*PAT June, 2016; 12 (2): 184-194 ISSN: 0794-5213*

*Online copy available at www.patnsukjournal.net/currentissue*

*Publication of Nasarawa State University, Keffi*

# Economic Evaluation of a Medi-Emitter Drip Irrigated Onion in Jos-North, Plateau- Nigeria

**Oiganji Ezekiel[1], Ahmed Abubakar[2] , A.M Nathaniel[1] and G. B. Deborah[1]**

Department of Crop Production Technology, Federal College of Forestry, P.M.B. 2019 Jos, Plateau State, Nigeria

[2]Department of Soil science, Bauchi State College of Agriculture, Bauchi-Nigeria.

Corresponding author email: ezeganji@gmail.com, +2348061279887

## Abstracts

The use of Medi-emitter gravity drip irrigation systems is gradually gaining popularity in Northern Nigeria. Medical infusion set was used in place of the conventional emitter to provide discharge. In the study reported herein, a field experiments was carried out at the federal college of forestry research Farm during 2016/2017 irrigation season to evaluate the yield response and economic return of a Medi-emitter drip irrigated onion. The field experiment consisted of four treatments replicated three times. The treatments comprises of a control treatment which was given full irrigation (irrigated at 100 % water requirement) and others at 25, 50, and 75% water with respect to water requirement of onion crop in the study area, when water deficit was imposed on the onion crop at 75, 50 and 25% the corresponding yield reductions were 12, 24 and 30% with respect to when 0% deficit was imposed on the onion crop The highest bulb yield value of 32.62 t/ha was obtained when null deficit was imposed on the onion crop, while the lowest bulb yield value of 23.08 t/ha was obtained when 75% deficit of water required was imposed on the crop.The highest revenue, profit and benefit- cost ratio of ₦ 4,893,000; ₦ 3,069,987 and 1.68, respectively were recorded for treatment T1(100%), while the lowest revenue, profit and benefit- cost ratio of ₦ 3,462,000; ₦ 1,652,637 and 0.91, respectively, were recorded for treatment T4 (25%).When the overall economic performances of the Medi-emitter drip irrigated maize at different irrigation level were compared in terms of B/C ratio, T1(100%) treatment resulted in higher per cent of B/C ratio value of 1.68 compared to others. However, in terms of benefit-cost ratio, treatment T4 (25%) is not economically viable a project to carry out by a farmer in the study area since the B/C is less than unity. Furthermore, when there is severe water scarcity farmers should adopt 50% deficit to achieve economically sustainable onion production.

**Keywords:** Medi-emitter, drip irrigation, benefit-cost ratio, bulb yield, Onion

## Introduction

Onion (*Allium cepa*) is a vegetable crop grown almost, all over the world, it is grown mainly for it's bulb, which is used in every home almost daily (Landry, 2007). Onion ranks second in importance after tomatoes among the vegetables in Nigeria, about 2.5 million metric tons are produced per annum with Sokoto State contributing about 60 – 68% of total yield from the months of October to February (FAOSTAT, 2007).

Onion is rarely used as a sole dish or in large quantities, its main use lies in flavouring and seasoning of wide variety of dishes. It's popularity is due to its aromatic volatile oil, which give a cherished flavor to food. As a constituent of a meal, both the green leaves and bulbs can be eaten raw, cooked or flood, or in soups and salads; onion plays an important role as a medical herb in many communities, it is claimed to minimize the risk of high blood pressure and other heart related diseases as an item of world trade (Simestad *et al.*, 2007.

Onion is grown widely during the wet and dry seasons. However, yields are much higher during the dry season because of fewer incidences of pests and diseases (Landry, 2007). Prices of onion tend to increase during the dry season before harvest begins. Although onion has been grown in Nigeria for a long time, yield is still low compared to other regions of the world. The reason for this according to Landry, (2007) is due to water scarcity mainly caused by lack of improved production practices not been made available to the generality of farmers. Among such improved mechanized farming system is drip/micro drip irrigation system.

Demand for onion is increasing as disposable income of the population increases, per capital consumption of onion has remained well above 3kg per annum for several years. The total available supply including imports has been in excess of 145,000metric ton annually. Local production of onion does not meet consumption needs in spite of large increases in production during the past decade. The deficit has been met with imports which required substantial outlays of foreign exchange (FAOSTAT, 2007).

