The effect of liquid organic fertilizer on some growth parameters and yield of *Cucumis sativa* L in North Agro-ecological zone of Delta State

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Abstract
This study examined the effects of liquid organic fertilizer on some growth parameters and yield of *Cucumis sativa* L. (Cucumber) in the north agro-ecological zone of Delta State. The experiment was a completely randomized design and replicated four times with treatments as 0 ml to 15 litres of water, 15mls to15 litres of water applied twice, 30mls to15 litres of water, 30 mls to15 litres of water applied twice, 45 mls to15 litres of water applied twice, 60 mls to 15 litres of water and 90 mls to 15 litres of water. Growth parameters were measured at different growth stages (2 to 11 WAP) for vine length (in cm), plant girth (in cm), number of leaves and leaf area (in cm^2) while yield parameters measured at harvest as fresh weight of the fruits, fruit diameter and fruit length. The result showed that the vine length, plant girth, number of leaves, and leaf area increased ($P < 0.05$) from 2 to 10 WAP and decreased at 11WAP. Similarly, the growth parameters increased ($P < 0.05$) with increase in the rate of fertilizer application. The fruit length, fruit diameter and fresh weight were ($P < 0.05$) higher at application of 90 mls in all single applications. Thus, 90 mls to 15 litres of water (2.20kg) and application of 45 mls to15 litres of water applied twice (2.25kg), are thus recommended to farmers in the North Agro-ecological zone of Delta State.

Keywords: Cucumber, girth, number of leaves, leaf area, liquid organic fertilizer, plant height, fruit length, fruit diameter, fruit weight

Introduction

Cucumber (*Cucumis sativus L.*) is an important vegetable crop in the family *Cucurbitaceae* (Lower and Edwards, 1986; Thoa, 1998). The cucumber has vines which grow on stakes or on trellises. The plant has large leaves that form canopy over the fruit. The fruit is roughly cylindrical, elongated with tapered ends and may be long in diameter. It is soft, succulent with high water contents. The fruits are used in unripe matured state, usually eaten raw in salads, eaten fresh as a vegetable raw, cooked or pickled and are also stewed in tropical regions (Grubben, 1977; Motes, 1977). Those eaten fresh are commonly called slicing cucumbers. Slicing cucumbers contains most of the vitamins needed to meet standard recommended daily nutritional needs. Cucumber contains vitamins B^1, Vitamin B^2, Vitamin B^3, Vitamin B^5, Vitamin B^6, Folic Acid, Vitamin C, Calcium, Iron, Magnesium, Phosphorous, Potassium and Zinc (Grant, 2011). Cucumber flesh is primarily composed of water but also contains ascorbic acid (Vitamin C) and caffeic acid; both of which help skin irritations and reduce swelling .and the juice is often recommended as a source of silicon to improve the complexion and health of the skin (Duke, 1997). Similarly, Cucumber has a high water content which gives it a unique and cooling taste (Wood, 1988). Cucumber can hold about thirty-times its own weight in water, compared to the fibre of wheat bran which can hold only four to six times its own weight (Foster *et al.*, 2003). Grant (2011) reported that, the high water content makes cucumbers a diuretic and has a cleansing action within the body by removing accumulated packets of old waste materials and chemical toxins (Grant, 2011). Cucumbers help eliminate uric acid which is beneficial for those who have arthritis and it's fibre-rich skin and high levels of potassium and magnesium helps regulate blood pressure and help promote nutrients functions (Grant, 2011). Cucumber is used in the production of a large variety of cosmetics including fragrances, body lotions, shampoos and soaps (Robinson and Decker-Walter 1997; Rubatzky and Yamaguchi, 1997).

