Effect of Radial Spacing on the Growth and Yield of Maize under Olla Irrigation

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Abstract- This research was carried out in Federal College of Forestry Jos, during the 2015/2016 cropping season, to determine the Effect of radial spacing on growth and yield of Maize (Zea mays L.) under Olla irrigation. The experiment consisted of four (4) treatment each replicated three (3) times in randomized complete block design (RCBD) .The parameters assessed were plant height, stem diameter, leaf count and grain yield. The spacing of 25x10cm (T_1) gave the highest plant height followed by 25x20cm (T_2) and 25x30cm (T_3), while 25x40cm (T_4) had the lowest. The spacing distance of 25x10cm recorded the highest stem diameter of 7.50cm while 25x40cm had the least value of 5.77cm.The same pattern was observed for the leaf count with highest value of 8.33cm for treatment one (T_1), while T_4 recorded the lowest value of 15.67cm respectively. The Grain yield ranged from 2.20- 12.22t/ha for treatment considered recorded under Treatment. The analysis of variance revealed significant difference ($p<0.05$) on the effects of radial distance on plant height and stem diameter. Conversely, no significant difference ($P>0.05$) was recorded for leaf count. When the radial spacing from the Olla Pot was increased from 10 to 20, 30 and 40cm; the corresponding yield reduction values were 33, 58 and 82%. There was no significant difference between grain yield of maize when it was planted at radial spacing of 20 and 30cm, implying that in the study area, planting at radial spacing of 20cm from Olla pot is recommended when a farmer is faced with a limited land spaced for farming, even though the impact on yield may be about 25% if 30cm is used instead of 20cm.

Keywords: Olla irrigation, radial spacing, grain yield, maize.

I. Introduction

On a global scale irrigated agriculture uses about 72% of available fresh water resources (Geerts and Raes, 2009).The rapid increase of the world population coupled with the corresponding demand for extra water by sectors such as industries and municipal, forces the agricultural sector to use its irrigation water more efficiently on the one hand and to produce more food on the other hand (Oiganji, 2016). This global water crisis has drawn worldwide attention to urgency of achieving a more efficient use of water resource(Andarzian *et al.,* 2011).

Water is the major threat to food security in Nigeria especially during the dry season; the dams located in different part of the country which are suppose to be engaged during the dry season are left redundant, and there are less water harvesting structures within the country which are suppose to be used during the rainy season to harvest water; the price of food in Nigeria is gradually beyond the reach of the poor, so there is need to uplift the incomes of users of rural land and water resources on a sustainable basis.

Drip is considered the 'choice' for water conservation but is ill suited for remote areas with low technology, unpressurized and unfiltered water systems. Drip systems are easily vandalized and repairs could be costly; the emitters are also easily blocked with sediment, salt, and several insect species. Olla irrigation system is one of the efficient systems of irrigation known to be more efficient than drip system and suitable for small scale farmers most of whom still use rudimentary hand tools for framing operations (Morrison, 1998).

The olla irrigation technology is a conservation irrigation system, which saves between 59% and 70% of water when compared to the conventional watering-can irrigation system. The clay pots can be made with locally available materials without pressurized filter (Morrison, 1998).Clay vessels or olla made from low fire terra cotta clay are porous enough to allow water to pass through them when buried in soil. The rate of water flow varies depending on the soil water potential and by the plants' uptake of water through their roots(Kirda C. 2002).

The water seepage is regulated by the water needs of any nearby plant. When the plant's water demands have been fulfilled and the soil is moist, the water seepage from the clay pot will stop. This process occurs at atmospheric pressure and requires no timers or pressure regulators to maintain soil moisture at near field capacity. The water seeps out through the walls of the buried clay pot at a rate that is in part determined by the water used by the plant; this auto regulation leads to very high irrigation efficiency. Buried clay pot irrigation allows soil amendments to be placed only where they will benefit the crops not the weeds. The precise water application minimizes weed growth and reduces both the labor requirement for weeding and weed competition with crops for water and nutrients (Morrison, 1998).

Buried clay pots is ideal for farmers and gardeners who are engaged in other income generating activities such as tailoring, trading, and household duties among others. The practice of having to irrigate

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several times a day strips them off the opportunity to undertake these other remunerative ventures (Mofoke, 2006).

