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Impact of Different Methods of Tillage on the Yield of Tomato (Lycoperiscum Esculentum) in Delta South Ecological Zone, Nigeria

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Abstract:
The study on impact of different methods of tillage on the yield of tomatoes in Delta south ecological zone, Nigeria was conducted in Delta State Polytechnic research farm Ozoro between March, 2013 and March 2014. The treatments used were zero tillage, raised bed, flat bed and ridge. Each of the treatments was replicated four times in a randomized complete block design. Parameters observed were, survival rate, plant height, number of branches, number of flowers, number of fruits, and weight of fruits. The result from the experiment shows that the height of tomatoes ranged from 68.60 to 83.71cm, numbers of flower ranged between 30 and 67; number of branches ranged from 6 to 11, numbers of fruit ranged from 20-45, weight of fruit ranges from 125 to 140g and all the tomatoes survived in all the treatments. No significant difference exist in the performance of tomatoes planted on zero tillage and raised bed treatments, but significant difference existed between the crops that grown on ridge, flat treatments and raised bed as well as zero tillage, it will therefore recommended that tomatoes should be grown on zero tillage in Ozoro environment to reduce the cost of production.

Keywords: *Tillage, environment, yield, method, parameter*

1. Introduction

Tomato *(Lycopersicoum esculentum)* is an important vegetable crop cultivated worldwide. The fruit is rich in lycopene which may have beneficial effects. Tomato is consumed in diverse ways, including raw as an ingredient in many dishes, sauces, salad and drinks. While botanically a fruit, it is considered a vegetable for culinary purpose.

Tomato is one of the most important vegetable crops in most region of the world ranking second in importance to potatoes (*Solanum tuberosum).* In many countries, the fruits are eaten raw or cooked, large quantities of tomatoes are use to produce soup, sauce, ketchup, paste and powder. They are extensively used in the canning industry. Green tomatoes are used for pickles and preserves.

The seed contain 24 percent oil and this is extracted from the pulp and residues of canning industry. The semi drying – oil is used as a salad oil and in the manufacturing of margarine and soap. The residual press cake is used for stock feed and fertilizer. (Okunajaja 2013)

Soil tillage is one of the very important cultural practices that affects physical properties and yield of crops (Keshavarpan and Rashidi, 2008). Khurshid et al., (2006) reported that among the crop production factors, tillage contributes up to 20%. Tillage method affects the sustainable use of soil resources through its influence on soil properties; proper tillage can improve soil related constraints, while improper tillage may cause a range of undesirable process such as destruction of soil structure, accelerated erosion, depletion of organic matter content and fertility (Rashid et al., 2000), destruction of water cycle, organic carbon and plant nutrients (Lai, 2003) and encourage excessive weed emergence (Takim and Fadayomi, 2010).

Tillage is an agricultural preparation of soil by mechanical agitation of various types, such as digging, stirring and over turning. Example of human powered tilling method using hand tools include shoveling, picking mattock work, hoeing, raking. Example of draft-animal powered or mechanized work includes ploughing. Harrowing and cultivating with cultivator shank (teeth) tillage is often classified into two types.

i. Primary Tillage: Is more deeper and thorough and it tends to produce rough surface finish whereas
ii. Secondary Tillage: Is shallower and sometimes more selective of a location however it tends to produce a smoother surface finish, such that is required to make a good seed bed for many crops.

The predominant land preparation practices in the tropical rain forest is the conventional tillage involving disc ploughing, harrowing and ridging and making of flat bed. These practices modified the soil structure by changing the physical properties such as soil bulk density, soil penetration resistance and soil moisture content. Annual disturbance and pulverizing caused by continuous tillage produce finer and loose soil structure as compared to conservation and no tillage method which leave soil intact (Reddy, 2012). These

differences result in change of number, shape continuity and size distribution of pores network, which controls the ability of soil to store and transmit air, water and agricultural chemicals. This improves porosity and water holding capacity (WHC) of the soil. This consequently leads to favourable environment for crop growth and nutrient use (Khan, 2001). The response of crop yield to conventional, no tillage and intensive farming system is well documented for temperate climate.

The tillage system that leaves >30% of crop residues on the soil surface comes under the category of conservation tillage (as defined by the conservation tillage information counter (TIC). The conservation tillage system is a generic term used to describe the soil and water losses due to conservation tillage practice (Rizva, 1987). The conservation tillage is basically collection of many tillage types with the objective of crop residue management. (Lai, 2003).