Soil fertility plays a unique role in the cultivation of cucumber. Infertile soils result in bitter and mis-shapen fruits which are often rejected by consumers (Eifediyi and Remison, 2010). Fertilizers are organic and inorganic. Inorganic or chemical fertilizers are expensive, mostly in fixed ratios, not readily available as at when needed by the resource poor farmers. Organic fertilizers/manures are more readily available throughout the year with little or at no cost. Organic manures can sustain cropping systems through better nutrients recycling and improvement in soil physical properties (El-shakweer *et al.*, 1998; Zhang *et al*, 2006). Similarly, Ranjan *et al*, (2008) posited that organic manures increases soil microbial biomass and total organic carbon as well as soil productivity. Ojeniyi (2000) reported that organic manures sustain cropping systems through better nutrients recycling and improvement in soil physical, chemical and biological properties. Improvement in environmental conditions with respect to public health has been observed as some of the major reasons for the need to adopt organic farming by farmers in the world

(Eifediyi and Remison, 2010).Though manures are usually very bulky and the cost of transporting them from one location to another is high, it is a safer source of nutrition as they are environmentally friendly releases their nutrients in a slow and steady manner to crops in the field, thereby activating the soil microbial activities (Eifediyi and Remison 2010). Thus utilizing liquid organic fertilizers are less bulky, ease to transport and effecious over a large area of farmland has been suggested. Liquid organic fertilizers are applied to the soil or to the leaves (foliar) and even to the soil and the leaves of plants. This is most preferably applied in the early mornings and evenings when liquids are most probably absorbed (www.organicgardeningguru.com, 2006). Adediran *et al.* (2005) reported a positive root development, vegetable growth and fruit yield of tomatoes to the complementary application of organic manure and mineral fertilizer. Similarly, Deore *et al.* (2010) reported that a novel organic liquid fertilizer improved the plant height, number of branches per plant, leaf area, number of fruits per plant total yield and fresh and dry weight of *Capsicum annum* L. Similarly, Saira *et al.* (2011) reported that foliar application of fertilizer increased number of leaves, plant height, leaf area, and diameter and flower quality in plants, while Matito *et al* (2006) reported an increase in nutrient up take by crops, improved plant growth and crop yield. Further, Biofarm, a commercial available liquid organic fertilizer has been shown to increase the presence of iron in pepper (Sureyya and Funda, 2012). There have been little or no information about the use of organic liquid fertilizers in the cultivation of cucumber in the North Agro ecological zone of Delta state. Hence, the objective of this study is to evaluate the response of cucumber to different rates of liquid organic fertilizer application.

Materials and Methods

The experiment was conducted at the Teaching and Research Farm of Delta State University, Asaba Campus, Asaba. Asaba is located on a latitude 06^0 $14^{'}$N and longitude 06^O $49^{'}$E. It lies in the rainforest agro ecological zone, characterized by seven months of rainy season between April to October, with a short break in August which was not experienced during the period of this experiment. Asaba has an annual rainfall of 1500 mm to 1849 mm, relative humidity of 68.80 %, mean temperature of 23.8 ^{0}C to 37 ^{0}C as maximum and a mean monthly soil temperature of 28.3 ^{0}C at 100cm depth (NIMET, 2010). Cucumber used for the study was sourced locally while the liquid organic fertilizer (power plant) was sourced from Green planet international in Jos.

Ten kilograms of soils obtained from the cleared site were emptied into each polythene bags. This resulted from a preliminary trial of 5, 10, 15 and 20kg's of soil and 10kg of soil and above sustained the growth of Cucumber till maturity. .Soil samples were taken at 20-30 cm depth, were bulked and air dried for 2weeks, crushed to pass through 2mm sieve mesh. The soil samples were later analyzed for physico-chemical properties. Planting took place on the 28th of June 2011 and repeated in 28th of June 2012. The experiment was a completely randomized design replicated four times. There were ten treatments namely: T_1 0mls of power plant to 15litres of water,

T_2 15mls of power plant to 15litres of water at 1 application

$T_3$15mls of power plant to 15litres of water at 2 applications

T_4 30mls of power plant to 15litres of water at 1 application

T_5 30mls of power plant to 15litres of water at 2 applications

T_6 45mls of power plant to 15litres of water at 1 application

T_7 45mls of power plant to 15litres of water at 2 applications

T_8 60mls of power plant to 15litres of water at 1 application

T_9 75mls of power plant to 15litres of water at 1 application

T_{10} 90mls of power plant to 15litres of water at 1 application

The liquid organic fertilizer (power plant) was applied at 2 WAP and applied to T_3, T_5 and T_7 at 6 WAP. The net stands were sampled at 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11 WAP for vine length using a flexible tape rule; stem girth with a vernier caliper, leaf area with a planometer while the number of leaves was visually counted. The fresh weight of the fruits was measured using a top load weighing balance in gramme while the fruit length and diameter were measured with a flexible tape rule and a vernier caliper respectively. The data obtained from this study were polled and subjected to analysis of variance and means showing significant difference were separated using Duncan Multiple Range Test (Duncan, 1955).