Radial spacing for the clay pots depends on the crop and size of the pot, but there is yet to be a specified radial spacing for crops grown under olla irrigation in the study area. There is need to determine the extent to which radial spacing can affect the growth and yield of maize under olla irrigation system. This research work is intended to provide useful information in the terms of radial spacing to farmers of maize under olla irrigation.

II. Materials and Methods

a) Study Area

The experiment was conducted in Federal College of Forestry Jos during 2016 cropping season at the experimental farm, Jos lies at latitude 9°56N, and 8°53E and longitude 9.933°N and 8.833°E in the middle belt within the southern Guinea Savannah ecological zone of Nigeria with a mean annual rainfall of 1260mm (Olowolafe and Dung, 2002).

b) Soil Analysis

Soil sample at 0-15cm depth from study area was taken to Chemical and physical laboratories, Nigerian institute of mining and geo-sciences, Tudun Wada, Jos for analysis. The analysis showed that the soil is sandy loam, pH of 6.30, 0.035% of Nitrogen (N), 2.09% of organic matter (OM), exchangeable bases include 49 ppm of phosphorus (P) 0.1ppm of Na, 1.5ppm of Ca, 0.45ppm of mg, and 20ppm of K, exchangeable acidity 3.5 mMOL/10 of H^+, while the clay, silt and sand were 6.34, 8 and 85.9% respectively.

c) Meteorological Data of the Study Area

The pan evaporation ranged from 5.0 to 49.5mm per day, while relative humidity was fairly stable from September – October, humidity value of 76.52% was recorded in the month of September as the highest and 56% in November as the lowest observed humidity. The highest rainfall value of 14.70mm was observed in September while the lowest rainfall value of 2.20mm was obtained in November. The highest temperature value of 30.49°C was observed in November, while the lowest temperature value of 23.25°C.

d) Experimental Design and Treatments

The experiment consists of four (4) treatments each replicated three (3) times and laid in a randomized complete block design (RCBD), the description of the experiment is as shown in Table 1.

Table 1: Description of treatment

Treatment	Description of treatment
T_1	Intra row spacing of 25cm and radial spacing of 10cm
T_2	Intra row spacing of 25cm and radial spacing of 20cm
T_3	Intra row spacing of 25cm and radial spacing of 30cm
T_4	Intra row spacing of 25cm and radial spacing of 40cm

The study was carried out from 3rd February, 2016 to 3rd March, 2016.The maize variety planted was pod corn, which was obtained from ASTC Kassa in Jos South LGA.The field was prepared manually; a hole was dug about three times as wide and two times as deep as the clay pot. The buried clay pots were placed with the soil mix and gently firm it. The buried clay pot was filled with four (4) liters of water and was watered twice in a day (Morning and evening) every day to keep it from becoming completely dry. The radial spacing was measured using ruler and three seeds were sown per hill and the seedlings thinned to two plants per hill two weeks after emergence, the prepared plots were watered for four days before the maize seeds were sown at intra row spacing of 25cm and radial spacing from 10-40cm. All the treatments were given equal volumes of water and compound fertilizer 15-15-15 (N-P-K) was applied at a rate of 250 kg/ha as side dressing, two weeks after sowing. Top dressing with Sulphate of ammonia, at the rate of 125 kg/ha was applied six weeks after emergence. Four (4) plants were tagged randomly within each plot at 2 WAP (weeks after planting) till eight week when maize had attained full maturity, for the assessment of height (cm), stem girth (cm) and leaves count. The height of the plant (cm) was determined from the above ground level using graduated meter rule. The numbers of leaves per plant were counted to obtain the mean value in each treatment. The harvest was done manually by cutting stems with cutlass respectively. The maize cobs were harvested 90 days after planting, dehusked and further dried until the moisture level of the grains was 14% before yield records were taken. The above ground biomass was harvested to obtain the biomass of each plot using a weighing balance.

The Vegetative and yield data were collected and subjected to statistical analysis of variance and the significance among treatment means was evaluated with Duncan's Multiple Range Test to check significant differences between the treatments (SPSS,2003).

