Effect of Mulch Materials on the Growth and Yield of Irrigated Tomatoes in Oke-Ibukun, Kogi State

Babalola T.S

Kabba College of Agriculture

Division of Agricultural Colleges, Ahmadu Bello University, PMB 205, Kabba, Kogi State Nigeria
pauloxti@yahoo.com, +2347030547750

Abstract: This study was carried out to evaluate the effect of three mulch materials on the growth and yield of three varieties of tomatoes during the 2015 and 2016 dry season. Mulch materials used are; Black polythene sheet (M1), Plant Residue (M2) and No mulch (M3). Tomato varieties considered include Harvester (V1), Bonny Best (V2) and Ibadan Local (V3). The experiment is a factorial experiment and was laid out in a randomized complete block design. The tomato plants were raised in the nursery for four weeks before transplanting to the field. In the field all agronomic practices were carried out and the following growth and yield data were collected; number of branches, number of leaves, plant height and weight of harvested fruit per plot. Data collected were analyzed using analysis of variance (ANOVA) and the means were separated using least significant difference. Result obtained shows that tomatoes varieties performed best at plots where Black polythene sheet (M1) was applied. The variety that gives the best yield performance is Bonny Best (V2). It was also observed that all the varieties studied did not perform in plots with No-mulch (M3). In conclusion, for dry season tomato production at Oke-Ibukun and environ the best variety is V2 while the best mulch material is M1. It is therefore recommended that farmers should cultivate V2 and adopt the use of M1 mulch materials in the area.

[Kabba College of Agriculture. **Effect of Mulch Materials on the Growth and Yield of Irrigated Tomatoes in Oke-Ibukun, Kogi State Babalola T.S.** *Rep Opinion* 2016;8(12):92-97]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). http://www.sciencepub.net/report. 8. doi:10.7537/marsroj081216.08.

Key Words: Black polythene sheets Mulch, Plant residue, No-mulch, Tomato, Varieties

Introduction

Tomato is one of the most important vegetable crops grown all over Nigeria. It is the world's largest vegetable crop after Irish potato and sweet potato. It tops the list of canned vegetables. In Nigeria, tomato is regarded as the most important vegetable after onions and pepper (Fawusi, 1978). It is an important condiment in most diets and a very cheap source of vitamins. It also contains a large quantity of water (%), calcium (%) and Niacin all of which are of great importance in the metabolic activities of man. Tomato is a good source of vitamins A, C and E and minerals that are very good for body and protect the body against diseases (Taylor, 1987).

Tomatoes are planted by an estimated 85% of the gardens each year. If well managed, tomato is highly productive (Denton and Swarup, 1983). Cropping of tomatoes during the wet and dry seasons contributes immensely to the national requirement but the bulk of production is from the dry season cropping particularly in southern states of Nigeria (Anon, 1989) Although the use of improved varieties and fertilizers has increased tomato production to much extent, the full potential of the crop production has not been achieved in developing countries compared to progressive countries (Rashidi *et al.*, 2010). Ideally; tomato requires a relatively cool, dry climate for high yield and premium quality. However, it is adapted to a wide range of climatic conditions. Tomatoes have been grown as far as the North Arctic Circle (under protection) and down to the hot and humid zone.

The optimum temperature range for growth and development of tomatoes is 21 to 24^0C. Prolonged exposure to temperatures below 12^0C can cause chilling injury; mean temperatures above 27^0C severely impair growth and fruit set. Destruction of pollen and egg cells occurs when the maximum day – time temperature is 38^0C or above for 5 to 10days, fruit set is also generally poor if the night temperature is above 21^0C just before and after flower formation. Hot dry winds can also cause flower abortion. Tomatoes are not sensitive to day length and set fruits in photo periods ranging from 7 to 19 hours. Tomatoes can be grown in many soil types ranging from sandy loam to clay loam soils that are rich in organic matter. The ideal pH range is 6 to 6.5, however or lower pH can cause mineral deficiencies or toxicities. Long period of flooding are detrimental to tomato growth and development.

In the study area tomato production is on subsistence scale among farmers this can be attributed to any of the factors (Soil, Water, humidity, Temperature, light and Choice of varieties) contributing to low performance of tomato. This investigation will consider different varieties, mulch materials and evaluate the best that is suitable for the soil and climate of the study area.

The objectives of this study are to:

1. evaluate the growth and yield performance of three varieties of tomatoes (*Lycopersicum lycopersicum)* in the study area.
2. evalaute the effect of three mulch materials on the growth and yield of three tomato (*Lycopersicum lycopersicum)* varieties in the study area.
3. evaluate the interaction between mulch materials and tomato varieties in the study area.

Material and Methods

Description of the Study Area

The experiment was carried out at Oke-bukun – Bunu, Kogi State within the Southern Guinea Savannah Zone of Nigeria on latitude 7.8536°N and longitude 6.1553°E with an altitude of 461m above sea level. The average rainfall is 1200mm per annum and it spans from March to November with the peak in June to September. The dry season extends from December to March. The mean annual rainfall is 1500 per annum with an annual temperature range of 18°C to 32°C. The mean relative humidity is 59% (MOSOTO Meteorological Data, 2014).