Results and Discussion

The results of the physico - chemical analysis of the soil are presented in Table 1, while the constituents of liquid organic fertilizer (power plant) according to Green planet International (2012) are indicated in Table 2. The soil is a sandy loam in texture and is slightly acidic with a pH of 6.6. The soil is low in organic carbon and nitrogen with moderate levels of exchangeable cations (Table 1). The liquid organic fertilizer is high (18%) in nitrogen, (8%) phosphorus and (4.5%) potassium and has appreciably quantities of micro-nutrients (Table 2).

Table 1: Physico-chemical properties of the experimental site

Parameter	Soil values
PH (H_20)	6.6
Available P (ppm)	53.238
Organic carbon (g/kg)	0.256
Total nitrogen (%)	0.015
Exchangeable cations	
Ca^{++} (cmol/kg)	3.12
Mg^{++} (cmol/kg)	1.68
K^{+} (cmol/kg)	5.092
Na^{+} (cmol/kg)	2.959
H^{+} (cmol/kg)	2.959
Al^{+} (cmol/kg)	0.0
ECEC (cmol/kg)	13.15
EC (cmol/kg)	17.59
Sand (g/kg)	87.3
Silt (g/kg)	9.7
Clay (g/kg)	3.0
Textural class	Sandy loam

The Effect of liquid Organic fertilizer on vine length

The effects of different rates of application of liquid organic fertilizer (power plant) on vine length are indicated in Table 3. The vine length ($P < 0.05$) increased with the age of the cucumber plant. The vine length was ($P > 0.05$) similar from 2 - 5WAP (Table 3). The vine length was significantly higher in the array of 90mls: 15litres of water > 75mls: 15 litres of water > 60ml: 15 litres of water > 45mls: 15litres of water > 30mls: 15litres of water > 0mls:15litres of water of liquid fertilizer application (Table 3). Similarly, the second application to T_3 (97.71 – 140.20 cm) at 6WAP improved the vine length better than T_4 (83.08 – 124.08 cm). Similarly, the second applications at T_5 and T_7 improved the vine length better than T_8 and T_{10} respectively (Table 3). At 11WAP, the vine length was higher at double applications of 45mls at 2 and 6WAP than in any other treatment. This result agreed with Smith and Taylor, (1996); Hochmuth and Hanton (1995) who reported that vine length increased with increase in the rate of fertilizer applications. Similarly, Maitio *et al.* (2006) reported an increase in plant growth using foliar and soil application of fertilizer.

Table 2: Liquid organic fertilizer (Power plant) constituents according to Green Planet International (2012)

Parameter	values
Nitrogen (%)	18.0
Phosphorous (%)	8.0
Potassium (%)	4.5
Copper (%)	0.05
Magnesium (%)	0.56
Sulphur (%)	1.8
Iron (%)	0.10
Manganese (%)	0.10
Boron (%)	0.03
Molybdenum (%)	0.002
Cobolt (%)	0.002

Effect of liquid fertilizer application on plant girth

The effects of liquid organic fertilizer on plant girth are indicated in Table 4. The plant girth were ($P > 0.05$) at 2 and 3 WAP but ($P < 0.05$) increased from 2WAP to 11WAP (Table 4). The plant girth at T_5, T_7, T_9 and T_{10} were ($P > 0.05$) similar but were ($P < 0.05$) higher than other treatments at 11WAP (Table 4). The plant girth at T_1 (1.99 – 3.99cm) were most significantly depressed from 6 – 11WAP (Table 4). This is supported by the works of Roe *et al,* (1997); Abou-Hadid *et al.*, (2003); Moral *et al.*,(2005) who reported that cucumber responded positively to organic fertilization.

