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ORIGINAL RESEARCH ARTICLE

GROWTH PERFORMANCE CHARACTERISTICS OF OKRA *(HIBISCUS ESCULENTUS)* USING IMPROVISED DRIP IRRIGATION SYSTEM

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ABSTRACT

Okra is a common and popular vegetable crop used in Nigeria. Irrigation method has very significant influence on okra *(Hibiscus esculentus)* production. A careful effect of marginal water quality on IDI and control system which were subjected to the same conditions was investigated. An experimental field area of 13.5 m^2 by 6.0 m^2 was properly cleared, stumped, ploughed, harrowed and leveled. High yielding and disease resistant okra variety seeds were carefully selected and planted at a regular interval of 0.6 m. The results of statistical analysis obtained using Completely Randomized Blocked Design (CRBD) ($P<0.05$) revealed that there were significant differences on water application which reflected an increase in some agronomic parameters such as growth, weight, yield and vegetative development of the okra. These selected okra agronomic parameters showed that the okra performed in IDI. Maximum fruit yield of 71.71% and water utilization efficiency of 55.49% was obtained by using IDI system.

1.0 Introduction

Okra *(Hibiscus esculentus)* is indigenous crop which grows throughout the tropics and in some part of the sub-tropic (Modupe 2015). The plant tropically grows to 180cm in height, but some indigenous varieties may grow to 360cm tall, with base stem of 6cm in diameter. The plant produces dark yellow flower that are about 5cm in diameter. The plant is cultivated in tropical, sub-tropical and warm temperate region around the world. (Okunade *et al.*, 2009). In Nigeria, it is among the foremost vegetable crops in term of consumption and production (Puneet and Arun, 2015). Okra is a hot weather crop with optimum soil temperature of 75°F to 90°F. It is tolerant to wide variation in rainfall (Kamran *et al.,* 2012). It will grow well on all types of soil but best performance is obtained on sandy loam soil with high organic matter content and optimum soil pH ranging from 6.0 to 7.0 (Sexena *et al.*, 2013). Okra is propagated by seed; 2-3 seeds are sown at 1-2cm depth per hole with 60cm – 90cm inter row spacing and 30cm along the rows.

Irrigation is the artificial application of water to the soil for the purpose of supplying the essential moisture for plant growth to eliminate moisture deficiency at various stage of plant growth (Michael, 2000). Irrigation is necessary to provide enough water to fill the deficit arising

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from the depletion of soil moisture from combine action exist between two separate phenomena of evaporation and transpiration (Fasina, 2008). Ahmad *et al.,* (2003) reported that the total amount of water that is used each year is utilized for the purpose of irrigation. Water management by irrigation practices are t complement the available water from natural sources such as rainfall, flood, dew and ground water. Therefore, irrigation is needed in most parts of West Africa where there may be a prolonged drought period and mostly where water from natural sources is inadequate for effective crop germination and production. The available lands in the tropical regions need irrigation to improve economic returns from production of crops by more than 100%. (Modupe *et al.,* 2015).

Drip irrigation is the method whereby water is supplied to crop root zone at regulated rate and fertilizer application can be done. It is very importance to carry out a study on the best irrigation system for the production of okra in Nigeria in order to maximize profit and reduce the cost of production. The main concern of productive agriculture is the effective and efficient supply of water and growing demand for crop production. It includes remunerative cropping which needs a systematic study of irrigation problem and method of efficient economic use of water since irrigation potential created and it utilization, and that makes the situation more serious. On the other hand, when it is limited as compound to available water, the aim would be to maximize production per unit of land without watching water. Under irrigated condition, it is usually not possible to grow more than one crop in a year and the yield from a rain-fed crop may hardly be between 1-2 tonnes of food per hectare in dry areas. But irrigation makes it possible to grow more than one crop in a year. Puneet and Arun (2015).

Metin *et al*., (2006) reported that timely irrigation leads to high yield multiple cropping under irrigation farming which assure high crop production. High yield varieties have a high water requirement than ordinary varieties; the potential of Okra varieties can be fully exploited if adequate amount of water is made available. Irrigation is necessary for vegetable (okra) production in Nigeria in order to make the crop available throughout the year.