In an effort to find an alternative method of irrigation or irrigating crops with high water demands, in an arid region consideration is given to drip irrigation (Sullivan *et al.*, 2001). Drip irrigation is an adopted mechanized system that saves water and fertilizer by allowing water to drip slowly to the roots of many different plants, either on the soil or directly on the root zone, through a network of valves, pipes, tubing and emitters (shock *et al.,* 2005). Drip irrigation is the slow even application of low pressure water to soil and plants using plastic tubing placed directly at the plant root zone. This method allows very little evaporation or runoff, saves water by directing it more precisely reducing the transmission of pathogens and produces fewer weeds and also reduces the cost of labour and fertilizer application (Sullivan *et al.,* 2001).

The drip irrigation system is highly recommended over other irrigation systems such as the surface, subsurface and sprinkler systems because of the advantages it offers which include: minimization of fertilizer and nutrient loss due to localized application and reduces leaching high efficiency in the application of water, minimize plant diseases by avoiding watering of leaves and fruits and over saturating the root zones and also increases the uniformity of irrigation applications; regrettably, the cost of conventional drip systems deters their adoption by peasant farmers who command the agricultural sector of developing countries (Mofoke *et al.,* 2006).

One of the primary goals in the design of the drip irrigation system is to have the hydraulic balance which ensures uniform discharge. The emitter being an important element of the drip irrigation system requires accurate design to achieve uniform discharge (Shock *et al.,* 2005).

The medical infusion set is used mainly in hospitals and clinics for transfusion purposes but Mofoke*, et al.,* (2006) reported its satisfactory performance as emitter for a continuous-flow drip irrigation. This was adopted as emitter for the drip system reported herein, here after referred to as "Medi emitter", which operates under flow rates best suited for vegetable crops.The complexity of medical infusion set makes it difficult to maintain precision during its production, as a result of changes in temperature, mould damage and non-uniform mixing of raw materials, these are some of the factors affecting Medi-emitter homogeneity.

The medical infusion set is a contrivance that has provision for accurate flow regulation and is widely available in almost all human communities at a cost price of about ₦100 per unit, it has a valve, backflow preventer, pressure regulator filter, tubing adapter, drip tubing and the outlet (emitter), was used to replace the conventional emitter, the device is considered affordable by farmers. These qualities accord the infusion set the potential to be adapted as a cheap constant discharge emitter for low cost drip irrigation system (Mofoke *et al.*, 2006).

Benefit- cost ratio (BCR) is an indicator used in the attempts to summarize the overall value for money of a project or proposal to know the net return from an investment after deducting all expenses from the gross income by investment will be used for the experiment (Oiganji, 2016).

The economic benefits derivable with the use of infusion set under the present condition of Nigeria, is timely, research results on appropriate ways and method of using limited water for irrigation is an important content for farmers at even household level, basic knowledge such as "what to produce, how to produce, how much to irrigate, when to irrigate and drip system optimum for small holders farmers can be answered (Mofoke *et al.,* 2006). The objective of the study therefore, is to determine the economic evaluation of the drip irrigated onion to judge the financial worthiness and its payback period.

## MATERIALS AND METHODS

### Study Area

The experiment was conducted in Federal College of Forestry Jos, during dry cropping season. Jos is located on latitude $9.56^0$N and $8.53^0$E and longitude $9.933^0$N and $8.833^0$E in the middle belt of Nigeria with a mean annual rainfall of 1260mm and altitude of about 180metres above mean sea level. The area lies within the southern guinea savannah ecological zone of Nigeria with temperature range between $10^0$c and $32^0$c depending on the season of the year (Olowolafe and Dung, 2004).

### 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.

### Experimental Field and Medi-emitter Drip Setup

The experimental field was 0.005ha as shown in Plate 1; the field was divided into plot sizes of 2.7m by 0.6m each. The plots consisted of four drip lines with 10cm Medi-emitter spacing, Medi-emitter was 20cm long, while each plot was 0.5m apart. A set of Medi-emitter drip system covering an area of $46m^2$ with lateral length of 2.4m and sub-main length of 2.7m was used in the study. The drip system consisted of four junctions along the sub-main length ($T_1$ to $T_4$). Each junction had a lateral connected to it, giving a total of four laterals, which was replicated three times to give a total of 12 laterals, each lateral had twenty four (24) evenly spaced Medi-emitters, giving a total of 288 Medi-emitters in the whole system.