Table 3: The influence of liquid organic fertilizer (power plant) on vine length/plant (in cm)

Treatment	**Weeks After Planting (WAP)**									
Concentration (mls)	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
T_1 (0mls:15ltrs)	2.33^{a}	3.89^{a}	19.35^{a}	23.89^{b}	36.30^{c}	42.31^{c}	50.96^{c}	60.18^{d}	74.68^{c}	80.21^{c}
T_2 (15mls:15ltrs)	2.73^{a}	3.78^{a}	21.20^{a}	34.05^{a}	42.29^{b}	58.60^{b}	69.71^{bc}	84.21^{c}	91.20^{bc}	105.26^{c}
T_3(15mls:15ltrs) (2 appl.)	2.65^{a}	3.98^{a}	20.10^{a}	35.20^{a}	40.80^{b}	68.60^{ab}	90.71^{ab}	105.21^{b}	121.26^{ab}	140.20^{b}
T_4 (30mls:15ltrs)	2.44^{a}	4.08^{a}	23.08^{a}	36.08^{a}	53.08^{ab}	73.08^{a}	83.08^{b}	93.05^{bc}	109.05^{b}	124.08^{bc}
T_5 (30mls:15ltrs) (2 appl.)	3.08^{a}	3.98^{a}	23.80^{a}	36.23^{a}	55.96^{ab}	78.31^{a}	102.96^{a}	130.18^{a}	144.68^{a}	160.21^{a}
T_6 (45mls:15ltrs)	3.02^{a}	3.08^{a}	24.50^{a}	36.80^{a}	58.44^{ab}	73.08^{a}	93.08^{ab}	113.00^{b}	123.08^{ab}	140.05^{b}
T_7 (45mls:15ltrs) (2 appl.)	2.84^{a}	4.45^{a}	24.40^{a}	36.70^{a}	58.12^{ab}	86.78^{a}	105.85^{a}	129.25^{a}	155.75^{a}	170.13^{a}
T_8 (60 mls:15ltrs)	2.80^{a}	4.45^{a}	25.78^{a}	38.40^{a}	62.88^{a}	75.15^{a}	94.20^{ab}	117.15^{ab}	135.00^{ab}	150.20^{ab}
T_9 (75mls:15ltrs)	2.90^{a}	3.97^{a}	27.21^{a}	40.00^{a}	66.58^{a}	80.41^{a}	104.46^{a}	127.10^{a}	140.50^{a}	155.30^{ab}
T_{10} (90mls:15ltrs)	2.92^{a}	3.89^{a}	28.21^{a}	42.08^{a}	70.00^{a}	88.10^{a}	104.25^{a}	130.16^{a}	145.04^{a}	168.70^{a}

Means in the same row with similar letter superscript are not statistically different at 5% level of probability according to Duncan Multiple Range Test

Table 4: The influence of liquid organic fertilizer (power plant) on plant girth/plant (in cm)

Treatment	**Weeks After Planting (WAP)**									
Concentration (mls)	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
T_1 (0mls:15ltrs)	0.50^{a}	1.00^{a}	1.75^{b}	1.89^{ab}	1.99^{c}	2.31^{c}	2.50^{c}	3.18^{c}	3.68^{c}	3.99^{c}
T_2 (15mls:15ltrs)	0.48^{a}	1.34^{a}	1.75^{b}	2.03^{ab}	2.46^{b}	2.60^{bc}	3.24^{b}	3.56^{bc}	4.00^{b}	4.05^{b}
T_3(15mls:15ltrs) (2 appl.)	0.58^{a}	1.40^{a}	1.80^{b}	2.06^{ab}	2.55^{b}	3.20^{b}	3.80^{b}	4.01^{ab}	4.26^{b}	4.56^{b}
T_4 (30mls:15ltrs)	0.68^{a}	1.40^{a}	1.96^{ab}	2.15^{a}	2.80^{b}	3.08^{b}	3.58^{b}	3.80^{b}	3.90^{c}	4.10^{b}
T_5 (30mls:15ltrs) (2 appl.)	0.63^{a}	1.36^{a}	1.90^{ab}	2.23^{a}	2.96^{b}	3.31^{a}	3.96^{ab}	4.38^{a}	4.62^{ab}	5.02^{a}
T_6 (45mls:15ltrs)	0.58^{a}	1.44^{a}	1.90^{ab}	2.58^{a}	3.08^{ab}	3.68^{ab}	4.04^{a}	4.25^{a}	4.48^{a}	4.76^{ab}
T_7 (45mls:15ltrs) (2 appl.)	0.59^{a}	1.45^{a}	1.98^{ab}	2.53^{a}	3.32^{a}	4.28^{a}	4.65^{a}	4.95^{a}	5.15^{a}	5.33^{a}
T_8 (60 mls:15ltrs)	0.61^{a}	1.46^{a}	2.00^{a}	2.58^{a}	3.48^{a}	3.90^{a}	4.00^{a}	4.14^{a}	4.45^{ab}	4.90^{ab}
T_9 (75mls:15ltrs)	0.58^{a}	1.48^{a}	2.21^{a}	2.60^{a}	3.56^{a}	3.90^{a}	4.04^{a}	4.26^{a}	4.60^{ab}	5.00^{a}
T_{10} (90mls:15ltrs)	0.60^{a}	1.48^{a}	2.24^{a}	2.68^{a}	3.78^{a}	4.11^{a}	4.26^{a}	4.76^{a}	4.80^{a}	5.20^{a}