2.0 Materials and Methods

2.1 Study area and land clearing

Field experiments were located at Teaching and Research Farm of Agricultural and Bio-Environmental Engineering Department, School of Engineering Technology, The Federal Polytechnic, Ado Ekiti, Ekiti State, Nigeria. It is located between Longitude 4^0 5′ and 5^0 45′ East of the Greenwch Meridian and Latitudes 7^0 5′ and 8^0 5′ north of the Equator. It lies South of Kwara and Kogi State, East of Kwara and bounded by Ondo State in the East and in the Kogi State. The plot has a flat topography and the area was chosen for its suitable soil structure, texture, water retention capacity, loamy fertile soil, nearness to water source (well) and availability of power supply to operate the electric water pump. Land preparation involved the use of tractor for ploughing and harrowing to make it suitable for undisturbed, unobstructed free flow of water and good crop management.

2.2 Experimental design and Installation layout

The consumptive water use of okra under Improvised Drip Irrigation system were measured and recorded. These agronomic data collected were analyzed using Completely Randomized Block Design (CRBD) ANOVA method. Total experimental plot of 13.5 m^2 by 6.0 m^2 was used. In drip irrigation system, the two drums 100 litres was placed on the raised platform that serve as water

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reservoir, the main pipe, lateral (PVC) were measured and cut into different sizes with measuring tape and hacksaw respectively. The pipe was connected to the reservoir with a valve, the screen filter was attached, and then a quick coupling elbow was used in the coupling of the main line of the length 450 m. The lateral line of 210 m was fixed on the main line at equal interval from each other.

Typical okra farm planted in row and freshly harvested okra in Plates 1a and 1b below, respectively, and the Installation layout of Improvised Drip Irrigation System in Plate 2

Plate 1a: Typical okra farm planted in a row

Plate 1b: Typical okra freshly fruits

Plate 2: Installation Layout of the IDI system

2.3 Irrigation Design

The purpose of irrigation layout is to transmit information from engineering plans to the irrigation field. This will locate the work and provide such lines and elevations as needed for the development of Improvised Drip Irrigation system. Pictorial details of IDI layout is presented in Plate 3.

Plate 3: Improvised Drip Irrigation system layout

2.4 Planting of okra and data collection

2.4.1 Planting of okra

Before planting of the seeds, the irrigation system was tested by pre irrigation in order to locate and correct any high or low spots which can lead to uneven water supply to the plants. The okra seeds were planted at 0.02 m depth with 0.6 m interval, the weeding was carried out manually on the experimental plot of land. The same treatments and analysis were carried out on the Improvised Drip Irrigation system and control at the same time on the same day to avoid predisposition of the results. The pesticide and NPK fertilizer were applied to control the diseases and increase the quality and quantity of okra yields.

2.4.2 Data collection

The moisture content and soil temperature were measured by means of moisture meter and soil thermometers, respectively from the day of planting to the maturity. The agronomic parameters, height, girth, number of leaves, okra yield, and flowers stage were measured and recorded: using digital weighing balance (± 0.01g). Kamran *et al., (*2012).

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3.0 Results and Discussion

Table 1 showed that the plant height (cm) for the readings after 5, 10, 15, 20, 25, 30, 35 and 40 days showed that there were a significant differences in IDI when compared to control system. The mean plant height after 40 days under IDI and control system were 151.68 and 63.32 cm, respectively Choudhary *et al.,* (2012) (Figure 1). the results obtained for height of okra against DAP and statistical analysis proved that there is significant difference in the methods used with respect to the height of okra for IDI and control (Okunade *et al*, 2009; Choudhary *et al.,* 2012). The mean plant diameter under IDI after 99 days 328.79 and 99.45 cm respectively.

From figure 2 results indicated that there is no significant difference in IDI used with respect to the Stem girth of okra against DAP in control system. (Babar *et al.,* 2008). The increase stem girth (cm) under IDI and control system for the eight reading after 5, 10, 15, 20, 25, 30, 35 and 40 days showed that there was a significant difference in IDI in comparison to control system. (Table 1). The mean plant stem girth after 40 days under IDI and control system were 2.696 and 2.289 cm, respectively as indicated in results by (Metin *et al*., 2006) in the studies of growth of okra fruits.

