Effect Of Hydroponic And Indigenous Technology On Spinach Production By Farmers For Livelihood In Makurdi, Benue State

Onu, D.O
Department of Vocational Agriculture and Technology Education, Federal University of Agriculture, Makurdi

Prof Agbulu O.N
Department of Vocational Agriculture and Technology Education, Federal University of Agriculture, Makurdi

Dr Ekele, G.E
Department of Vocational Agriculture and Technology Education, Federal University of Agriculture, Makurdi
ABSTRACT

The study investigated the effect of hydroponic and indigenous technology on the growth and maturity of spinach in Makurdi, Benue state. The study adopted experimental research design and a population 100 spinach crop plants with a sample size of 66 crop plants. The crop plants were observed upon application of two treatments (hydroponic and indigenous technology). The experiment was replicated three times and 11 crop plants each were randomly selected from the replicates per treatment. The data were analyzed using frequency table, mean and t-test to determine the effect. Also the hypotheses were tested at 0.05 level of significant difference. The findings from the study showed that hydroponic technology has a positive effect on the growth and maturity of spinach than the indigenous technology. It was then recommended that trainings, workshops and seminars be organized for farmers to train them on the use of this technology.

Keywords: Spinach, Hydroponic technology, production and Farmers

1. INTRODUCTION

Spinach is a warm-season and annual crop commonly grown during the rainy season. It belongs to the Family of Chenopodiaceae with its scientific name as Spinacia oleracea L. and it is commonly called Amaranths. It is among the most popular and widely consumed African leafy vegetables (ALVs) in Africa. It is a crop that can be grown with the optimum temperature of 16 to 24°C and it is well adapted to hot conditions and long days (Niederwieser, 2001). It has large, freshy, dark green leaves and broad leaf stalks (Vanwyk, 2005). Spinach leaves are rich in calcium, contain fibre and ascorbic acid, iron, mineral as well contain the highest protein content with good management (Prem, et al 2012). Gichunge, Kidwaro, Ohiokpehai and Oyoo. (2009) reported that in Africa, where the diet of the many people is high in carbohydrates and low in protein, leafy Spinach is a good source of protein. It has high energy value of 20kcal per 100g cooked leaves, the leaves also contain relatively high level of bioactive compounds such as vitamin C and vitamin A (30mg 100g⁻¹ and 61161 I.U respectively), and also minerals such as potassium (379mg 100g⁻¹) sodium (213mg 100g⁻¹) and Iron (1.80mg 100⁻¹) (Maboko 2013). Due to its protein content, it is a good substitute for meat for those who don’t eat meat and those who cannot afford to buy meat. In the submission of WHO (2013), the inclusion of spinach in human diet can go a long way to improve one’s health and longevity. However, there are other socio-economic advantages to include; employment opportunities, sources of income generation, raw materials for industries, medicinal purposes and festivity purposes (Phiri and Modi 2005).

There are so many problems facing the indigenous way of crop production in our world today, many threats arising from human induced changes in nature’s systems like the global warming, which is probably the most widely known of these changes, causes the sea level to rise as a result of ice melting at the poles and a subsequent increase in the volume of sea water. There is widespread debate on exactly how far the sea level will rise in the
nearest future, but it is clear that there are some places in the world where the sea level has already risen and affected the people’s life styles. Furthermore, a warming planet will most probably have more frequent flash floods, intensive tropical storms and rainfall (Lynas 2008). The competing demands on land for urbanization, industrialization, road constructions, among others make land inadequate for agricultural activities (Igbabaka 2015). Also, soil depletion is another challenge facing land use. The problem of land inadequacy for agriculture is often compounded by erosion, cut surfaces; (disturbed soils) poorly formed soils with hard pans and abandoned lands (Raven, Berg and Johnson 1998). The Encyclopedia Britannica (2014) pointed out that, because of the need to increase food and vegetable production, it becomes imperative to adopt alternative strategies to land use. The indigenous technology is a practice that involves the traditional way of cultivating land using hoes, cutlasses and other implements on land to produce crops. It depends solely on weather and climate. With the indigenous technology, crops are produced seasonally either once or twice in a year whereas the needs for those crops go beyond that especially spinach. Once it is not production season, it goes out of market. The indigenous technology favours only farmers with fertile agricultural land, the cost of labour for tilling and cultivation is high with limited yield. There is need to look into technologies other than the indigenous for spinach production by farmers which is more of soilless practice. Hydroponic technology may be a good alternative to the indigenous technology.

