Growth and Development of Green pepper (Capsicum annuum L.) as Influenced by Planting Dates and Fertilizer Application in Owo, South West Nigeria

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Abstract  
Field experiments were conducted in 2014 under rainfed and irrigation cropping to evaluate/monitor the influence of fertilizer application and planting dates on the growth and yield of green pepper in Owo, South West Nigeria towards its production year round. Treatment evaluated consisted of two varieties of sweet pepper (California wonder and Tattasaidan-garko), three fertilizer types (organic, urea and organonomineral) and four planting dates in each season (2-April; 12-April; 22-April and 2-May for early season and 22-Sept.; 01-Oct.; 11-Oct. and 23-Oct. for the late season planting).These were factorially combined in a randomized complete block design (RCBD), and replicated three times. Compared to control, OMG, ORF and Urea fertilizers significantly (P < 0.05) increase both the growth and yield parameters. The growth and yield of the crop was favoured at the late planting date when the soil moisture was augmented with the supplementary irrigation and on the other hand, the rainfed cropping favours production of higher biomass, thus reducing the total harvested yield. The 02-May and 23-Oct. planting dates and the application of OGM recorded the best growth and yield attributes. Among the varieties, California wonder exhibited adaptable superior characteristics in terms of number of fruits (59.59) fruit weight (6.68 g) harvestable yield (2480.82 kg/ha). The interaction effect showed that variety California wonder transplanted on 23-Oct recorded more improvement in the form of highest leaf area (8.79 cm2), maximum number of fruits/ plant, fruit weight (86.93 g) and fruit yield (854.69 g/plant and 23.08 t/ha). The results established that 23-Oct. is ideal for bell pepper planting and the variety California wonder is the most stable performing variety with respect to the different planting dates.

Keywords  
Green pepper; Planting date; Fertilizer; Variety; Yield

1 Background  
Food security is defined as the physical and economic access to sufficient, safe and nutritious foods, which meet the individual’s dietary needs and food preferences for an active and healthy life (FAO, 1996). Thus, solving food insecurity requires a comprehensive approach that incorporates numerous fields of planning and considers a wide range of factors, which could be socio-economic, political or environmental in nature (Dillley and Boudreau, 2001; Vogel and Smith, 2002; Clover, 2003; Leary et al., 2007; Ericksen, 2008).

Sweet Pepper (Capsicum annuum L.), also known as bell pepper, green pepper, or Pimento, belong to the family Solanaceae (Olarawaju and Showemimo, 2006; Kabura, 2008). It is a warm season annual crop when grown in temperate regions and an herbaceous perennial when cultivated in tropical areas. Bell pepper is considered “sweet” since it lacks the pungent chemical (capsaicin) present in hot pepper. It is an important vegetable crop all over the world (Peet, 2006) which ranks third in the vegetable cycle after tomato and onion (Akinfasoye, 2006). Green pepper is a delicious vegetable that can be enjoyed either raw or cooked. In Nigeria, Its cultivation which originally confined to the drier savannah regions in the north, is now gradually gaining ground in the southern parts of the country. Green pepper is an excellent source of antioxidants, vitamin A and C as well as nerve-supportive vitamin B6. It is also a very good source of heart-healthy fiber, vitamin E, folate, potassium, and vitamin K as well as the enzyme-supportive molybdenum.

In South West Nigeria, production level is far below the average production level of about 10tons/ha recorded in the Northern part of Nigeria. Among the major contributing factors to the low production in South West Nigeria
are populace acceptance/social adaption, cultural management practices such as management of the planting time/date (Carl, 2009) which is one of the important factors for proper growth and development, soil properties, and influence of climatic condition in the zone. The climatic condition is characterized by high temperature throughout the year and, heavy torrential rainfall (Met Data 2014, NASA Data 2016). Present status of scientific knowledge aligned with monitoring the effects of climate change and weather variability, season of sowing in particular, planting dates, appropriate crop and soil management practices (spacing, mulching, fertility and tillage system) and use of appropriate harvesting, handling and processing are the research efforts to provide some management options and technologies for farmers.

Research reports also show that high and sustained crop yield could be achieved with a balanced use of organic and inorganic fertilizers. Nutrients from mineral fertilizers enhance the establishment of crops, while those from mineralization of organic manure promote yield when both fertilizers are combined. Pepper production can also be increased by exploring the use of suitable land management such as date of planting, amount of rainfall, day and night air temperature trends and sunshine duration, tillage system etc. In the production of green pepper, planting date is a major problem faced by farmers in their production. The use of planting date in pepper production is very important because it the period to determine when the crop will be produced at the maximum potentials and when the crop will command higher economic value, reduces competition between plants and weeds among others. When appropriate planting date is got in plant production, it increases crop growth and yield. Competition for water and nutrients in time of planting might be responsible for the decrease in plant growth and yield, (Knavel, 2008). Monitoring planting date also prevents the spread of pests and diseases from one plant to another (Celac, 2001). According to Moniruzzama (2007), effect of planting dates on the growth and development of Green pepper increases fruit yield and support its availability for a longer period within the year.