The experiment consisted of four (4) treatments replicated three times and load in a randomized complete block design (RCBD), carried out on an onion crop cultivated under Medi-emitter gravity drip system, water doses applied were according to water requirement of onion crop. The treatments description is shown in Table 1.

**Table 1:Treatment Description**

| Treatment | Description |
|---|---|
| $T_1$ | 100% Daily water requirement |
| $T_2$ | 75% Daily water requirement |
| $T_3$ | 50% Daily water requirement |
| $T_4$ | 25% Daily water requirement |

**Plate 1: Experimental field layout**

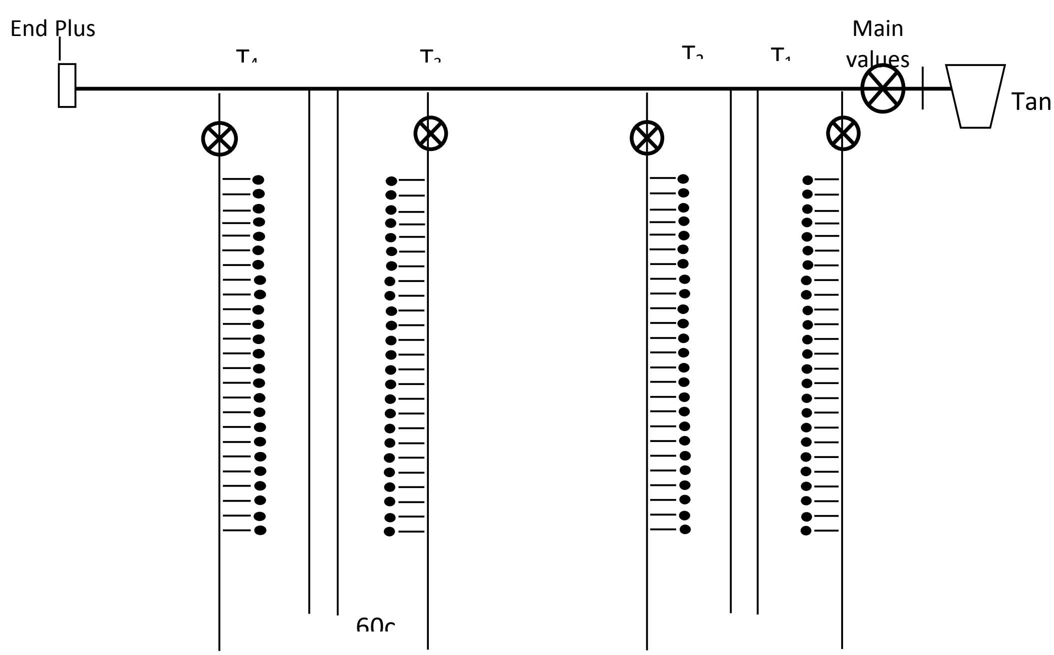


**Figure 1: Experimental Layout**

**Agronomy Practices**

An onion nursery of 3m x 3m was raised on 2nd December, 2016. The bed was well tilled and rows of 15cm-20cm were marked out along the bed. Then a groove of 1.5cm deep was made along the row and the seeds were treated with Aldrex T. Dust at the rate of 6kg/ha . The groove was then covered lightly with soil; the bed was watered with a watering can with fine rose. The bed was covered with straw until germination after which the straws were removed; the onion variety planted was composite 4. Transplanting was done after 5 – 6 weeks after sowing on the 9th January, 2016, when the seedlings were about 5-7cm high. Spacing between row to row and plant to plant was 60cm, and 10cm respectively, with the root spread carefully in the natural position before pressing the soil around the plant; each treatment plot a total of 24 stands of onion was planted, the experimental plots were irrigated starting from the date of transplanting with equal depth of irrigation water which was applied for four weeks before proposed treatment levels was imposed throughout the growing season. Seed beds were made after the ploughing on which the beds were uniformly irrigated for 3 days. The drip irrigation system was constructed and was set on the experimental field before transplanting of onion seedling from the nursery. Onion seed (allium cepa L.) was planted at the college nursery in a perforated plastic bowl with soil mixture of sharp sand, top soil and manure at the ratio of 5:10:5 should each respectively. The mixed soil was watered and onion seeds were planted on the 7 October 2016. Urea at 200kg/ha and Compound fertilizer was applied at a rate of 60kg/ha of Nitrogen, phosphorus and potassium as recommended by the Food and agricultural organisation. Four (4) plants were tagged randomly within each plot at four (4) WAP (weeks after planting) till twelfth (12) 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.