Hydroponic is a technology which uses any media except soil such as water, saw dust, lahar, vermiculite, perlite among others in crop production. It was Gericke in 1936 of the university of California who came up with the term Hydroponics from the Greek word, ‘hydro’ (water) and ‘ponos’ (work), meaning working with water. Gericke was the first person to carry out large scale commercial experiments in which he grew tomatoes, lettuce and other vegetables (Inter-American institute for Cooperation on Agriculture, IICA 2010). Hydroponics is however a technique for growing plants without using soil utilizing this technology, the root absorbs a balanced nutrient solution dissolved in water that meets all the plant development requirements. Improved yield and quality of leafy vegetables have been reported in a closed hydroponic system (Maboko and Duplooy 2009) due to more efficient use of water and nutrient. Vegetables that are hydroponically produced are of high value and can play an important role in income generation for small holder and commercial farmers (Duplooy, 2012). Vegetable production in soilless culture is highly productive, conserves water and land and it is more environmentally friendly compared to indigenous technology (Resh, 1996). Thus Hydroponic is a technology which uses any media except soil such as water, saw dust, Lahar in crop production. It is an alternative to land use as its practice does not involve the use of soil for crop production.

Hydroponics is not gender sensitive either sex could apply this technology in crop production. It is not a labour intensive type of production; therefore, it could be adopted by anyone who wants to increase the quantity and quality of his/ her produce from youths to retired employees, even workers of any establishment. The production
process is easy and however, the produce are of superior quality and can be marketed in supermarkets, fast food chains establishments, restaurants, hotels and even global market, Zepeda (2012).

There is a vast and growing population of flat-dwellers in most urban centers and hydroponics is especially suited to these people. Flower- boxes filled with vermiculite and watered with nutrient will grow anything the flat dweller may desire; attractive indoor gardens, window – sill arrangements, balcony vegetables, all are possible with hydroponics. Even though, hydroponic technology has proven to be better than indigenous technology in other countries such as Sri lanker, India, Kenya, United Kingdom, Babylon but there is no experimental evidence if the condition is same in this part of the World. It is based on this gap in knowledge that this study will be embarked upon. Spinach production is the raising of spinach crops for human use and income generation. Income generation is the capital returns from sales of produce and products of farmers. Farmers are individual adults who engage in farming practices of raising crops or animals as occupation.

2. STATEMENT OF THE PROBLEM

It was observed by the researcher over time that the rate of spinach production is low especially that it is done seasonally except for those that do irrigation farming by the river side and it is not all farmers that can access land by the river side to embark on its production. Also, today, most farmers are facing diverse challenges as it pertains land for agriculture and agricultural purposes owning to threats from global warming, low availability of land for agriculture due to competition for constructions and setting up of industries, the tediousness of using hoes and cutlasses for the cultivation of land for spinach production by farmers using indigenous technology. Results from literature has shown that this technology hydroponic is highly effective and have served as good alternative to land use in places like Egypt, Kentucky, California among others but there are no experimental evidence of such in this part of the country, it is on this basis that the researcher deemed it fit to embark on this study.

3. PURPOSE OF THE STUDY

The general purpose of the study is to investigate the effects of indigenous and Hydroponic technology on spinach production. The specific objectives of this study covered the effects of indigenous and hydroponic technology on the:

- growth of spinach (plant height, number of leaves produced per plant)
- maturity of spinach
- yield of spinach
4. RESEARCH QUESTION

The following research questions were answered by the study

- What is the effect of indigenous and hydroponic technology on the growth of spinach (plants’ height, number of leaves produced)?
- What is the effect of indigenous and hydroponic technology on the maturity of spinach at 28 days of planting?
- What is the effect of indigenous and hydroponic technology on the yield of spinach?