Means in the same row with similar letter superscript are not statistically different at 5% level of probability according to Duncan Multiple Range Test

Effect of Power plant on number of leaves

The effects of fertilizer applications on the number of leaves are presented in Table 5. The number of leaves increased progressively from 2 WAP to 10WAP in all the treatments. The leaf production was significantly higher in the array of 90mls: 15litres of water > 75mls: 15 litres of water > 60ml: 15 litres of water > 45mls: 15litres of water > 30mls: 15litres of water > 0mls:15litres of water of liquid fertilizer application in single application (Table 5). At the second fertilizer application, the leaf productions were ($P > 0.05$) similar at T_5, T_7, and T_{10} (Table 5). The leaf productions were most significantly depressed T_1 from 5 – 11WAP (Table 5). The higher the rate of liquid fertilizer application, the higher the leaf production agreed with the findings of Forbes and White (1986); Roe *et al* (1997) and Eifediyi and Remison, (2010) who asserted that the higher the rate of fertilizer application, the higher the number of leaves.

The effect of liquid fertilizer application on leaf area

The effects of liquid organic fertilizer application on the total leaf area of cucumber are indicated in Table 6. The total leaf areas of T_1 - T_{10} were ($P > 0.05$) similar at 2WAP (Table 6). The total leaf area increased with cucumber age in all treatments from 2 to 10WAP but declined at 11WAP. Between the various treatments, total leaf area was most ($P < 0.05$) enhanced in T_7 (4026.71) at final observation while the total leaf area was most significantly depressed at 0ml of liquid fertilizer application from 5 to 11WAP (Table 6). This result agreed with Deore *et al.*, (2010) who reported that the higher the rate of Novel fertilizer application, the higher the leaf area of tomato. Similarly, Eifediyi and Remison, (2010) and Saira *et al.*, (2011) reported that the higher rate of foliar or fertilizer application, the higher the leaf area in plants.

Table 5: The influence of liquid organic fertilizer (power plant) on number of leaves/plant