Suitable plant date can lead to optimum yield and on the other hand incorrect planting dates could result in relatively low yield and poor quality fruits. Specifically, the Southwestern farmers could take advantage of the possibility to grow the sweet pepper twice a year to generate additional income and therefore increase their overall annual farm income. The potentials of sweet pepper as a cash generating crop is significant for farmers especially those residing near the urban areas because of its importance in both local and international dishes. For an increase in production and a continuous availability year round, the relationship between soil, crop and the weather can be integrated. Thus this study is to examine the influence of fertilizer application and selection of planting date for year-round production of green pepper in agro-ecosystem of Owo area of Ondo State, South West Nigeria.

2 Materials and Methods
2.1 Field description
A Field experiment was conducted at the Teaching and Research Farm of the Rufus Giwa Polytechnic Owo, Lat. 9°12’N, long 5°35’E within the derived savanna transition zone of South west, Nigeria. This area is subjected to marked wet and dry seasons with a bimodal rainfall pattern, with two rainfall peaks (July and September) that make two growing seasons possible. There is heavy rainfall in May-June-July, which is interrupted by a dry period of about two weeks in August, this is followed by another period of heavy rainfall from September to October. Dry season length is between 120 -130 days, mean of annual rainfall is between 2.0 to 2.5 m, annual temperature range is between 28 to 34 C, relative humidity is never below 70% (MET, FUTA, 2014).

2.2 Soil description
The soil belongs to an order Alfisol, (USDA system, ) and can be classified as OxicTropuldulf or Luvisol soil with argillic or textural B horizon and have high base status of greater 50% by NA4OAC extraction (FAO classification), It is of the Okemesi Association, (Symth and Mongomery, 1962) derived from rocks composed essentially of quartz. (Gneisses and schist), which are resistance to weathering. Profile colour are typically pale grayish brown to brown and a textural classification of the site is sandy loam. (USID Staff survey) The soil is generally low in organic matter, total nitrogen, and available phosphorus (Agbede and Ojeniyi, 2009).
2.3 Sourcing for raw materials

Raw materials were the branded organic fertilizer (Sunshine Organic Fertilizer of N: 3.5%; P: 1%; K: 1.2%), Organomineral fertilizer (N: 3.5%, P₂O₅: 2.5% and K₂O: 1.5%) from Ondo state raw material recycalation centre, urea fertilizer from Agricultural development programme office. The preplanting soil samples were collected from the site and analysed. Nutrient element status of the organic fertilizer was also verified through laboratory chemical analysis. The seeds were obtained from Pioneer seed Kano and Nihort, Ibadan.

2.4 Pre-soil sample analysis

Soil samples at a depth of 0-75 cm were taken randomly on the experimental site, bulked, air-dried and sieved using 0.5 mm for physical and chemical analysis. The physical analysis includes Bulk density, Field capacity and Permanent wilting point, Porosity between Bulk density and Particle density and Particle size analysis. Chemical analysis include Total N, organic carbon (%), (NH₄ - Nppm) P (kgHa⁻¹), K (kgHa⁻¹), pH (a soil/water of 2:1) Exchangeable acidity, Cation exchangeable capacity and available microelements (Fe, Cu, Zn & Mn). The chemical analyses followed the analysis procedures as suggested by the soil and plant Test Laboratory manual (IITA, 2000). The analysis of the soil sample is shown in Table 1.

Table 1 The Soil Physical and Chemical Properties of the Experiment Site at Soil Depth of 0-30 cm

| Parameters             | Values |
|------------------------|--------|
| % Sand                 | 47.7   |
| % Clay                 | 27.6   |
| % Silt                 | 23.7   |
| Organic Carbon (g/kg)  | 1.31   |
| Organic matter (g/kr)  | 2.25   |
| pH                     | 6.22   |
| Nitrogen (g/kg)        | 0.13   |
| Phosphorus (mg/kg)     | 5.69   |
| Potassium (cmol/kg)    | 0.65   |
| Calcium (cmol/kg)      | 2.80   |
| Magnesium (cmol/kg)    | 0.50   |
| Iron (mg/kr)           | 17.94  |
| Copper (mg/kg)         | 6.18   |
| Manganese (mg/kg)      | 0.31   |
| Zinc (mg/kg)           | 8.17   |
| Silicon (mg/kg)        | 2.74   |
| chloride (mg/kg)       | 2.81   |
| Boron (mg/kg)          | 0.65   |
| Bulk Density (g/cm³)   | 1.29   |

2.5 Weather data

Weather data was obtained from the Meteorology Weather Station situated at the meteorological station in the Department of meteorology, FUTA. The variables collected include daily records of solar radiation/ sunshine duration, maximum and minimum temperature, rainfall amount/volume, relative humidity. These data was collected on daily basis over the period of the field experiments. The weather data is as shown in Figure 1.