**Statistical Analysis**

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)**.**

**Evaluation of Economic Performance**

The economic evaluation was analyzed with reference to 1 hectare size of plot, by estimating production costs (fixed and variable cost) per hectare per treatment. The fixed cost considered were cost of the drip irrigation system (low-density polyethylene pipe for main, laterals, control valve, medical infusion set, and other accessories), 80 liter tank container, six (6) nine inches block used as stand for the tank .

The fixed cost (depreciation of farm tools and equipment) was calculated using the straight-line method (Oiganji, 2016), life cycle costing method was used to calculate the costs of production involved in this study. Life cycle costing was done using capital recovery factor (CRF) (Nega, 2009). Capital recovery factor is the uniform series of annual values for depreciation and interest rates over the analysis period that is equivalent to the single present worth value as cited by Oiganji (2016). This factor is calculated by:

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1} \quad (1)$$

Where, i= annual interest rate expressed in decimal, n=number of years in the life cycle, CRF = capital recovery factor

The salvage values were obtained by using a straight-line depreciation method to determine the values which are not fully depreciated at the end of the analysis period. Salvage value assumes a fixed rate till the salvage value is reached expressed as (Oiganji, 2016):

S = life cycle x present worth value (2)

The annual amortization value (AV) as cited by Oiganji (2016) is calculated by:

AV = (PW) (CRF) (2a)

Where:

PW = present worth value

CRF = capital recovery factor

The present worth value (PW) is calculated (Thompsom *et al*., 1980) by:

PW = $s\ (1+i)^{-n}$ (2b)

Where:

S = replacement cost

i= interest rate

n= number of years the cost will be incurred in the future

The annual operating cost includes labour, land preparation, seeds, fertilizers, and water supply, were obtained by direct application of the appropriate percentage values to the initial cost of each component. The tank operation and maintenance cost was fixed at zero, while that of drip kits were fixed at 7% of the initial cost of each (Thompsom *et al*., 1980). The cost of irrigation water was calculated based on the cost of 20 liters of water per irrigation per treatment.

The revenue generated from each treatment was estimated on the basis of marketable bulb yield from 1 hectare farm land for one cropping season. The revenue generated for each treatment was calculated using the current wholesale price (1 tonne = N 30, 000 for onion, while the prevailing interest rate for Agricultural loans in Nigeria was pegged at 8% (www.articlesng.com/federal-government;www.dailytrust.com.ng). Subsequently, the net return for onion at different irrigation levels were calculated, considering total cost (fixed + operating) and gross return ( Imtiyaz *et al*., 2000a).

The total revenue generated was calculated based on the assumption that onion will be cultivated twice in a year during the dry season for a period of 5 years. The total production cost was subtracted from the revenue generated from the maize sale to obtain the profit made in each treatment. The benefit –cost ratio (B/C) was then calculated by dividing the total gross revenue by the total production cost; the annual B/C ratio for a period of 5years was further evaluated. The annual cost for 0.005ha was ₦ 8,298, therefore, the total fixed cost for 1 hectare = ₦ 1,803,913/ha/yr.

The annual operation, maintenance, and repair cost were obtained by direct application of the appropriate percentage values to the initial cost of each component. The tank and stand operation and maintenance cost was fixed at zero, while that of the drip kits was fixed at 7% of the initial cost of each as reported by Deborah, (2017).