Treatment Concentration (mls)	**Weeks After Planting (WAP)**									
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
T_1 (0mls:15ltrs)	3.05^{a}	3.88^{a}	6.63^{a}	9.13^{c}	14.06^{c}	18.30^{c}	20.60^{c}	21.18^{c}	22.80^{c}	18.20^{c}
T_2 (15mls:15ltrs)	3.00^{a}	3.94^{a}	7.00^{a}	10.50^{b}	16.20^{b}	20.20^{b}	22.71^{bc}	24.25^{bc}	25.60^{c}	20.86^{c}
T_3(15mls:15ltrs) (2 appl.)	3.01^{a}	3.92^{a}	7.00^{a}	10.43^{b}	16.25^{b}	20.90^{ab}	23.60^{bc}	28.20^{a}	30.00^{a}	28.20^{ab}
T_4 (30mls:15ltrs)	3.13^{a}	4.63^{a}	7.02^{a}	11.08^{b}	17.40^{ab}	20.00^{b}	23.08^{bc}	24.40^{bc}	25.80^{bc}	21.40^{b}
T_5 (30mls:15ltrs) (2 appl.)	3.02^{a}	4.60^{a}	7.05^{a}	11.25^{b}	17.60^{ab}	23.30^{a}	23.90^{bc}	27.50^{a}	30.60^{a}	32.21^{a}
T_6 (45mls:15ltrs)	3.04^{a}	4.64^{a}	7.08^{a}	13.18^{a}	18.40^{a}	21.80^{ab}	23.40^{bc}	28.00^{a}	30.60^{a}	24.20^{ab}
T_7 (45mls:15ltrs) (2 appl.)	3.08^{a}	4.65^{a}	7.28^{a}	13.13^{a}	18.42^{a}	24.00^{a}	27.50^{a}	30.25^{a}	34.00^{a}	34.80^{a}
T_8 (60 mls:15ltrs)	3.00^{a}	5.20^{a}	7.40^{a}	13.40^{a}	18.80^{a}	22.80^{a}	25.60^{ab}	27.60^{ab}	29.50^{ab}	26.80^{ab}
T_9 (75mls:15ltrs)	3.11^{a}	5.40^{a}	7.50^{a}	14.50^{a}	19.40^{a}	23.00^{a}	26.20^{a}	28.10^{ab}	29.50^{ab}	27.40^{ab}
T_{10} (90mls:15ltrs)	3.13^{a}	5.50^{a}	7.50^{a}	14.90^{a}	19.60^{a}	24.10^{a}	28.60^{a}	29.90^{a}	31.40^{a}	30.70^{a}

Means in the same row with similar letter superscript are not statistically different at 5% level of probability according to Duncan Multiple Range Test

Table 6 : The influence of liquid organic fertilizer (power plant) on leaf area/plant (in cm^2)

Treatment Concentration (mls)	**Weeks after planting (WAP)**									
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
T_1 (0mls:15ltrs)	246.14^{a}	428.58^{c}	698.18^{b}	1374.61^{d}	2336.49^{c}	3083.81^{c}	3528.78^{c}	2792.79^{c}	2746.72^{d}	2133.77^{c}
T_2 (15mls:15ltrs)	241.10^{a}	435.37^{c}	871.57^{ab}	1580.88^{cd}	2621.16^{bc}	3422.69^{bc}	3890.22^{bc}	3197.61^{b}	3084.03^{c}	2448.99^{c}
T_3(15mls:15ltrs) (2 appl)	242.91^{a}	433.16^{c}	872.12^{ab}	1570.34^{cd}	2647.71^{bc}	3541.29^{b}	4118.20^{b}	3818.28^{ab}	3855.04^{ab}	3296.72^{b}
T_4 (30mls:15ltrs)	252.62^{a}	511.68^{b}	870.81^{ab}	1688.48^{c}	2891.53^{b}	3388.80^{bc}	3953.60^{b}	3217.14^{ab}	3108.08^{b}	2519.64^{bc}
T_5 (30mls:15ltrs) (2 appl.)	243.71^{a}	508.30^{b}	877.79^{a}	1714.39^{c}	2926.70^{b}	3947.49^{a}	4170.55^{a}	3726.25^{ab}	3708.13^{ab}	3795.94^{ab}
T_6 (45mls:15ltrs)	245.33^{a}	512.67^{b}	881.84^{ab}	2008.50^{ab}	3057.77^{a}	3693.57^{ab}	4008.42^{b}	3691.52^{ab}	3486.38^{ab}	2849.31^{ab}
T_7 (45mls:15ltrs) (2 appl.)	248.59^{a}	513.78^{b}	882.18^{ab}	2000.88^{ab}	3066.39^{a}	4066.08^{a}	4698.75^{a}	4098.88^{a}	4095.98^{a}	4026.71^{a}
T_8 (60 mls:15ltrs)	241.10^{a}	574.60^{ab}	921.89^{a}	2095.76^{ab}	3126.25^{a}	3862.23^{a}	4285.28^{a}	3639.06^{ab}	3553.86^{ab}	3155.43^{b}
T_9 (75mls:15ltrs)	250.98^{a}	596.75^{a}	934.20^{a}	2267.80^{a}	3226.03^{a}	3897.12^{a}	4353.38^{a}	3704.70^{ab}	3553.39^{ab}	3226.08^{b}
T_{10} (90mls:15ltrs)	252.59^{a}	607.80^{a}	934.52^{a}	2330.36^{a}	3259.28^{a}	4083.32^{a}	4590.26^{a}	3942.02^{a}	3882.44^{a}	3614.62^{ab}