Experiment 1: Establishment of green pepper varieties in the nursery:

Four planting dates within the best period for planting variety of Pepper to capture the variability that may be due to weather conditions in both seasons of sowing were chosen, and the seeds were planted in the nursery with a rich organic soil on 2-April; 12-April; 22-April; 2-May for rainfed planting and 22Sept.; 01-Oct.; 11-Oct.; 23-Oct. for late season planting in 2014. The seedlings were transplanted into the experimental field after five weeks at a planting space of 30 cm by 90 cm (Agele et al., 2003) to give a planting population of 370370 plants/ha. Cultural practices carried out include weeding, disease and pest control, application of fertilizer (mineral fertilizer) at a recommended rate of 45kgN, 45kg P₂O₅ and 45K₂O per ha (Vietnam 1998) as NPK 15-15-15 at transplanting and 60kg N ha⁻¹ split applied at 3 and 6 WAT as top dressing using Urea as Nitrogen sources (Maynard et al., 2003).
Experiment 2: Growth and development response of green pepper to fertilizer application and planting dates under rainfed and irrigated conditions:

Drip irrigation was adopted because it minimizes water loss and stem or crown of the crop will not be covered with water. Time of irrigation was adapted from the meteorological report of the environment. (November to March). Soil Parameters determined include soil moisture at saturation, field capacity to calculate and determine irrigation schedule and proper irrigation.

Fertilizer treatment and rate: Inorganic fertilizer (N.P.K) at the rate of N60kg, P<sub>2</sub>O<sub>5</sub> 32 kg and 20kg K<sub>2</sub>O, 10 tons/ha Organic fertilizer (SOF), 5 ton/ha Organomineral fertilizer (OGM) and the control (No fertilizer treatment).

Experimental Design: The experimental design was split-split plot (4 planting dates x 4 N fertilizer sources x 2 Green Pepper varieties x 3 replications) experiment in RCBD. The first split was the planting date as the main plot, the fertilizer levels as the subplot and the Green Pepper varieties from the sub-sub plots in three replicates. The experiment was laid out in a completely randomised design with three replicates. The treatments imposed were three types of fertilizers: 100% Sunshine organomineral fertilizer at 5 t/ha; 100% Organic fertilizer (Sunshine organic fertilizer SOF) at 10t/ha; 100% Inorganic fertilizer (Urea); Control (No fertilizer). The organomineral fertilizer was evenly mixed with the soil two weeks before transplanting. The organomineral fertilizer was a commercial fertilizer and has the following composition; organic carbon 8.34, organic matter content 14.38, nitrogen 4.424 g/kg, calcium, 2.8, magnesium, 3.87, available phosphorus 7.04 and exchangeable potassium 0.352;

Data were collected fortnightly beginning at 4 WAT from two plants in each plot for the following growth and yield parameters; plant height (cm), number of leaves per plant, number of branches per plant, fruit weight (g), days to 50% flowering, number of fruits per plant, harvested weight, harvest index among others. Plant height was assessed by using a measuring tape from the base to the terminal point of the plant, number of leaves and the number of branches was visually counted. At harvest, the plants were uprooted and weighed using a sensitive weighing balance. Analysis of variance (ANOVA) for all measurements were performed using Genstat software version 12 statistical packages and mean separation was done based on the work of Steel and Torrie (1980).

3 Result and Discussion

The Figure 1 shows the mean climatic condition of the study site between the years 2013-2014 to cover the experimental years. The maximum mean temperature is in a range of 26 °C - 30 °C and a mean of 28 °C while the
minimum temperature was between 21 °C – 23 °C with the mean at 22 °C, there is slight variation in the temperature range throughout the seasons of cropping. The rainfall gradually rise from February with a value of 71 mm to its peak in July at a value of 180.2 mm, a drop occurs in August to give the August break and the second peak by September to early November with a mean annual rainfall volume were 119.4 mm-256.2 mm. This marks the beginning of dry season. The study area is characterized by 3-4 months of dryness usually from December to early March, the raining month are characterized with high relative humidity >70%. The solar radiation evenly distributed through the year expect for late July to August when the rainfall ceases, “August Break”, at the peak of dry season the atmosphere is clear thus the radiation too is high and at the least when the rainfall is at the peak value.

The growth response of green pepper cultivation to fertilizer and Planting dates under rainfed and irrigation conditions as measured by leaf weight, plant height and branch number at 2-12 weeks after transplanting were summarized in Table 2, Table 3 and Table 4. Mean plant height as shown in Table 2 for both cropping seasons reveals that California wonder performed better than Tattasi Dan-Garko and the performance was more pronounced under rainfed condition. There were slight variation in value but it was significant (P < 0.05) California wonder produced the maximum plant height (74.61 cm) than Tattasi Dan-Garko (71.68 cm).

The result in Table 3 shows that the highest number of leaves of green pepper was recorded at 12WAT under rainfed cropping season and at 10WAT for irrigation. There was significant difference in the number of leaves for both cultivars at the weeks of measurement. The number of branches increases with the weeks of evaluation (Table 4).