## RESULTS AND DISCUSSION

### Leaf Count

Table 2 shows the leaf count of the onion crop for 12 weeks, the leaf count ranged from 6.2 - 16cm, the highest leaf count value of 16cm was obtained at week 11 and 12 when null deficit was applied (100%), while the lowest leaf count value of 6.2cm was obtained at week 4 when 75% deficit of water required by onion crop was imposed (25%).

**Table 2 Leaf Count**

| | Weeks after transplanting (WAT) (cm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| T1 (100%) | 7.4[a] | 8.3[a] | 9.4a | 13.4a | 13.6a | 14.6a | 15.1a | 16.0a | 16.0a |
| T2 (75%) | 6.4ab | 7.4ab | 8.7ab | 12.7a | 12.8ab | 13.4ab | 14.1ab | 15.0ab | 15.4ab |
| T3 (50%) | 6.3b | 7.3ab | 8.3ab | 11.7ab | 11.6b | 12.7b | 13.6b | 14.9ab | 15.0ab |
| T4 (25%) | 6.2b | 6.8b | 8.2b | 11.6b | 11.4b | 11.4b | 12.9b | 14.9ab | 14.3ab |

Means that do not share a letter are significantly different

The result obtained showed that there is no significant difference in the leave count after 8WAT, when 50 and 25% water was applied. Metwally (2011) reported leaf count ranging 5.33- 6.77cm which was within obtained in this research. However, there was no significant difference between treatment T1 (100%) and T2 (75%), which means that applying water 25% less the water requirement for onion crop in the study area will not be different from a situation of null deficit. Thabet *et al.* (1994) indicated that the number of leaves, leaf and bulb dry matter and bulbing ratio were increased by increasing irrigation. El-Haris and Adbel Razek (1997) revealed that growth characteristics, yield and yield components generally improved with the increased in total water applied during growing period.

**Plant Height**

Table 3 shows the plant height 12 weeks after transplant, the plant height ranged from 22.6 - 42.9cm, the highest plant height value of 42.9cm was obtained at week 12, when 100% water was applied with respect to water requirement of onion in the study area, while the lowest plant height value of 22.6 cm was obtained when 25% of water required was imposed on the onion crop.

**Table 3 Plant Height**

| | Weeks after transplanting (WAT) (cm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Treatments | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| T1 (100%) | 26.2a | 30.6a | 35.0a | 37.2a | 39.3a | 41.3a | 41.7a | 42.9a |
| T2 (75%) | 26.0a | 30.1a | 33.8ab | 36.6a | 39.1a | 38.6ab | 39.8a | 41.0a |
| T3 (50%) | 25.3ab | 29.6a | 33.1ab | 35.3a | 37.0ab | 35.3b | 38.9a | 40.2a |
| T4 (25%) | 22.6b | 27.2a | 33.1ab | 34.4b | 36.7ab | 35.2b | 37.5a | 38.9b |

Means that do not share a letter are significantly different.

There was no significant difference between treatment T2 (75%) and T3 (50%) throughout the season, however, there was significant difference between T2 (75%) and T4 (25%) with exception of week 6 and 8, respectively. Bagali *et al.*, (2012) reported plant height ranged from 49.99 - 66.56 cm, which is higher than the values reported herein, discrepancies may be due to variations in agronomic measures, soil, climatic and variety used. Metwally (2011) reported Plant height ranged 40.1 – 53.4cm, which was almost same with the result reported herein. However, El-Oksh *et al.* (1993) reported that plant height, number of leaves, fresh and dry weight increased with increasing soil moisture level.

**Stem Girth**

Stem girth is one of the important growth parameters which indicates vigour of the plant; The stem girth ranged from 1.7- 7.1 cm as shown in Table 4; the highest stem girth value of 7.1cm was obtained at week 12, when 100% water was applied to the onion crop, while the lowest stem girth value of 1.7cm was obtained when 75% deficit was imposed on the onion crop.