Means in the same row with similar letter superscript are not statistically different at 5% level of probability according to Duncan Multiple Range Test

The effect of organic liquid fertilizer application on fruit yield

The effect of liquid organic fertilizer (power plant) on fruit length, fruit diameter and fruit weight are presented in Table 7. The fruit length was ($P < 0.05$) enhanced at T_7 and T_{10} as 17.40cm and 17.16cm and most significantly depressed at T_1 as 11.05cm. Similarly, the second fertilizer application to T_3 13.80 (cm), compared favorably with fruit length of T_4 (13.20 cm) and T_7 (17.40 cm) compared favorably with fruit length of T_9 (17.16 cm) respectively (Table 7). The fruit diameter was significantly depressed T_1 (9.04 cm) and were similar ($P > 0.05$) at T_7 and T_{10}. The fruit weight ranged from 0.95 – 2.25 kg/plant. The fruit weight at 0 mls: 15litres of water was most significantly depressed (Table 7). The higher the rate of liquid fertilizer application, the higher the fruit length, fruit diameter and fruit weight agreed with the findings of Deore *et al.*, (2010) who reported that liquid fertilizer application significantly enhanced number of fruits per plant, total yield and fresh and dry weight of *Capsicum annum* L. The higher the rate of fertilizer application, the higher the uptake by crops, the higher plant height, number of leaves and leaf area's would have probably resulted in higher photosynthate, fruit length, fruit diameter and fruit weight. This agreed with Zodape et *al.*, (2011) who reported that foliar fertilizer application improved nutrient uptake and yield of tomato. Similarly, Eifediyi and Remison, (2010) reported similar yield on cucumber using farm yard manure and inorganic fertilizer while Maitio *et al.* (2006) reported an increase in crop yield resulting from improved nutrient up take and plant growth.

Generally, the split application of liquid organic fertilizer enhanced the growth parameters and yield than a single application of fertilizer of the same quantity but was not significant. This enhancement may have increased nutrient use efficiency, reduce loss of growth resources and perhaps yield. Fertilizer Institute (2013) reported that split fertilizer application optimized nutrient management and matches nutrient supply with crop requirement. Similarly, Kulmala (2012) posited that split application increased grain yield and grain protein content and reduces the risk of leaching while McKenzie and Middleton (2013) reported that an adequate amount of P during the first 6 weeks of growth and an adequate amount of P during the during the rest of crop growth and yield is ideal for higher productivity.

Table 7: Effect of liquid organic fertilizer on fruit length, fruit diameter and fruit weight.

Treatments Concentration (mls)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (kg/plant)
T_1 0ml:15litres of water	11.05^{d}	9.04^{c}	0.95^{d}
T_2 15ml:15litres of water	12.08^{c}	12.08^{b}	1.45^{c}
T_3 15ml:15litres of water (2 appl)	13.80^{c}	12.90^{ab}	1.96^{ab}
T_4 30ml:15litres of water	13.20^{c}	12.08^{b}	1.84^{b}
T_5 30ml:15litres of water (2 appl)	15.44^{ab}	14.84^{ab}	2.10^{a}
T_6 45ml:15litres of water	14.94^{ab}	13.40^{ab}	1.68^{b}
T_7 45ml:15litres of water (2 appl)	17.40^{a}	14.94^{ab}	2.25^{a}
T_8 60ml:15litres of water	14.94^{ab}	12.94^{ab}	2.00^{a}
T_9 75ml:15litres of water	15.40^{ab}	13.80^{ab}	2.00^{a}
T_{10} 90ml:15litres of water	17.16^{a}	14.90^{a}	2.20^{a}

Mean with similar letters superscript are not significantly different at 5% level of probability at Duncan Multiple Range Test.

Conclusion

It has clearly been demonstrated from this study that, 90ml: 15litres of water of the liquid organic fertilizer out-yielded other rates of application applied than other rates of application and 2 application rates enhanced higher vine length, number of leaves, leaf area, fruit length, fruit diameter and yield than a single application rate of the liquid organic fertilizer is hereby recommended.

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