *et al*., 2017).

The available Sodium (Na), Potassium (K), Calcium (Ca) and Magnesium (Mg) with mean values of (0.77 mg/100g, 2.12 mg/100g and 0.34 mg/100g), (0.34 mg/100g, 0.55 mg/100g, and 0.06 mg/100g), (5.73 mg/100g, 8.18 mg/100g, and 2.11 mg/100g), (1.63 mg/100g, 3.97 mg/100g and 0.84 mg/100g) for sawdust, rice husk and soil respectively were seemingly low compared to the ratings of FMANR (1996) for the ecological zone (Olaniyi and Ojetayo, 2010). A substrate/soil's ability to hold and supply nutrients is related to its cation and anion exchange capacities; these revealed there is need for amendment in form of fertilizer or nutrient solution application to improve the growth and the yield of the vegetables.

Plant Height, Number of Leaves and Stem Girth of Cayenne Pepper as Influenced by the Substrates and the Soil

The plant height of cayenne pepper showed no statistically significant differences ($p<0.05$) among the mean plant height on the substrates (Table 2). However, testing for the differences among the pair of means, using LSD (0.05) as shown in Table 2, Cayenne pepper planted on the rice husk has the highest mean plant height of 21.91 cm while that planted on the sawdust had the least mean plant height of 17.83 cm. Generally, the plant height increased as the plant aged. In terms of physiological features of the plant, rice husk could be recommended because the plant height from this substrate produced the highest yield. The differences in plant height could be as a result of irrigation time, difference in physicochemical parameters as rice husk contain high organic matter and other environmental factors.

Table 1: Results of Mean Physical and Chemical Properties of the Substrates and the Soil

	Values Obtained		
Parameters Measured	**Sawdust Samples**	**Rice husk Samples**	**Soil Samples**
Moisture Content	12.1%	18.8%	8.7%
Water Holding Capacity	54	76	14
Total Porosity	46	24	86
Permeability	Low	Very Low	High
Bulk Density	0.94 g/cm^3	0.92 g/cm^3	1.41 g/cm^3
Clay	NS	NS	9.5%
Silt	NS	NS	3.8%
Sand	NS	NS	86.7%
pH	6.1	6.5	5.3
EC	470µS/cm	651µS/cm	425µS/cm
Organic Carbon	5.54	7.10	1.73
Organic Matter	9.53 g/kg	12.2 g/kg	2.98 g/kg
Total Nitrogen	0.50	0.65	0.14
Fe	75.3 mg/kg	92.4 mg/kg	188.1 mg/kg
Mn	5.17 mg/kg	6.82 mg/kg	24.4 mg/kg
Zn	18.3 mg/kg	22.9 mg/kg	37.1 mg/kg
Cu	1.10 mg/kg	1.25 mg/kg	5.46 mg/kg
Pb	0.24 mg/kg	0.19 mg/kg	0.82 mg/kg
Na	0.77 mg/100g	2.12 mg/100g	0.34 mg/100g
K	0.34 mg/100g	0.55 mg/100g	0.06 mg/100g
Ca	5.73 mg/100g	8.18 mg/100g	2.11 mg/100g
Mg	1.63 mg/100g	3.97 mg/100g	0.84 mg/100g

Each data is mean of three replicates.

The number of leaves of cayenne pepper showed no statistically significant differences ($p<0.05$) among the mean number of leaves on the substrates. However, testing for the differences among the pair of means, using LSD (0.05) as shown in Table 2, cayenne pepper planted on the rice husk has the highest mean number of leaves of 39.60 while that planted on the soil has the least mean number of leaves of 29.36. Generally, the number of leaves increased as the plant aged. In term of physiological features of the plant, rice husk and sawdust could be recommended because the number of leaves from this substrate produces the highest yield. The differences in number of leaves could be as a result of irrigation time, difference in physicochemical parameters and other environmental factor.

The stem girth of cayenne pepper showed no statistically significant differences ($p<0.05$) among the mean stem girth on the substrates. However, testing for the differences among the pair of means, using LSD (0.05) as shown in Table 2, cayenne pepper planted on the rice husk has the highest mean stem girth of 0.3414 cm while that planted on the soil has the least mean stem girth of 0.3059 cm. Generally, the stem girth increased as the plant aged. In term of physiological features of the plant, rice husk and sawdust could be recommended because the stem girth from this substrate produces the highest yield. The differences in stem girth could be as a result of irrigation time, difference in physicochemical parameters and other environmental factors.