The superior performance of the green pepper (California wonder, Tattasi Dan-Garko) in rainfed cropping can be attributed to the environmental as well as climate conditions. The production of more leaves, increase in height and well developed structure were in line with the findings of Agele (2010) and Oladitan et al. (2014) that reported that good climatic conditions favour maximum growth parameter under adequate moisture and nutrient supply. There were little variation in their growth because of similar genetic composition and their ability to adapt to the environment. Availability of moisture enhances better nutrient utilization which might have induced a significant higher growth parameter than irrigation cropping. This result coincided with finding of Saidu and William (2015).

Mean data on plant height of green pepper cultivars were presented in Table 2, which indicated a progressive increase in plant height across the evaluation period. The application of OGM fertilizer in both seasons produced the tallest plant heights and was consistent for the weeks of evaluation. Rainfed cropping produced higher plant height value than irrigation cropping (68.53 cm) (71.53 cm), however, there was an irregularities at 12WAT under irrigation. At 6, 8, and 10 WAT for rainfed cropping, the application of ORF exhibit a significant different to urea while the control recorded the least plant heights i.e. 41.06 cm and 61.06 cm respectively, for the two varieties.

The application of OGM fertilizer gave the best response with respect to the plant height and was slightly significantly (P < 0.05) different to application of ORF. This was however significantly different from the Urea fertilizer application, an indication that green pepper responds better to organic fertilizers. The shortest plant heights were observed in the control treatment in both cropping seasons. The better crop performance as regard to plant height could be as a result of the presence of growth promoting factors in the combination of organic and inorganic fertilizers as reported by Abdel-El-Moez et al. (2001) and Arancon et al. (2005).

The summary of growth parameters in Table 2, Table 3 and Table 4 show that different planting dates exhibit significant (at 5% level significant) effects on the growth characteristics of green pepper cultivars in both cropping seasons. 23-Oct. planting date produced the maximum height (66.33 cm), closely followed by that of 11-Oct. planting date. This was significantly (P < 0.05) different to 22-Sept. planting date that produced the least plant height (61.13 cm). Green pepper planted under rainfed cropping had a superior performance to irrigation
condition in term of growth parameter. 2-May planting date had the maximum plant height (68.64 cm) not significant to 12-April planting date but significantly different to 2-April planting date.

Number of leaves varied significantly due to different sowing dates and cropping time. It was recorded that 2-May planting date produced the maximum (120.5) number of leaves which was statistically different from other planting dates whereas the least number was recorded in 2-April planting date. The same pattern of result was noted for rainfed 23-Oct. planting date produced the highest number of leaves for the period of evaluation (12 weeks) and statistically different to other planting dates.

The maximum average number of branches 13.34 and 21.62 was obtained at 12WAT (2-May & 23-Oct.) and was statistically similar to those of 12-April &11-Oct. planting dates. Minimum number of branches (11.94 and 18.05) per plant was found at 8-Feb. & 12-May planting dates and was statistically similar to the 12-April & 11-Oct. planting dates.

The Interactive Effects on the Growth Parameters Across the Season of Planting

The analysis of variance (Table 2; Table 3; Table 4) indicates that the main interactive effect (planting date and fertilizer) had a significant influence on the leaf number. Plant height and branch number of the crop. The significant effects were more pronounced on the interaction of varieties and fertilizer for both planting seasons except at 2WAT. The interaction of the varieties and the planting dates were also significant ($P < 0.05$). Application of different fertilizer at different planting date significantly influences the performance of the green pepper cultivars. The finding confirms the observation of Edossa Etisa et al. (2013) on the influence of N and P fertilizer and difference planting dates. Spacing and fertilizer applications had been observed as some of the factors that affect growth development of a crop.

Hamman et al. (2012) and Islam et al. (2010b) reported that optimum sowing dates and fertilizer application to crop ensure proper growth, development and maximize crop yield. Fertilizer and planting date interaction as well as the variety versus fertilizer and planting date were not significant ($P < 0.05$) under irrigation except at 10WAT while rainfed cropping had a significant effect. This can be related to the influence of climate condition under irrigation. Interactive effects of varieties and fertilizer; fertilizer and planting date were significant ($P < 0.05$) except at 4WAT, fertilizer and planting date were significant with the exception of 2, 4 and 10 WAT.

Interaction treatment effect were noted to be significant for branched number under rainfed, variety and fertilizer varieties and planting date were significant ($P < 0.05$) while fertilizer and planting date; Variety x Fertilizer x planting date were not significant.

Effects of Planting Date and Fertilizer Application on the Yield and Yield Component of Green Pepper Varieties