**Table 4 Stem Girth**

| | Weeks after transplanting (WAT) (cm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Treatments | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| T1 (100%) | 2.4a | 3.9a | 5.3a | 5.0a | 5.9a | 5.9a | 5.8a | 6.7a | 7.1a |
| T2 (75%) | 2.2a | 3.8ab | 5.2b | 4.9ab | 5.2ab | 5.9a | 5.8a | 6.5ab | 7.0a |
| T3 (50%) | 1.9ab | 3.7ab | 5.2b | 4.9ab | 5.2ab | 5.7ab | 5.7ab | 6.1ab | 6.7ab |
| T4 (25%) | 1.7ab | 3.6b | 4.8c | 4.8b | 5.1b | 5.6ab | 5.4b | 6.0b | 6.6ab |

Means that do not share a letter are significantly different

Bagali *et al.,* (2012) reported stem girth ranged 3.37- 4.49cm, which was still within the ranged reported herein, but Metwally (2011) reported stem girth ranged from1.04 - 1.58 which was below the ranged obtained in this research. However, according to Bagali *et al.,* (2012) increase in the bulb yield is mainly attributed to positive association between yield and yield contributing parameters like bulb weight and size in terms of equatorial and polar diameter of the bulb.

**Yield and Biomass**

The biomass yield obtained ranged from 30.76 – 40.39 t/ha as shown in Table 5, the highest biomass yield value of 40.39 t/ha was obtained when 100% water was applied to the onion crop, while the lowest biomass yield value of 30.76 t/ha was obtained when 25% of water required was applied to the onion crop. Final biomass yield for T1 (50%) and T4 (25%) were not significantly different from each other, but when null deficit and 25% deficit was imposed, the biomass were significantly different from each other. When the 75, 50 and 25% depth of water applied was imposed on the onion crop, the corresponding biomass yield reductions were 9.5, 19.1 and 23.8%, respectively.

**Table 5 Final bulb and biomass yield of onion**

| Treatment | Bulb Yield (t/ha) | Biomass yield (t/ha) |
|---|---|---|
| T1 (100%) | 32.62a | 40.39a |
| T2 (75%) | 28.85ab | 36.54b |
| T3 (50%) | 25.0b | 32.39c |
| T4 (25%) | 23.08b | 30.76c |

Furthermore, the bulb yield obtained ranged from 23.04 – 32.62 t/ha, the highest bulb yield value of 32.62 t/ha was obtained when null deficit was imposed on the onion crop, while the lowest bulb yield value of 23.08 t/ha was obtained when 75% deficit of water required was imposed on the crop. Treatment T1(100%) and T2 (75%) were not significantly different from each other, which implies that in a situation where a farmer is faced with severe water scarcity, 25% deficit imposed on the onion crop will still yield expected return; nevertheless, T3 (50%) and T4 (25%) were not significantly different as shown in Table 5. When water deficit was imposed on the onion crop at 75, 50and 25% the corresponding yield reductions were 12, 24 and 30% with respect to when 0% deficit was imposed on the onion crop.
The bulb yield of onion obtained in this research were within the range of yields obtained in the literature, some are reported herein: Bagali *et al.,* (2012) reported a bulb yield of 38.16 t/ha, while Job *et al.,* (2016) reported bulb yield of 57.60 t/ha; Teferi, (2015) reported a yield of 28t/ha when it was grown under Semi-Arid Condition of Northern Ethiopia. David *et al.,* (2016) reported a yield of 34.4 and 18.9 t/ha when deficit was imposed at 0 and 50%; for a sub surface drip system Patel *et al.,* (2013) reported a yield of 44.4t/ha in India when 100% water required of onion was applied. Ramalan, (2010) reported the following bulb yields 37.20, 31.23, 27.39 and 24.32t/ha under mulched conditions at Melkassa Agricultural Research Centre in the Central Rift Valley of Ethiopia, when 100, 75, 50 and 25% water application depth with respect to ETo was applied. Differences in bulb and biomass yield reported, may be due to the following: crop variety, extent of irrigation deficit, irrigation method, climate and other agronomic practices.