III. Results and Discussion

a) Growth Parameters

i. *Plant Height*

The plant height ranged from 14.90 to 182.67cm. The lowest plant height value of 14.90cm was recorded at 2WAP with radial spacing of 40cm, while the highest plant height value of 182.67cm was recorded at 8WAP with radial spacing of 10cm as shown in Fig.1.There was no significant difference between planting maize with radial distance of 20 and 30cm, throughout the crop growing season, while there was significant difference between plant height of maize planted with radial spacing of 10 and 40cm as shown in Fig 1.However, at 8 WAP there was no significant difference in height among all the treatments under consideration. The plant height obtained in this research was higher than that obtained by Oiganji *et al.*,(2016), variations could be as a result of difference in irrigation method (surface) employed, climate and other agronomic practices.

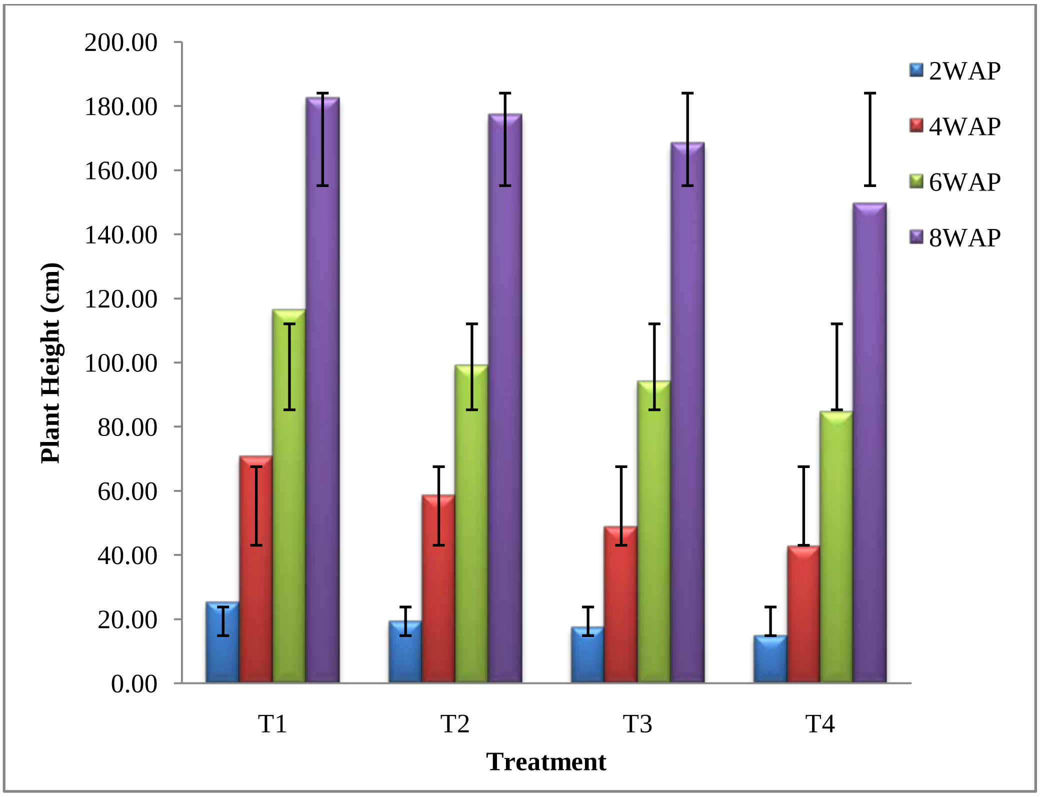

Figure 1: Plant height for period of 8WAP

b) Stem Diameter

Figure 2 shows the stem diameter of the maize crop which ranged from 3.30 - 9.03cm.The highest stem diameter was recorded when maize crop was planted with radial spacing of 10cm from the olla pot at 8WAP, while the lowest stem diameter was obtained with radial spacing of 40cm from the olla pot. The stem diameter at 4 and 8WAP were not significantly different, when maize was planted at 20, 30 and 40cm radial spacing from the olla pot. However, there was significant difference for stem girth at 2, 4, 6 and 8WAP, which indicate that the closer a maize crop is to the Olla pot, the higher the stem diameter.