The effects of planting date and fertilizer application on green pepper Yield and Yield Component (Table 5) were not significant with respect to the number of days to flowering, numerically, the highest numbers of days to first flowering (48.92 and 48.78 days) were recorded with California Wonder and Tattasai Dan-Garko respectively. Significant differences ($P < 0.05$) were noted among fertilizer types applied on days to 50% flowering. ORF took the longest days to 50% flowering (50.07 days), while it was shortest at control (48.73 days), this may be due to more availability of nitrogen that are released slowly and encouraged production of more biomass than at the time of flowering. A similar result was obtained from tomato cited in Sheresh Ghimere et al. (2013). Days to 50% flowering was found to be significant in irrigation production though with a similar statistical values while it was not significant for rainfed production, however, the 22-April planting date recorded the shortest day to flowering. The days to flowering were numerically similar because it is majorly determined by the genetic composition of the green pepper cultivars which could only be influenced by the environmental factors (Sagar Koner et al., 2015). The interactive effects of varieties and fertilizer were significant while other treatment factors were not significant.
Table 2 Effect of Fertilizer Application and Planting Date on Plant Height of the Green Pepper

| PARAMETERS          | Irrigated       | Rainfed         |
|---------------------|-----------------|-----------------|
|                     | WAT 2   | 4   | 6   | 8   | 10  | 12  | 2   | 4   | 6   | 8   | 10  | 12  |
| California Wonder   | 16.8a   | 23.5a| 33.1b| 46.7a| 51.1a| 69.6a| 19.7b| 31.7a| 46.2a| 66.3a| 66.7a| 74.6a|
| Tattasai Dan-Garko  | 14.6b   | 24.6a| 34.4a| 47.3a| 52.5a| 67.9a| 20.8a| 37.8b| 68.6b| 62.1b| 67.3b| 71.7b|
| FERTILIZERS        |         |     |     |     |     |     |     |     |     |     |     |     |
| Organ-mineral       | 18.4a   | 25.5a| 37.4a| 47.1a| 59.6a| 68.5a| 21.1a| 33.9a| 47.4a| 67.6a| 69.9a| 71.5a|
| organic             | 17.4ab  | 23.3b| 35.5b| 40.9b| 49.7b| 67.6a| 29.3b| 31.1b| 44.8ab| 66.9a| 66.2ab| 70.6b|
| urea                | 15.9bc  | 27.0c| 31.7c| 38.1c| 41.6c| 47.5b| 23.2c| 29.3bc| 42.8bc| 64.7a| 62.7bc| 64.5c|
| control             | 5.0c    | 22.2d| 27.1d| 33.9d| 36.9d| 41.0c| 18.4d| 27.9c| 31.2c| 53.8b| 58.9b| 61.1d|
| PLANTING DATE       |         |     |     |     |     |     |     |     |     |     |     |     |
| PD1                 | 15.0c   | 23.5d| 30.4d| 41.8b| 50.8d| 65.3b| 26.7d| 32.5b| 48.9c| 60.5c| 65.8c| 66.3c|
| PD2                 | 15.1bc  | 25.6c| 34.9c| 42.8a| 51.3c| 62.3d| 29.9c| 39.2bc| 52.6bc| 63.7b| 64.3c| 65.3b|
| PD3                 | 17.4ab  | 25.7b| 37.5b| 45.4d| 57.3b| 63.4c| 31.5b| 42.7a| 55.7ab| 66.14b| 67.4b| 68.5a|
| PD4                 | 18.3a   | 28.8a| 38.9a| 49.8c| 57.8a| 64.0a| 34.8a| 42.9a| 59.1a| 68.7a| 69.6a| 68.6a|
| interaction         |         |     |     |     |     |     |     |     |     |     |     |     |
| Var+Fertilizer      | ns      | *   | *   | *   | *   | *   | *   | *   | *   | *   | *   | *   |
| Var+planting date   | ns      | *   | *   | *   | *   | *   | *   | *   | *   | *   | *   | *   |
| Fert+planting date  | ns      | ns  | ns  | ns  | *   | ns  | **  | ns  | *   | *   | ns  | *   |
| Var+Fert+planting date | ns  | ns  | ns  | ns  | ns  | ns  | *   | ns  | *   | *   | ns  | *   |

Note: Means with similar alphabet along the column and within same treatment are not significantly different p< 0.05 (DMRT) * significant; **significant at p<0.01, WAT Weeks after transplanting; Irrigated planting date for PD1-22Sept.; PD2-01Oct.; PD3-11Oct.; PD4-23Oct. and Rainfed planting date PD1-22April; PD2-29April; PD3-05May and PD4-12May
Table 3 Effects of Fertilizer Application and Planting Date on Leaf Number of the Green Pepper