**Effect of Deficit Irrigation on Benefit-Cost Ratio of Medi-emitter Drip Irrigated onion**

Table 6 shows the total production cost, economic returns per treatment per hectare in just a season for 5 years. The highest revenue, profit and benefit- cost ratio of ₦ 4,893,000; ₦ 3,069,987 and 1.68, respectively were recorded for treatment T1(100%) for 5 years, while the lowest revenue, profit and benefit- cost ratio of ₦ 3,462,000; ₦ 1,652,637 and 0.91, respectively, were recorded for treatment T4 (25%) for 5 years as shown in Table 4.5.
When the overall economic performances of the drip irrigated maize at different irrigation level were compared in terms of B/C ratio and total volume of irrigation water used, T1(100%) treatment resulted in higher per cent of B/C ratio value of 1.68 compared to others. However, in terms of benefit-cost ratio, treatment T4 (25%) is not economically viable a project to carry out by a farmer in the study area since the B/C is less than unity.
The results imply that, if a farmer in the study area irrigate with 50% deficit of water required for maize production through out the crop growth stages for 5 years, the total accumulated cost will be less than the total accumulated revenue for 5 years, which is a worth while adventure because the B/C ratio were above unity.

**Conclusion**

Economic return and yield response of Medi-emitter drip irrigated maize was evaluated using field experiments conducted in 2016/2017 irrigation season in Jos, Plateau state-Nigeria. Water deficit at 75% with respect to crop water requirement resulted in severe decrease in yield and net income. However, farmers should adopt deficit at 25 and 50% at most with respect to daily water required for onion crop in the study area using Medi-emitter drip system to achieve economically viable production as an alternative to full irrigation in the study area.

**Table 6 Summary of total production cost, returns on drip irrigated onion per treatment for 5years per hectare**

| Treatment | Water applied (liters) | Cost of water applied (₦) | Cost of Irrigation equipment (₦)[a] | Farm inputs and labour (₦) | Yield per plot (t/ha)[b] | Total cost production (₦) | Revenue (₦) | Profit (₦) | B/C |
|---|---|---|---|---|---|---|---|---|---|
| T1 (100%) | 700 | 14,000 | 1,803,913 | 5,100 | 163.1 | 1,823,013 | 4,893,000 | 3,069,987 | 1.68 |
| T2 (75%) | 525 | 1,050 | 1,803,913 | 5,100 | 144.3 | 1,810,063 | 4,327,500 | 2,517,437 | 1.39 |
| T3 (50%) | 350 | 700 | 1,803,913 | 5,100 | 125.0 | 1,809,713 | 3,750,000 | 1,940,287 | 1.07 |
| T4 (25%) | 175 | 350 | 1,803,913 | 5,100 | 115.4 | 1,809,363 | 3,462,000 | 1,652,637 | 0.91 |

[a]Detail cost breakdowns are reported by Deborah,(2017), [b] Grain yield for a season per hectare for 5years

## REFERENCES


Bagali, A. N.; H. B. Patil, M. B. Guled and R. V. Patil (2012). Effect of scheduling of drip irrigation on growth, yield and water use efficiency of onion (*Allium cepa* L.). *Karnataka J. Agric. Sci.,25 (1) : (116-119)*

David, K. R.; C. E Kipkorir and J. K. Taragon (2016). Effects of deficit Irrigation on yield and quality of onion crop. Journal of Agricultural Science; Vol. 8, No. 3 ISSN 1916-9752

Deborah, G.B (2017) Economic evaluation of a micro drip irrigation system for onion in federal college of forestry Jos**.** unpublished HND project in the department of crop production technology, federal college of forestry Jos

El-Oksh, I.I., A.M. El-Gizawy, M.M.F. Abdallah, A.R.A.G. Mohamed and A.A.G. Abdalla, 1993. Effect of soil moisture and nitrogen fertilizer levels on onion grown in mixture of talfa and sand. Bull. Fac. Agric. Univ. Cairo, 44(1): 145-156

El-Haris, M.K. and R.H. Abdel Razek, 1997. Effect of water quantity on onion yield under sprinkler irrigation. Alex. Jour. of Agric. Res., 42(2): 127-135.