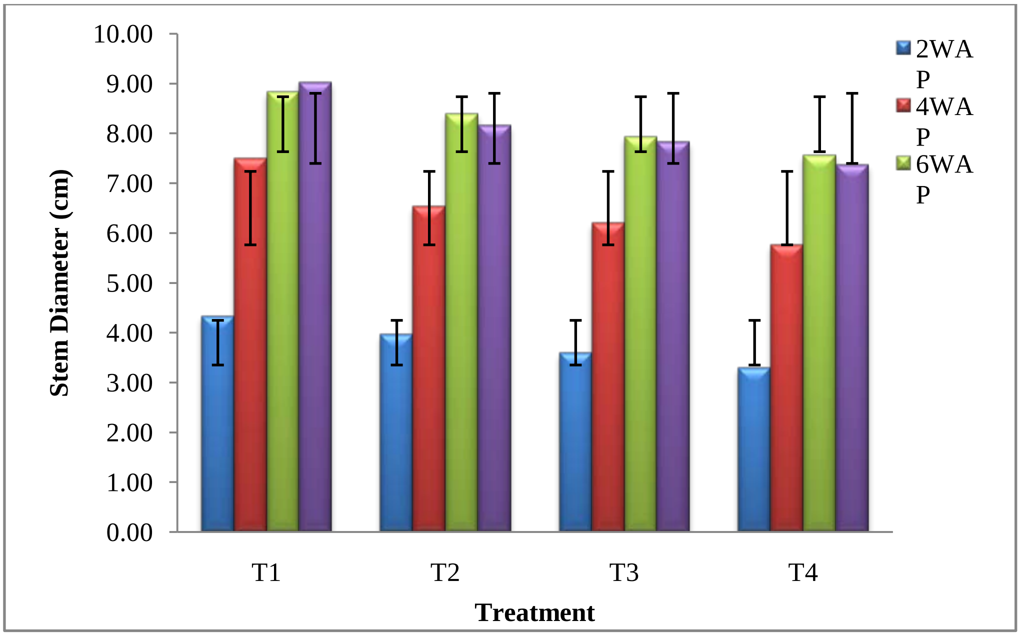

Figure 2: Stem Girth for Period of 8WAP

i. *Leaf Count*

Figure 3 shows the leaf count of the maize crop. The leaf count ranged from 7 - 16.50, the highest leaf count value of 16.50 at 8WAP was recorded when maize was planted at radial spacing of 10cm from the Olla pot, while the lowest leaf count value was recorded when maize was planted at radial spacing of 40cm at 2WAP. However, there was no significant difference on leaf count of maize when planted at different radial spacing from Olla Pot. However, the leaf count obtained in this research was higher than that obtained by Oiganji *et al*.,(2016), variations could be as a result of difference in irrigation method (surface) employed, climate and other agronomic practices.