| WAT     | Rainfed | Irrigation |
|---------|---------|------------|
|         | 2       | 4          | 6       | 8       | 10      | 12      | 2       | 4       | 6       | 8       | 10      | 12      |
| VARIETIES |        |            |         |         |         |         |         |         |         |         |         |         |
| California Wonder | 13.4a  | 60.9a      | 89.6a   | 98.2a   | 101.5a  | 96.7a   | 18.52a  | 61.68a  | 94.6a   | 98.65a  | 102.9a  | 105.3a  |
| Tattasai Dan-Garko | 14.3a  | 55.5b      | 82.3b   | 92.8b   | 105.8b  | 94.9a   | 19.94b  | 60.77b  | 94.03b  | 96.84b  | 107.4b  | 106.2a  |
| FERTILIZERS |        |            |         |         |         |         |         |         |         |         |         |         |
| Organ-mineral | 16.2   | 66.3a      | 82.3a   | 93.9a   | 116.3a  | 108.5a  | 18.53a  | 74.99a  | 97.16b  | 99.97a  | 102.6a  | 116.7a  |
| organic | 16.1   | 65.7a      | 85.4a   | 92.0a   | 110.7b  | 104.7ab | 17.1b   | 75.58a  | 95.69a  | 98.73b  | 109.7b  | 116.66b |
| urea    | 13.9   | 65.2a      | 79.0b   | 86.8b   | 103.74c | 94.8bc  | 14.21c  | 71.91b  | 94.25b  | 95.7c   | 97.1c   | 106.5c  |
| control | 12.3   | 55.1b      | 62.4c   | 71.1c   | 96.0d   | 89.9c   | 10.61d  | 63.37b  | 77.17c  | 85.68d  | 87.2d   | 92.5d   |
| PLANTING DATE |       |            |         |         |         |         |         |         |         |         |         |         |
| PD1     | 12.1   | 62.7b      | 79.3c   | 94.3d   | 95.5d   | 78.2d   | 13.83d  | 64.99c  | 93.72b  | 94.54d  | 103.6d  | 96.8d   |
| PD2     | 14.2   | 63.9b      | 83.5b   | 94.9c   | 99.8c   | 100.0c  | 16.23c  | 66.33c  | 96.44abc | 98.56c  | 103.8bc | 102.0c  |
| PD3     | 15.3   | 66.7a      | 85.0a   | 95.8b   | 98.9b   | 112.8b  | 70.61b  | 95.19ab | 96.87b  | 118.3c  | 117.8b  |
| PD4     | 16.9   | 68.8a      | 89.4a   | 97.8a   | 102.7a  | 120.5a  | 19.66a  | 73.92a  | 94.93a  | 96.1a   | 129.3a  | 128.0a  |
| Interaction |       |            |         |         |         |         |         |         |         |         |         |         |
| Varieties*fertilizer | ns     | *          | *       | *       | *       | *       | *       | *       | *       | *       | *       |
| Varieties*planting dates. | ns     | *          | *       | *       | *       | *       | ns      | *       | *       | *       | *       |
| Fertilizer*planting dates | ns     | *          | *       | *       | *       | *       | ns      | *       | *       | *       | ns      |
| Var*fert*planting date | ns     | *          | *       | *       | *       | *       | ns      | ns      | ns      | ns      | *       |

Note: Means with similar alphabet along the column and within same treatment are not significantly different p< 0.05 (DMRT) * significant; **significant at p<0.01; WAT Weeks after transplanting; Irrigated planting date for PD1 - 22Sept.; PD2 - 01Oct.; PD3 - 11Oct.; PD4 - 23Oct. and Rainfed planting date PD1 - 22April; PD2 - 29April; PD3 - 05May and PD4 - 12May
Table 4 Effect of Fertilizer Application and Planting Date on Branch Number of the Green Pepper

| PARAMETERS | Irrigation | Rainfed |
|------------|------------|---------|
|            | 4          | 6       | 8     | 10       | 4         | 6       | 8     | 10       |
| VARITIES   |            |         |       |          |           |         |       |          |
| California Wonder | 2.4a  | 9.3a | 11.4a | 12.27a | 2.8a | 9.3a | 20.49a | 20.86a |
| Tattasai Dan-Garko  | 2.4a  | 8.6a | 10.1a | 12.84a | 2.7b | 9.2a | 19.95b | 20.94a |
| FERTILIZERS |            |         |       |          |           |         |       |          |
| organomineral | 2.2a | 8.2a | 14.4a | 15.48a | 2.4a | 9.2a | 19.99a | 20.18a |
| organic    | 1.9a | 8.4a | 13.4b | 14.69b | 2.2b | 9.4b | 18.12b | 20.85a |
| urea       | 1.5b | 7.8b | 12.6c | 14.03c | 1.8c | 9.6c | 16.47d | 19.61b |
| control    | 1.1c | 6.0c | 7.7d | 9.96d | 1.8d | 8.9d | 12.96c | 14.39c |
| PLANTING DATE |         |         |       |          |           |         |       |          |
| PD1        | 1.2c | 8.0c | 9.7d | 11.94c | 1.9d | 9.9c | 12.7d | 18.05c |
| PD2        | 1.5b | 8.8b | 11.0c | 12.08b | 2.1c | 9.5d | 12.91c | 18.73d |
| PD3        | 1.6b | 9.4a | 12.4b | 13.77b | 2.1b | 10.44a | 16.55b | 20.63b |
| PD4        | 2.5a | 9.3a | 13.7a | 16.34a | 2.2a | 10.33b | 17.38a | 21.62a |
| interactions | *   | *    | *    | *    | *    | *    | *    | *    |
| varieties*fertilizer | *   | *    | *    | *    | *    | *    | *    | *    |
| varieties*planting dates | *   | *    | *    | *    | *    | *    | *    | *    |
| fertilizer*planting dates | ns  | ns   | ns   | ns   | *    | *    | *    | *    |
| varieties*fert.*planting date | ns  | ns   | ns   | ns   | *    | *    | *    | *    |