FAO. (2014) Water Development and Management Unit: Crop water Information for Maize FederalGovernment Assistance in Agricultural Finance.www.articlesng.com/federal-government accessed on 21st December, 2015

FAOSTAT, (2007). Food and Agriculture Organization Statistics, FAOSTA www.fao.org/faostat

Imtiyaz M, Mgadla NP, Manase SK, Chendo K, Mothobi EO (2000a). Yield and economic return of Vegetable Crops under variable Irrigation. Irrigation Science19: 87-93

Job, M.; S.R. Bhakar1; P.K. Singh1;G.S. Tiwari; R.K. Sharma; S.S. Lakhawat and D. Sharma (2016) Water Requirement and Soil Moisture Distribution Studies of Drip Irrigated Onion Crop Under Plastic Mulched and Non Mulched Condition. International Journal of Science, Environment and Technology, Vol. 5, No 1, 2016, 176 – 184 ISSN 2278-3687

Landry, J. F (2007). Taxonomic review of the Leekmoth genus aeroepropisis. (Lepidoplera: Aerole piidae) in North America 139 (3) : 319 – 35.

Metwally, A.K. (2011). Effect of Water Supply on Vegetative Growth and Yield Characteristics in Onion (*Allium Cepa* L.) Australian Journal of Basic and Applied Sciences, 5(12): 3016-3023, ISSN 1991-8178

Mofoke, A.L. E, J.K Adewumi and O.J. Mudiare, (2006). Design construction and Evaluation of a continuous flow – drip Irrigation system. Unpublished Ph.D Thesis in Department of Agricultural Engineering ABU Zaria.

Nega, H. (2009) "Effect of deficit irrigation and mulch on water use and yield of drip Irrigated Onion". Unpublished M.sc Thesis. Department of Agricultural Engineering, Ahmadu Bello University, Zaria-Nigeria

Olowolafe, E.A and J. E. Dung (2000). Soils Derived from Biotite Granites on Jos, Plateau, Nigeria: their Nutrients Status and Management for Sustainable Agriculture. Elsevier Science Resources. Pp 234 -238

Oiganji, E. (2016). Development of deficit irrigation scheduling strategies for a maize crop under gravity-drip irrigation system. Unpublished PhD thesis in department of Agricultural Engineering, ABU Zaria.

Patel, N.; T.B.S. Rajput (2013). Effect of deficit irrigation on crop growth, yield and quality of onion in subsurface drip irrigation. International Journal of Plant Production 7 (3) ISSN: 1735-6814

Ramalan, A.A. H. Nega; M. A. Oyebode (2010) Effect of deficit irrigation and mulch on water use and yield of drip irrigated onions. Sustainable Irrigation Management, Technologies and Policies III 39, WIT Transactions on Ecology and the Environment, Vol 134, doi:10.2495/SI100041

Shock C.C, Feibert E.B.G and Saunder L.D (2005). Onion response to drip irrigation intensity and emitter flow rate. Horticulture technology. 391722-1727

Slimestad, R, Fossen, T; Vagen I.M. (2007). "Onions: A source of unique dietary flavonoids". Journal of Agricultural and Food Chemistry. Page No. 55 (25: 10067 – 80.

SPSS, (2003). Sigma Plot for Windows. Ver. 11.5. Chicago, Ill.: SPSS, Incorporated

Sullivan, D.M., B.D. Brown, C.C. Shock. D.A. Horneek, R.G. Stevens, G.Q Peter, and E.B.G. Felbert. (2001). Nutrient Management for sweet Spanish Onion in the pacific Northwest. Pacific Northwest Extension publication PNW 546. 26. Pp.

Teferi Gebremedhin (2015) Effect of Drip and Surface Irrigation Methods on Yield and Water Use Efficiency of Onion (*Allium Cepa L.*) under Semi-AridCondition of Northern Ethiopia. Vol.5, No.14, Journal of Biology, Agriculture and Healthcare

Thabet, E.M., A.A.G. Abdallah and A.R.A.G. Mohamed, 1994. Productivity of onion grown in reclaimed sandy soil using tafla as affected by water supplyand nitrogen levels. Annals of Agric. Sci., 39(1): 337-344. (C.f. Hort. Abst., 65(9): 7885-1995.

Thompson, G.T., L. B. Spies, J.N. Kinder (1980). Farm Resources and System Selection. In: Design and Operation of Farm irrigation Systems. M.E. Jensen (Ed.), number 3 in a series published by American Society of Agricultural Engineers. 2950 Niles Road, St. Joseph, Michigan 49085, USA

www.dailytrust.com.ng: Price of onion in Nigeria 2015, accessed on the 2nd May,2017.