5. RESEARCH HYPOTHESES

Three null research hypotheses were formulated and were tested at 0.05 level of significance.

- There is no significant difference in the growth of spinach planted using indigenous and hydroponic technology.
- There is no significant difference in the maturity period of spinach grown hydroponically and with indigenous technology.

6. METHODOLOGY

The study adopted an experimental research design. The specific experimental design is the demonstration experiment. This type of experiment is good for the research so as to show the result of these technologies under local control.

The experiment was conducted in two phases at the Federal University of Agriculture, Makurdi which is situated on Latitude 7° 41 ″N and Longitude 8° 37 ″E in the Southern Guinea Savannah region of Nigeria. The first phase was carried out in the Laboratory in nutrient solution to determine the nutrient present in the soil before the start of the experiment while the second phase was on the University of Agriculture Makurdi Teaching and Research Farm. This location is ideal for the experiment so as to enable the researcher have a close monitoring of the plants. The sample for this study was 66 plants randomly selected from a three replicates of the two treatments (hydroponic and indigenous technologies). 11 plants were selected randomly from each replicate. This gave a population of 66 plants. The plants were observed and monitored closely for the period of 28 days after planting and data were collected on the following variables, plants’ growth (height, number of leaves), and maturity of spinach in the two treatment. The data collected were analyzed using frequency table, mean and t-test.

The effect in this study was determined by comparing the mean value of the two treatments under study. The difference in the mean values obtained is the effect. That is \( \text{XI}-\bar{XH} \), where XI is mean of indigenous and XH
is mean of hydroponics. The hypothesis formulated were tested using t-at 0.05 level of significance. The t-parametric test of significance is used to determine the difference in the mean of the two groups of observation.

The decision rules for the hypothesis testing are as follow:

- If the t-calculated value of an item is greater than the t-table value on that item $P_{0.05}$ there is no significant difference in the mean rating of the two groups of treatments for that item and therefore the null hypothesis of no significant difference will be accepted for that item while if the t-calculated value of that item is less than the t-table value $P_{0.05}$ there is significant difference in the mean ratings of the two groups of treatments for that item and therefore the hypotheses of no significant difference will be rejected for that item.

7. DATA ANALYSIS

Research question 1

What are the effects of indigenous and hydroponic technology on the growth of spinach (height and number of leaves produced)?

Table 1: mean ratings of the effects of indigenous and hydroponic technology on the growth of Spinach

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plants’ height</th>
<th>Plants’ leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous</td>
<td>10.29</td>
<td>8.52</td>
</tr>
<tr>
<td>Hydroponics</td>
<td>15.41</td>
<td>11.67</td>
</tr>
<tr>
<td>Effects</td>
<td>5.12</td>
<td>3.15</td>
</tr>
</tbody>
</table>

The data in Table 1 shows that indigenous technology has a mean rating of 10.29 for plants’ height and 8.52 for plants’ leaves and hydroponic technology has 15.41 for height and 11.67 for leaves with the effect of 5.12 and 3.15 respectively. This indicates that hydroponic technology has a higher growth than the indigenous technology.

Research question 2

What is the effect of indigenous and hydroponic technology on the maturity of spinach at 28 days of planting?

Table 2: mean ratings of the effects of indigenous and hydroponic technology on the maturity of spinach at 28 days after planting

<table>
<thead>
<tr>
<th>Status</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants’ maturity</td>
<td>33</td>
<td>12.04</td>
</tr>
<tr>
<td>Indigenous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydroponics</td>
<td>33</td>
<td>18.16</td>
</tr>
<tr>
<td>Effect</td>
<td></td>
<td>6.12</td>
</tr>
</tbody>
</table>

The data in Table 2 shows that indigenous technology has a mean rating of 12.04 for plants’ maturity and hydroponic technology has 18.16 with effect of 6.12. This indicates that hydroponic technology has a faster maturity than the indigenous technology.
Hypotheses tested

Hypothesis 1: There is no significant difference in the growth of spinach planted using indigenous and hydroponic technology. The data for testing hypothesis 1 are presented in table 3.