The growth parameters can be seen to be increasing with age. The cayenne pepper plant growth pattern shows an initial slow growth and then accelerated as observed after the normal slow establishment of the plant. This result agreed with the findings of Olaniyi and Fagbayide (1999) and Olaniyi *et al*. (2010) who found that the plant showed growth in height at the beginning rather slowly, increasing to a maximum then slow down again so that the chart obtained by plotting height, number of leaves and stem girth against weeks after planting is an oblique 'S' in shape. The positive response and increased in growth parameters of pepper with applied nutrient solution to rice husk and sawdust might be due to the low initial nutrient status in the soil, which revealed the vital role played by the nutrient solution in soilless farming crop production (Olaniyi and Ojetayo, 2010).

Table 2: Plant Height, Number of Leaves and Stem Girth of Cayenne Pepper Plants Grown on the Substrates and the Soil

Substrates	**Plant height (cm)**	**Number of leaves**	**Stem girth (cm)**
Sawdust	17.83a	35.00a	0.3105a
Ricehusk	21.91a	39.60a	0.3414a
Soil	17.84a	29.36a	0.3059a

Means that do not share a letter are significantly different at $p < 0.05$ according to Fisher's Least Significance different (LSD).

Yield and Biomass Components of Cayenne Pepper as Influenced by the Substrates and the Soil

The number of flowers, number of fruits, fruit weight per plant and total fruit yield per hectare of cayenne pepper as influenced by different substrates in drip hydroponic farming system are presented in Table 3. There was no significance difference for the number of flowers among the substrates, higher value was recorded for rice husk (15.99 cm) while soil gave the least value (12.40 cm) as shown in Table 3. The fruit yield per plant and total fruit yield were not significant difference among the substrates. The highest value was recorded from rice husk while sawdust gave the least value. The low value of yield obtained for soil might be due to non-development of flowers into fruits as most of the flowers did not developed into fruit. Most of the flowers were dried up and fell off or they might form tiny fruits which shriveled up and fall off without further development which was prevented in the case of substrates soilless farming inside the greenhouse.

The fresh weight of leaves, stem and root of African spinach plant as influenced by different substrates in drip substrates soilless farming system were presented in Table 4. Rice husk has the highest value of these component parts of the plant. Although, there was no significant difference in fresh weight of leaves, stem and root in the three substrates as shown in Table 4. This agreed with findings carried out that most experiments comparing different substrates for horticultural crops indicate that the differences were not marked (Voca *et al*., 2007, Borowski and Nurzyński, 2012). At the end of the experiment, regardless of the substrates treatment, the plants grown on rice husk and sawdust had the greatest vegetative growth, characterized by their high leaves, stem and root biomass value.

Table 3: Yield Components of Cayenne Pepper as Influenced by Substrates and the Soil

Substrates	No. of Flowers/ substrates	No. of Fruits/ substrates	Fruit weight/ substrates
Sawdust	14.60a	10.20a	31.798a
Ricehusk	15.00a	10.80a	31.89a
Soil	12.40a	8.60a	29.50a

Means that do not share a letter are significantly different at $p < 0.05$ according to Fisher's Least Significance different (LSD).

Table 4: Biomass Components of Cayenne Pepper as Influenced by Substrates and the Soil

Substrates	Fresh weight of leaves/substrates	Fresh weight of stem/substrates	Fresh weight of root/ substrates
Sawdust	20.26a	28.27a	19.91a
Ricehusk	22.35a	32.43a	24.95a
Soil	19.96a	19.55a	19.55a

Means that do not share a letter are significantly different at $p < 0.05$ according to Fisher's Least Significance different (LSD).

Proximate Analysis and Mineral Composition of Cayenne Pepper with the Substrates and the Soil

The results of the proximate analysis and mineral composition of cayenne pepper with different substrates are presented in Table 5. The fruit mineral nutrient composition such as sodium, potassium, calcium, magnesium and iron from rice husk and sawdust showed significant influenced by the substrates. There is inconsistency in the nutritional values obtained in the study for these pepper with different substrates. The cayenne pepper on rice husk closely followed by sawdust recorded higher nutritional values more than the soil that served as control. Contents of magnesium, calcium, sodium, potassium and iron in cayenne pepper planted using the three substrates showed that potassium had the highest values in all as shown in Table 5. In a similar study, Park *et al*. (2006) and Zou *et al*. (2015) found that the most abundant mineral in pepper seeds was potassium, which agreed with the findings of these result. The outstanding values of the cayenne pepper as a source of special nutrient needed in the diet are indicated by the nutritive values. Calcium aids the formation of bones, while Fe in the diet serves as a source of blood formation to the body of a man (South pacific foods, 1995). All the substrates used are good sources of quality mineral elements. These nutrient elements were above the quantity that can be found in normal field planting of this plant according to World Health Organization (WHO) as shown in Table 5. The increased in these values might have been because of inorganic nutrient added to the solution. The variation in the nutritive values of cayenne pepper from all the substrates used as support system might be as a result of environmental effect in which they are grown and chemical composition of the substrates. Also, distribution of minerals needed for human health in the edible portion of plants can be affected by cultural production method as in case of soil (Russo, 1996). Mineral is one of the most important nutritional quality factors in many crops and has many biological activities in the human body.