Note: Means with similar alphabet along the column and within same treatment are not significantly different p< 0.05 (DMRT) * significant;**significant at p<0.01, WAT Weeks after transplanting. Irrigated planting date for PD1-22Sept.; PD2-01Oct.; PD3-11Oct; PD4-23Oct. and Rainfed planting date PD1-22April; PD2-29Apr; PD3 -05May and PD4-12May
Fruit Number, Fruit Weight (Dry and Wet)
The green pepper variety (Table 5) shows that fruit dry weight for both seasons were not significantly different. Fruit number showed an overlap numerical value though similar but slightly differs and the fruit-wet weights were significantly different. The control showed a significant difference (P < 0.05) in the number of fruits, fruit weight (wet & dry) to Urea. organomineral fertilizer had a superior performance, significantly different to organic fertilizer, however there was an overlap. This agrees with the findings of Agele (2001), Adekiya and Agbede (2009) and NingJian Feng et al. (2010) who found that increase in organic N-source organic matter resulted in better growth and yield of Tomato. The fruit weight per plant showed no significant difference among the planting date (Table 5), the planting date had similar numerical value but was not significant for both season. This might be due to genetic composition of the green pepper varieties Sagar Koner et al. (2015)

Fruit Number, Fruit Weight (Dry & Wet) and Harvested Weight
California wonder variety (Table 5) recorded a better performance in yield, a higher numerical value for fruit number and weight and not significantly different from the values obtained from Tassasai Dan-Garko. A significant variation was observed between the varieties showing California wonder to produce the highest fruit number and harvested weight. (43.2 and 3221 kg/ha) for irrigation and (49.81 and 3229.85 kg/ha) for the rainfed. organomineral fertilizer application recorded the highest fruit number and harvested weight (60 and 3535 kg) closely followed by ORF (56.6 and 2976 kg) for irrigation and (68.58 & 2935 kg) for rainfed. The least numerical value was recorded from the control in both seasons. This may be due to availability of N2 sources from the organic and organo-mineral fertilizers to the plant. Shuresh et al. (2013), Agele (2001) cited in Saidu et al. (2012) reported that increase in concentration of N resulted in better growth and yield of tomato. Planting date had a significant influence (P < 0.05) on the number of fruit per plant (Table 5). The highest mean fruit number (72.5) was recorded from 2-May planting date and the minimum fruit number was recorded from 2-April planting date for irrigation and the harvested weight (dry & wet) followed the same pattern, Significant differences (P < 0.05) were noted for the fruit number, fruit weight and harvested weight in rainfed cropping. 23-Oct. planting date recorded the highest value and the 2-April planting date produced the least value. This was as a result of the climatic condition during the planting period. 2-May and 23-Oct. planting dates received favourable environment for growth and this produced the highest value. The report of Oladita and Akinseye (2014), and Agele (2014) on the effect of climate variability on tomato production confirms that the nutrient in the soil and fertilizer applied were released to both soil and plant and with the presence of moisture enhanced the growth and yield of crops. Interactive effect of variety and fertilizer types as well as variety and planting date interaction were significant on the fruit number and harvested fruit weight for both seasons.

The varieties showed a significant influence on shoot dry weight and the harvest index (HI) under irrigation but not significant in rainfed condition. Fertilizer application had no significant influence on the HI however, significant effects was noted for control plots. Fertilizer application affected shoot weight of the green pepper varieties, organomineral fertilizer produced the highest shoot weight, closely followed by organic fertilizer while the control recorded the least value under rainfed. The ORF recorded the maximum value which was significantly different from organomineral fertilizer value, control recorded the least. This may be due to the influence of source of N and the period of release for plant use. This supports the findings of Edossa et al. (2013) on the growth and yield of tomato as influenced by N and P fertilizer. The interaction of treatment factors was not significant with respect to shoot weight under irrigation while it was significant in rainfed cropping. HI was significant in both planting seasons.
Table 5 Effect of Fertilizer Application and Planting Date on Yield and Yield Parameters of the Green Pepper