Tillage induced effects on soil physical characteristics. The soil physical characteristics are those that can be seen or felt. The soil physical characters are of outmost important for the crop production. The physical properties are of permanent nature and usually difficult to change, compared to soil chemical properties. The soil physical properties are affected by the tillage operation carried out and tillage implement used. Tillage operations increase soil porosity by loosening the soil structure and reduce bulk density and mechanical impendence (pigeon and some, 1988).

The change in soil physical characteristics induced by tillage may persist for varying lengths in various soil types (Busscher, 2012). The deteriorations of soil structure as a result of continuous cropping can affect crop growth adversely. The choice of suitable tillage system will be useful to control degradation.

Both adverse and beneficial effects occur as a consequence of intensive tillage. The adverse effects include soil compaction (Soane 2013). Soil erosion, (Kaiser, 2006) loss of soil organic matter (Unger 1982), and ultimately destruction of internal drainage (Coote and Ramsey, 2009). The possible beneficial effects include increased water conductivity into soil profile through macro pores in minimum tillage system (Lindstorm, 2010), and organic matter stabilization in certain tillage residue management system (Soane, 2013). Results of 50years of minimum tillage (Pikul and Allmaras, 1986) show that residue management altered certain soil quality (physical and chemical) parameters. The protection of soil erosion and soil moisture conservation of crop should be major objectives of conservation tillage.

The physical soil environment is very important from plant growth point of view. The physical environment is a result of the combined effects of soil structure and consistence. Tillage is aimed at producing good soil tilth. The shoot development, crop yield and nutrient accumulation have been studies under diverse soil conditions under non tillage system. The greater soil strength of surface soil causes unfavorable soil condition (Addae, 1995). The length and distribution of the root may affect crop yield in nutrient poor soil. (Richer 2013). Indicated that the development of the shoot at the third leaf-stage may ensure adequate water and nutrient supply and enable genotypes to realize their inherent yield potential improved rooting in the deeper soil layers under no-tillage resulted in a higher above ground biomass than to conventional tillage, while Hughes (1992) stated that restricted root development under none tillage (NT) is the main factor delaying early plant growth. Gregory (2000) reported a close correlation between leaf area and root density at deep soil layers in the plant.

Voorhees (1992) did not find any relations of maize shoot dry matter to root length, but found a direct relation to root weight at the same growth stage. The relation between root and above grown wheat biomass is limited and diverse.

Some reports showed that there exists a correlation between development of leaves and root (Belford *et al.*; 1986) but the economic yield was not always related to patter of root distribution (Gregory, 2000) reviewed the relationship between the roots, shoots and crop yield. However, the results are inconsistent and highly specific for the crop species and the soil and water conditions.

However, there has been conflicting reports on the influence of soil tillage practices on performance of tomato in Nigeria. For example, while studies conducted in Northern Guinea savanna (Adeoti and Olarewaju, 2004) and the derived savanna (Babalola and Olaniyi 2004), reported significantly higher fruit yield with conventional tillage compared to the zero tillage system, Omidiyi (2010) observed no significant yield difference between the two practices in the southern Nigeria. Study conducted by Adekiya et al., (2009) which compared the effect of five tillage methods on soil properties, nutrients content, growth and yield of tomato on an alfisol soil on the other hand showed that ploughing plus harrowing and ridging increased tomato yield by 40, 16, 24 and 62% over manual moulding, ploughing plus ploughing harrowing respectively. These according to the authors, conclude that the effect of tillage method on tomato yield may depend on the environment and soil type. Therefore the objectives of this study is to investigate the impact of different methods of tillage operation on the yield of tomato in ozoro environment.

2. Materials and Methods

The experiment was conducted in Delta State Polytechnic Research Farm Ozoro in Isoko North Local Government Area.

Isoko North Local Government Area is located within the rain forest zone of the mid western Nigeria between latttitude $5^0 30^1$N and $5^0 45^1$N of the Equator and $6^0 05^1$E and $6^0 13^1$E of the Greenwich meridian. She has the mean annual rainfall of between 2500mm and 3000mm and temperature range between 28^0C and 30^0C, its attitudinal position is below 50metres above the sea level (meteorological station, 2012). The soil of the study area is moderately drained acidic loamy sand, (Ogboi and Emakpor 2006).

The different tillage methods (Zero tillage, ridge, raised bed and flat beds) used in the experiment were prepared accordingly into a randomized complete block design and were replicated four times; the seedlings were raised in a nursery and were transplanted four weeks after germination to already prepared different treatments (Zero tillage, Ridge, Raised Bed and flat Bed).

The performance parameters observed were survival rate, plant height, number of branches, the number of flowers, the number of fruit and weight of each fruit.