Figure 3 results showed a linear relationship in IDI when compared to control between number of leave against DAP from the results obtained there is significant differences at 0.05 percent. (Pravukalyan *et al., 2011;* Al-Harbi *et al.,* 2008). The number of leaves (cm) under IDI and control system for the eight reading after 5, 10, 15, 20, 25, 30, 35 and 40 days showed that there was a significant difference in IDI compare to control system. The mean plant height after 40 days under IDI and control system was 936 and 598 cm, respectively as indicated in results by (Alkaff, 2003) in the studies of growth of okra fruits. Therefore, this result show that as the plant growth increased inline plant height and stem diameter as contributed to the conserved soil moisture, seedling emergence, and improved plant growth (Okunade *et al*., 2009).

Figure 4, the results of yield for the eight days after planting showed a significant difference in DAP 5, 10, 15, 20, and 25 days among the irrigation system. However, there were no significant in 30, 35, and 40 days from plant growth under IDI as indicated by (Sexena *et al*., 2013). The mean okra yield performance after 40 days under IDI and control system was 3470 and 292 cm, respectively (Table 1). Based on the results in Figure 4, the analysis carried out proved that there is significant difference in IDI used with respect to the number of okra yield against DAP in control. Therefore, the number of Okra increase based on the amount of rainfall. (Jayapiratha, *et al.,* 2010).

From figure 5 displayed the relationship between the weights of okra against day after harvest, the relationship is linear and there is significant difference in IDI respect of control systems (Danso *et al.,* 2015). The weight of okra production against days after planting (cm) for the eight reading after 5, 10, 15, 20, 25, 30, 35 and 40 days showed that there was a significant difference in IDI compare to control system Ahmad *et al., (*2013). The summation of weight of production after 40 days of planting under IDI and control system was 45.61 and 10.60 kg, respectively (Puneet *et al.,* 2015). Thus growth is not faster under the control system because no treatment was added. This system and results is in line with findings of Ahmad *et al*., (2013).

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Table 1: Growth performance under Improvised Drip Irrigation system (IDI)

DAP	Height of Okra (cm)		Stem girth (mm)		Number of leaves		Okra yield (kg)		Weight of okra (kg)	
	IDI	Control	IDI	Control	IDI	Control	IDI	Control	IDI	Control
5th	6.30	2.10	0.136	0.121	34	15	34	0	1.07	0
10th	12.20	6.30	0.171	0.141	50	30	344	0	5.07	0.84
15th	16.03	5.45	0.254	0.222	68	44	519	30	5.14	1.40
20th	17.49	9.54	0.264	0.330	101	99	415	37	5.20	1.20
25th	20.13	9.55	0.332	0.311	115	99	393	44	6.96	2.72
30th	22.13	9.56	0.394	0.324	201	101	650	72	6.18	1.72
35th	27.00	10.12	0.465	0.412	231	104	528	62	5.55	1.84
40th	30.40	10.70	0.680	0.430	251	106	587	47	10.45	0.88

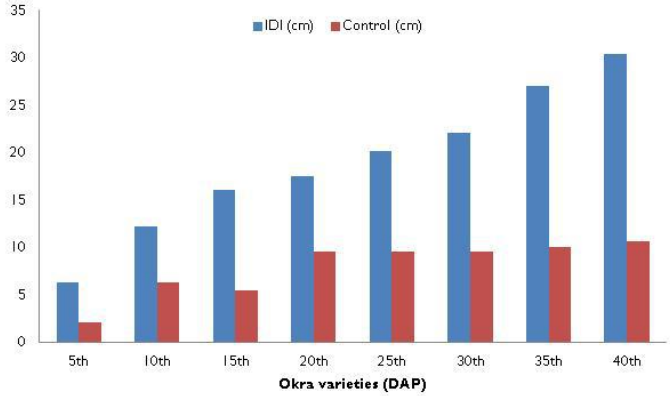

Figure 1: Height of Okra production (cm) against Day after Planting

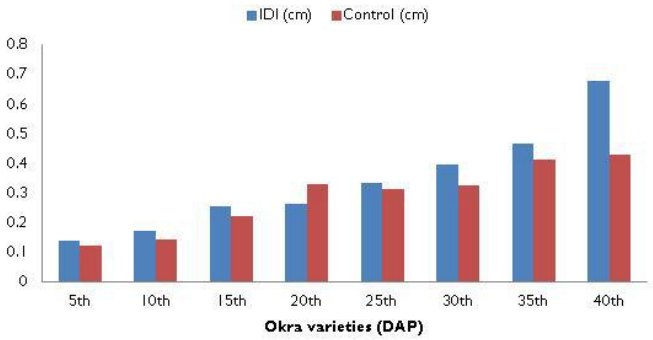

Figure 2: Stem girth of Okra (cm) against Days after Planting (DAP)