Table 3: t-test of the mean growth rate of indigenous and hydroponic technology on the growth of spinach

<table>
<thead>
<tr>
<th>Status</th>
<th>N</th>
<th>Mean</th>
<th>Std</th>
<th>Std Error Mean</th>
<th>Df</th>
<th>Sig.</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous</td>
<td>33</td>
<td>8.52</td>
<td>1.66</td>
<td>.28867</td>
<td>64</td>
<td>.000</td>
<td>S, R</td>
</tr>
<tr>
<td>Hydroponics</td>
<td>33</td>
<td>11.67</td>
<td>3.75</td>
<td>.65283</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N= number of plants, Std = standard deviation, Sig.= P-value; significant at p ≥ 0.05, S = significant, R= rejected

Data in table 3 shows a p-value of .000 which is less than the alpha value of .05. This indicates that there is significant difference in the mean growth rate of indigenous and hydroponic technology on the growth of spinach. Therefore, the hypothesis of no significant difference was rejected.

Hypothesis 2

There is no significant difference in the maturity period of spinach grown hydroponically and with indigenous technology.

Table 4: t-test of the mean maturity rate of indigenous and hydroponic technology on the maturity rate of spinach

<table>
<thead>
<tr>
<th>Status</th>
<th>N</th>
<th>Mean</th>
<th>Std</th>
<th>Std Error Mean</th>
<th>Df</th>
<th>Sig.</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous</td>
<td>33</td>
<td>5.69</td>
<td>1.53</td>
<td>.20392</td>
<td>64</td>
<td>.000</td>
<td>S, R</td>
</tr>
<tr>
<td>Hydroponics</td>
<td>33</td>
<td>7.94</td>
<td>2.32</td>
<td>.39908</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N= number of plants, Std = standard deviation, Sig.= P-value; significant at p ≥ 0.05, S = significant, R= rejected

Data in table 4 shows a p-value of .000 which is less than the alpha value of .05. This indicates that there is significant difference in the mean maturity rate of indigenous and hydroponic technology on the growth of spinach. Therefore, the hypothesis of no significant difference was rejected.

8. DISCUSSION OF RESULTS

The findings from table 1 revealed that growth of spinach is higher with hydroponic technology that with indigenous technology in terms of height and number of leaves produced. This reveal agrees with Fernando, Libia and Trejo (2012) who explained that hydroponic spinach production has a significantly increased growth as it allows a more efficient use of water and fertilizers as well as better control of weather and pest factors which result in higher competitiveness and economic income. This statement is in consonance with Morelock and Corell (2006) who stated that hydroponically grown spinach does faster than field production (indigenous).
However, findings in table 2 showed that the maturity of spinach under hydroponic technology was faster than the indigenous technology. In accordance to Foss and Jones (2005), crop yield succeeds crop maturity and spinach matures in an intermediate growth pattern in hydroponic technology. Donald (2014) also noted that the influence of Phosphorus (P) on crop maturity is often an added advantage to its effect on increasing yields as phosphorus fertilization hastened cotton maturity by increasing yield of the first picking and total seed cotton yield at several locations in Arkansas especially with hydroponic technology. These authors affirmed that the use of this technology exerts positive effect on maturity.

9. CONCLUSION

The study has shown the advantages of hydroponic technology over indigenous technology in terms of growth and maturity and so it is a technology that its practice and technical- know how- should be taught and demonstrated to farmers by extension agents so as to adopt this technology in the production of vegetables not only spinach.

10. RECOMMENDATIONS

The study recommends the followings for implementations.

- Trainings, seminars and workshops should be organized by extension agents who are skilled in use of this technology to enlighten the farmers on the importance of this technology and its application.
- Tertiary institutions who offer agriculture as a course should integrate the practical aspect of this technology into teaching and learning instead of leaving it at the theoretical aspect in the class. This will enable students get better understanding which they can pass to their parents who are practicing farmers.

11. REFERENCES