| Parameter                  | Irrigated 50% Flowering | Irrigated Fruit wt. (g) | Irrigated Fruit no./M² | Irrigated Harv. wt. (kg/ha) | Irrigated Shoot dry wt. (g) | Irrigated Dry wt. (g) | Irrigated HI | Rainfed 50% Flowering | Rainfed Fruit wt. (g) | Rainfed Fruit no./M² | Rainfed Harv. wt. (kg/ha) | Rainfed Shoot Dry wt. (g) | Rainfed Dry wt. (g) | Rainfed HI | Rainfed Fruit wt. (g). |
|----------------------------|--------------------------|-------------------------|------------------------|----------------------------|----------------------------|------------------------|---------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---------------|------------------------|
| VARIETY                    |                          |                         |                        |                            |                            |                        |               |                        |                        |                        |                        |                        |                        |               |                        |
| California Wonder          | 48.9a                    | 4.4a                    | 43.2a                  | 3221.4a                    | 29.6a                      | 0.05a                  | 29.9a         | 48.6a                  | 5.9a                   | 49.8a                  | 3229.8a                | 20.4a                    | 0.1a                    | 31.9a                    |
| Tattasai Dan-Garko         | 48.8ab                   | 3.9a                    | 46.9a                  | 2976.7b                    | 27.9b                      | 0.03b                  | 26.5b         | 48.4a                  | 5.9a                   | 46.7ab                 | 2985.2b                | 21.0a                    | 0.1a                    | 27.5b                    |
| OGM                        | 49.8b                    | 6.5a                    | 60a                    | 3527.5a                    | 32.9a                      | 0.05a                  | 73.3a         | 50.5b                  | 7.7a                   | 72.9a                  | 3535.9a                | 25.4b                    | 0.1a                    | 77.3a                    |
| ORG                        | 50.1a                    | 5.8b                    | 56.6b                  | 2926.7b                    | 29.9b                      | 0.05a                  | 63.5b         | 50.7a                  | 6.8b                   | 68.5b                  | 2935.2b                | 25.5a                    | 0.12a                   | 70.5b                    |
| UREA                       | 47.6d                    | 5.6b                    | 59.9b                  | 2070.3c                    | 29.0b                      | 0.05a                  | 40.9c         | 49.2d                  | 5.9c                   | 55.1c                  | 2078.8c                | 23.1c                    | 0.11a                   | 62.9c                    |
| Control                    | 48.2c                    | 4.8c                    | 55.5c                  | 1120d                      | 26.7c                      | 0.04c                  | 28.8d         | 47.9c                  | 4.9d                   | 53.3d                  | 1128.5d                | 21.4d                    | 0.1b                    | 48.8d                    |
| PD1                        | 48.6b                    | 5.6a                    | 38.7c                  | 2349.9d                    | 28.3c                      | 0.02d                  | 37.3d         | 48.8b                  | 5.9a                   | 57.6c                  | 2358.4d                | 26.5a                    | 0.08d                   | 39.9d                    |
| PD2                        | 48.6b                    | 5.7a                    | 45.6b                  | 2398.9e                    | 28.5bc                     | 0.03c                  | 42.2c         | 48.8a                  | 5.9a                   | 58.2bc                 | 2407.6c                | 24.5b                    | 0.09c                   | 48.2c                    |
| PD3                        | 48.7b                    | 5.8a                    | 53.4a                  | 2423.4b                    | 30.2ab                     | 0.06b                  | 52.3b         | 49.9a                  | 6.1a                   | 58.3ab                 | 2431.8b                | 22.8c                    | 0.12b                   | 63.3b                    |
| PD4                        | 48.7a                    | 5.6a                    | 55.5a                  | 2472.3a                    | 31.7a                      | 0.09a                  | 71.1a         | 49.8a                  | 6.6a                   | 59.6a                  | 2480.8a                | 21.7d                    | 0.15a                   | 76.1a                    |

interaction

|                      | Var*Fert                | Fert*PD                | Var*PD                |              |              |              |              |              |              |              |              |              |              |              |              |
|----------------------|--------------------------|------------------------|------------------------|              |              |              |              |              |              |              |              |              |              |              |              |
| VARIETY              |                          |                        |                        |              |              |              |              |              |              |              |              |              |              |              |              |
| California Wonder    | *                        | *                      | *                      | *            |              |              |              |              |              |              |              |              |              |              |              |
| Tattasai Dan-Garko   | *                        | *                      | *                      | *            |              |              |              |              |              |              |              |              |              |              |              |
| OGM                  | *                        | *                      | *                      | ns           |              |              |              |              |              |              |              |              |              |              |              |
| ORG                  | *                        | *                      | *                      | *            | ns           |              |              |              |              |              |              |              |              |              |              |
| UREA                 | *                        | *                      | *                      | ns           | ns           |              |              |              |              |              |              |              |              |              |              |
| Control              | *                        | *                      | *                      | *            | ns           |              |              |              |              |              |              |              |              |              |              |
| PD1                  | *                        | *                      | *                      | *            | ns           |              |              |              |              |              |              |              |              |              |              |
| PD2                  | *                        | *                      | *                      | *            | *            |              |              |              |              |              |              |              |              |              |              |
| PD3                  | *                        | *                      | *                      | ns           | ns           |              |              |              |              |              |              |              |              |              |              |
| PD4                  | *                        | *                      | *                      | *            | *            |              |              |              |              |              |              |              |              |              |              |

Note: Means with similar alphabet along the column and within same treatment are not significantly different p< 0.05 (DMRT) * significant; **significant at p<0.01. WAT Weeks after transplanting. Irrigated planting date for PD1-22Sept; PD2 -01Oct; PD3-11Oct; PD4-23Oct. and Rainfed planting date PD1-22April; PD2-29April; PD3 -05May and PD4-12May.
4 Conclusion

The study indicated that application of N fertilizer enhances the growth and yield characteristics of green pepper in both cropping season. However, the use of OGM appears to favour the production of biomass and yield, hence enhanced productivity. The use of OGM can replace the use of chemical fertilizer. It is evident from the result that proper monitoring of the planting date, rainfall onset of rainfall or availability of supplementary or full irrigation and adequate application of fertilizer will produced the maximum yield and availability throughout the year.

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