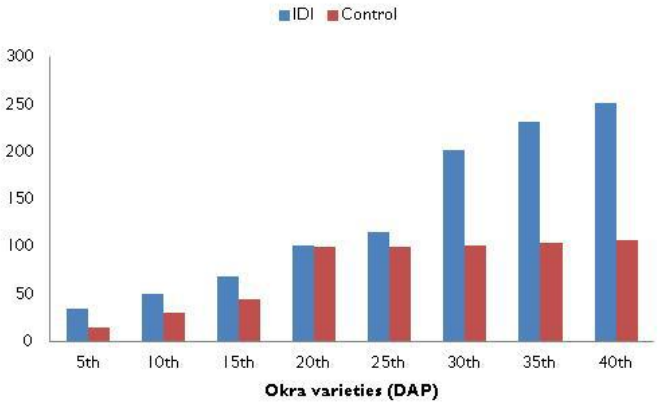

Figure 3: Number of leaves (cm) against Days after Planting (DAP).

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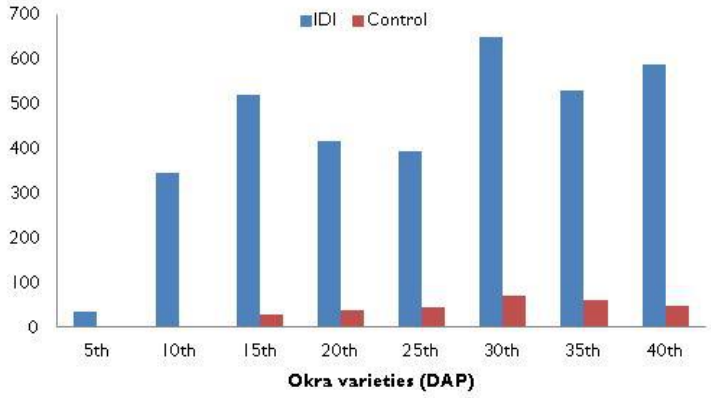

Figure 4: Number of Okra yield performance (cm) against Days after Planting (DAP)

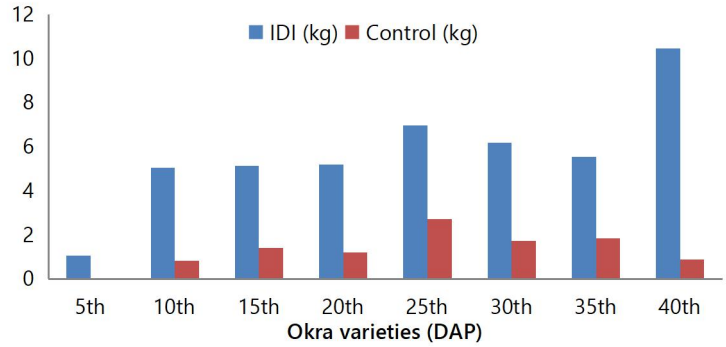

Figure 5: Weight of Okra production (kg) against Days after Planting (DAP)

4.0 Conclusion and Recommendation

4.1 Conclusion

The growth performance characteristic of Okra on improvised drip irrigation system was investigated, this leads to minimized of water usage, fertilizers, land utilization and increased fruit yields as well as production of okra calls for an effective irrigation system. Growth occurs through the effect of soil types and watering treatments had no significant different on its. Therefore, okra may not require much water for maximum growth germination at the initial stage.

4.2 Recommendation

Based on the results obtained from the study, Improvised Drip Irrigation system (IDI) is highly recommended for the effective cultivation of okra seeds and the amount of water required to irrigate is low compared to other irrigation systems.

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