The percentage of moisture content, ash content, crude protein, fibre, fat and energy values of cayenne pepper fruits showed significant influenced by the substrates. There is inconsistency in the nutritive values obtained in the study of these pepper with different substrates. The cayenne pepper on rice husk closely followed by sawdust recorded higher values of these parameters more than the soil that served as the control. These values of moisture, ash content, crude protein, fibre, fat and energy values of cayenne pepper using the three substrates were as shown in Table 5. Cayenne pepper production is currently on the increase in Nigeria partly in recognition of its food values as a source of essentially body building proteins, vitamins and mineral (Vilareal, 1980). Protein helps in the building up of new cells in the body and enhances growth. Fat in the diet serves as a source of energy in the body of a man (South Pacific Foods, 1995). The moisture content in the powder of the fruits on wet basis from all substrates ranged from 64.84 – 64.37%. This value was close to those observed by other authors, such as Al-Jasass and Al-Jasser (2012), who obtained moisture values of 44.8% for black pepper seeds (*piper nigrum*). Ash content ranged from 1.42 – 1.31%; protein range from 48.21 - 47.25%; crude fibre ranged from 16.37 – 15.22%; fat ranged from 6.69 – 6.68% and energy contents were 439.14 – 436.12 KJ/g respectively. These values were close to those found by Embaby and Mokhtar (2011), who obtained values of 4.88, 19.57 and 19.28 g/100 g for hot pepper seeds. The little difference in ash, crude fat and crude protein contents of pepper could be related to the individual substrates and environmental influence. Chemical composition of plant was controlled by climate, soil and plant factors (Koyuncu *et al*., 2014). These same plant might show different response to uptake of nutrient from the substrates even when they were grown in the same conditions (greenhouse) (Yildiz *et al*., 2014).

Table 5: Proximate Analysis and Mineral Composition of Cayenne Pepper with Substrates and the Soil (values per 100 g edible portion, Fresh weight basis)

Parameters	% MC	% Ash	% Protein	% Fibre	% Fat	Energy (KJ/g)	% Mg	% Ca	% Na	% P	Fe (mg/kg)
Sawdust	64.67b	1.31b	47.25c	15.22c	6.68a	436.12b	6.81b	34.70b	19.11b	52.54b	2.06a
Rice husk	64.84a	1.42a	48.21a	16.37a	6.68a	439.14a	6.85a	34.65c	19.21a	52.62a	2.06a
Soil	64.38c	1.31b	47.45b	16.32b	6.66a	434.81c	6.75c	34.75a	19.14ab	52.32c	2.06a
WHO Values	25 – 50	-	-	-	-	-	0.032	0.02	0.015	0.035	20

Means that do not share a letter are significantly different.
Mg: Magnesium; P: Phosphorus; Na: Sodium; Ca: Calcium; Fe: Iron; MC: Moisture content.

CONCLUSIONS

This study was carried out to evaluate some growth and yield indices of two different organic substrates (rice husk and sawdust) inside greenhouse and soil for convectional farming method with cayenne pepper plants. Results of the experiment revealed that planting with substrates such as rice husk and sawdust had the highest physiological appearances and growth of the plant. It also suggests that in the absence of the conventional farming techniques in area such as desert, riverine area, urban centers, etc. any of the substrates may be used to obtain similar or higher result of yield. Therefore, in our growing condition, the substrates such as rice husk and sawdust in drip hydroponic soilless planting system is the most suitable while soil by conventional farming for cultivation of cayenne pepper plants gave least values in most of the parameters measured. The selection of these suitable media is the key that ensures the success of this technique, seeing that the adoption of conventional planting system as control for this experiment did not produce as much as the cayenne pepper in the greenhouse planted through rice husk and sawdust. Proximate and mineral analysis showed that these crops contain appreciable amount of proteins, energy, fat, fibre and mineral elements. Thus, it can also be concluded that these crops can be grown hydroponically and contribute significantly to the nutrient requirements of man in area where soil for conventional farming support cannot be found or scarce such as urban centers or riverine area. Also, this system avoids contamination of soils, underground water and aquifers due to the release of fertilizers and other chemicals on soil for crop productions. As conventional growing condition of crops is becoming difficult most especially in urban cities where there is no availability of fertile soil or where the distance to available and fertile soil for crop production is not within reach, people can venture into the production of these crops at their home where there is open structure by adopting soilless farming technique and to help improve the yield and quality of the produce even where the soil is good so that we can ensure food security of our country. In spite of the close proximity of values obtained for the substrates and the soil, future research work such as optimization of the management of this system could lead to better results and use of other substrates could be a better support for cayenne pepper.

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