The above data were collected on weekly bases for twelve weeks (3 months). All data were subjected to statistical analysis using analysis of variance (ANOVA).

Parameters	Measures values
Clay	16%
Silt	10%
Fine Sand	50%
Coarse sand	24%
Total Sand	74%
Textual sand	Loamy sand.
Bulk density	1.25g/dm^3
Porosity	47.1%
MWDD	1.203
MWDW	0.816
PH (H_2O)	5.6
Pf(KCL)	4.1
Carbon	0.64%
Organic matter	1.10%
Nitrogen	0.124
Sodium	0.05meg/100g
Potassium	0.03meg/100g
calcium	0.50meg/100g
Magnesium	0.59meg/100g
AC BC	AC VC
BC EC	4.8meg/100g
B, Sat	25%
Phosphorus	3.5%
Aluminum	2.8%
Hydrogen	0.8%
Exchangeable acidity	3.6%

Table 1: Properties of soil of the study area

Soil los. 2013
MWDD = Mean Weight Diameter Dry
MWDW = Mean Weight Diameter Wet
SOURCE: LAB, 2012

TREATMENTS	PH (cm)	ANB	ANF	AFNP	AWF (g)	S R (%)
ZERO TILLAGE	81.29	8	60	43	138	100
RAISED BED	83.71	11	67	45	140	100
FLAT BED	77.37	7	60	24	126	100
RIDGE	68.60	6	56	20	125	100
LSD	2.80	2.00	0.776	2.16	2.10	-

Table 2: Response of tomatoes to different tillage method at three weeks after transplanting.

PH = plant height (cm) ANB = average number of branches, ANF = average number of flowers.
AFNP = average number of fruits per plant, AWF = average AWF = average weight (g) of fruit.
SR = survival rate (%).

3. Result and Discussion

The properties of soil of the study area are shown in Table 1. The texture of soil is loamy sandy and this may be attributed to the parent material of the soil. (coastal flain sand). Anikwe (2000) observes that coastal plain sands usually give rise is strongly acidic and its is low in organic mater content (London, 2010). The certain exchange capacity is low and this may be attributed to increase pressure on land use for cropping, oil exploration, massive infrastructural development and limited fallow period due to increased population (Agbim, 2000).

The response of tomatoes to different tillage methods is shown in Table (2). The table revealed that the height (cm) of tomatoes ranged from 68.50cm to 83.71cm. The highest heights (83.71cm) was obtained in raised bed while the lowest height (68.50cm was obtaining in the ridge tillage. There was no significant difference were observed in the height (cm) tomatoes between raised bed, flat bed and ridge treatments. This finding disagreed with Adekiye (2009) findings that had better height in ridge treatment. This may be attributed to the nature of soil and growth condition in ozoro environment. The average numbers of flower of the tomatoes plants

ranged from 30 to 67. The highest number of flowers (67) was obtained from raised bed treatment, while the lowest number (32) was obtained from the ridge treatment. This result was in agreement with the findings of Omidiyi (2010) who had highest number of flower from raised be in tomatoes grown in western part of Nigeria.

The average branch numbers ranged from 6 to 11. The highest branch number (11) was obtained in raised bed treatment and the lowest number (6) was obtained from the ridge treatment. Significant difference existed among the treatments for numbers of branches.

The average numbers of fruits per plant ranged from 20-45. The highest number of fruits (45) was obtained in raised bed treatment and the lowest numbers of fruits (20) was obtained in ridge treatment, in terms of number of fruits.

The average weight per fruit of tomatoes ranged from 125 to 140g. The highest weight (140g) was obtained in zero tillage and raised bed treatments while the lowest weight (125g) was obtained from flat bed treatment. Significant differences in fruit weight exist between zero, flat and ridge treatments. This finding is at variance with Omidiji (2010) finding, who observed no significant different in fruit weight of tomatoes grown on zero tillage and conventional tillage.

Studies conducted in Northern Guinea by Adeoti and Olarewaju (2004) and in savannah by Bebalola and Olaniyi, (2004) reported significantly higher yield with conventional tillage compared to zero tillage system. However, Omidiji (2010) observes no significant difference in fruit yields between conventional tillage and zero tillage practices in south western Nigeria. Therefore, the effect of tillage on tomatoes performance may depend on the environment. In all the treatments, 100 percent survival rate was observed.

4. Conclusion and Recommendation

Arising from the sturdy, the performance of tomatoes was best on raised bed treatment, though, not significantly different from zero tillage; it is recommended therefore that zero tillage practice be adopted in ozoro environment to reduce cost of production.

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