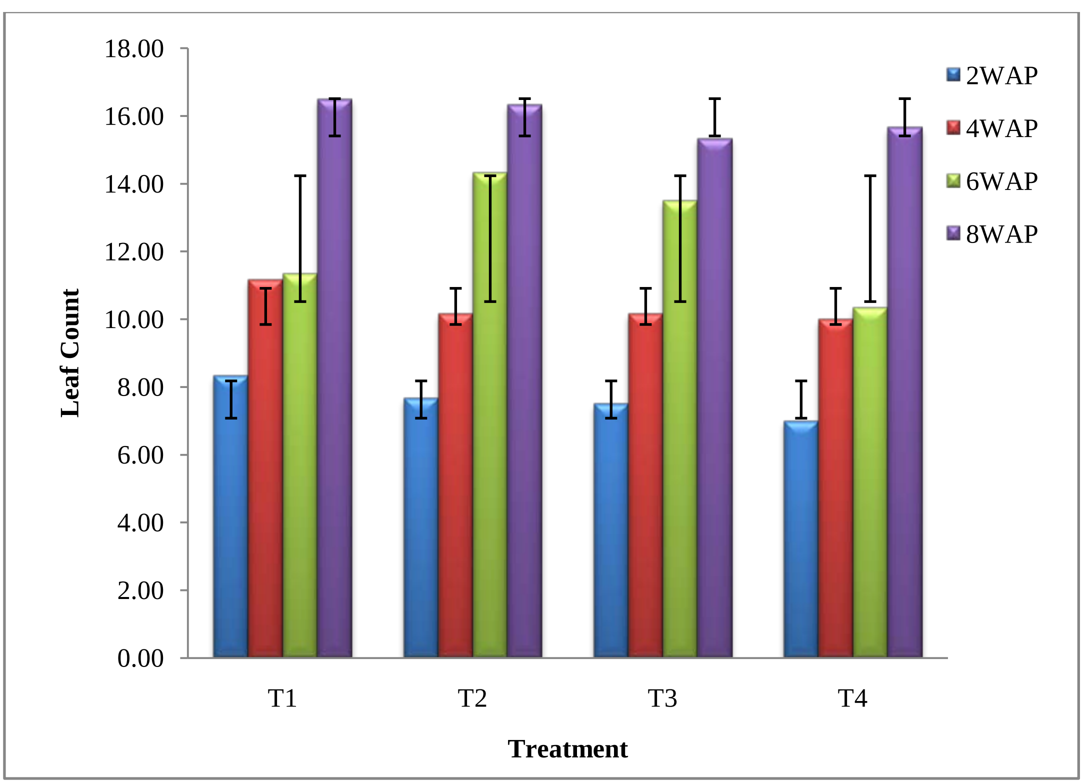

Fig. 3: leaf count for period of 8WAP

ii. *Grain Yield*

The grain yield obtained ranged from 2.20 - 12.22 t/ha as shown in Fig 4. The highest grain yield value of 12.22 t/ha was obtained when maize was planted at a radial spacing of 10cm, while the lowest grain yield value 2.20 t/ha was obtained when maize was planted at a radial spacing of 40cm. When the radial spacing from the Olla Pot was increased from 10 to 20, 30 and 40cm; the corresponding yield reduction values were 33, 58 and 82%.

The grain yield ranges obtained in this study were in consonance with the report of Sefer *et al*. (2011), who obtained range of grain yield ranging from 1.93- 10.4 t/ha under clay loam soil with the use of drip irrigation system in the Eastern Mediterranean climatic conditions of Turkey; Lyocks *et al.,*(2013) who found that grain yield ranged from 2.05- 3.98 t/ha within Samaru region. Garba and Namo (2013) reported grain yield of 3.88 and 3.49 t/ha within two savanna agro-ecologies of Saminaka (lowland)and Vom (mountainous) in Nigeria. Differences in grain and biomass yield reported, may be due to the following: crop variety, extent of irrigation deficit, irrigation method, climate and other agronomic practices.

IV. Conclusion

There was no significant difference between grain yield of maize when it was planted at radial spacing of 20 and 30cm, implying that in the study area, planting at radial spacing of 20cm from Olla pot is recommended when a farmer is faced with a limited land spaced for farming, even though the impact on yield may be about 25% if 30cm is used instead of 20cm.

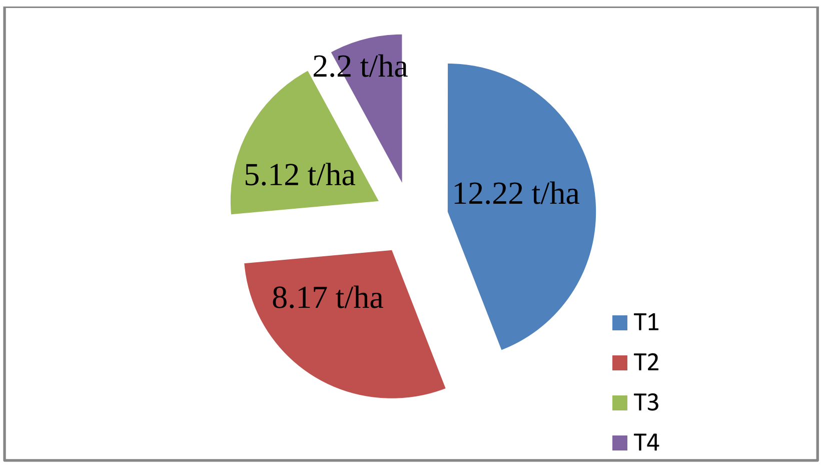

Fig.4: Grain yield of maize in tonnes/hectare

Plate 1: Application of water to the Olla pot during flowering stage (42DAP)

Plate 2: Maize crop during the Grain filling stage (63DAP)

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