The main vegetation of the area is dominated by tall grasses, shrubs, some tress, oil palm, cashew etc in some part of the area however, had been put to cultivation of arable like maize, sorghum, soybeans, Cowpea, Okra, Pepper cassava and yam in the past cropping seasons.

Soil Sampling: A composite soil sample was collected from each experimental plot before treatment application for laboratory analysis of soil pH, exchangeable cations (Sodium (Na), Potassium (K), Calcium (Ca) and Magnessium (Mg)), Exchangeable acidity (A1 and H), Effective Cation Exchange capacity. (ECEC = EB + EA), Organic matter content and Available P (Bray-1-P) following the procedure of IITA (1979).

Experimental Design: The experiment is a factorial experiment laid out in a Randomized Complete Block Design. Factor A is variety with 3 levels while factor B is the mulch materials with 3 levels. There were 9 treatment combinations and were replicated 4 times. The experiment has 36 experimental plots.

Factor A: Variety (V1) Harvester, Variety (V2) Bonny Best, Variety (V3) Ibadan local.

Factor B: Mulch material (M1) Black polythene sheet, Mulch material (M2) Plant residue, Mulch material (M3) No – mulch.

Treatment Combination: V_1M_1 V_1M_2 V_1M3 V_2M_1 V_2M_2 V_2M_3 V_3M_1 V_3M_2 V_3M_3.

Field Work: The size of each plot was 3 by 1.5m and buffer zone 0.5m. Tomato Varieties raised in the nursery were transplanted at 60 x 60cm spacing. Before transplanting the mulch materials were applied and the soil (seed bed) was well irrigated. The insecticides and fungicides were applied according to recommendations (FFD, 2011). Regular watering was done every day of the week. All other necessary cultural practices were kept normal and uniform for all experimental plots.

Data Collection: The following parameters were measured: Plant Height (cm), Number of Branches, Number of Leaves and Total yield/plot (grams).

Data Analysis: Data collected were subject to analysis of variance (ANOVA). Means were separated using Least Significance Difference at 5% level of significance (Gomez and Gomez, 1983).

Results and Discussion

Pre-Planting Soil Properties

The result laboratory analysis of the soil used for the experiment is presented in table 1 it indicates that the that the texture of the soil is sandy clay loam; sand is the dominant particle however the soil contain enough clay and sediments to provide some structure and fertility for tomatoes production. The soil pH 5.7 is slightly acidic although it falls within the favourable range for vegetable production which according to Haynes (2000) is between 5.5 and 6.5 in mineral soil. The soil bulk density value 1.44 kg cm^3 is optimum for tomatoes production, ideal bulk density for plant growth in sandy soil is < 1.60 kg cm^3. The organic matter, available P and essential nutrients are low but in agreement with reports for Nigerian soils (Aduayi *et al*., 2002; Jones and Wild, 1975; Ogunwale and Ashaye, 1975; Ojo Atere *et al*., 1978; Fasina, 2001; Aiboni, 2001; Babalola *et al*., 2012).

Table 1: Pre-Planting Soil Properties

Soil Properties	Value
Particle size Analysis	
% Sand	68.14
% Clay	22.86
% Silt	9.00
Soil Texture	Sandy Clay Loam
pH(H_2O)	5.7
Bulk density (g cm-3)	1.44
Organic matter (%)	3.12
Total nitrogen (%)	0.16
Available phosphorus (mg kg^{-1})	11.86
Exchangeable Cations (cmol kg^{-1})	
Potassium	0.23
Calcium	0.14
Magnesium	0.58
Sodium	0.15

Growth Performance of Varieties Studied

Result presented in table 1 showed that there is significant differences in the number of branches at 2 and 4 weeks after transplanting (WATP) with

Harvester (V1) having the highest value. At 6WATP there was no significant difference in the number of branches.

There is no significant difference in the number of leaves at 2 and 6WATP, at 4WATP significant difference was observed and the highest value was recorded in Harvester (V1).

For plant height, there is no significant difference at 2 and 4WATP, at 6WATP significant difference was observed and the highest value was observed at Harvester (V1).

The result of the growth performance of variety revealed that Harvester (V1) had the best growth performance among the variety studied this can be due to combination of favourable environmental factors and agronomic practices employed in the study.

Table 2: Growth Performance of Varieties studied

Treatments	No of Branches at 2 WATP	No of Branches at 4 WATP	No of Branches at 6 WATP	No of Leaves at 2 WATP	No of Leaves at 4 WATP	No of Leaves at 6 WATP	Plant Height at 2 WATP		Plant Height at 4 WATP	Plant Height at 6 WATP
V1	2.56a	6.78a	10.07a	11.08a	31.21a	47.22a	15.40a		32.22a	49.27a
V2	2.04b	5.62b	9.68a	10.87a	29.34ab	47.07a	15.02a		32.04a	47.79a
V3	1.53b	4.92b	9.67a	10.78a	29.00b	46.66a	14.87a		30.57a	44.75b
LSD	0.22	0.34	0.57	0.49	0.85	1.23	0.20		0.83	0.99

**WATP= weeks after transplanting*

** Mean followed by the same letter(s) within the same column and treatments are not significantly different at 5% level of probability*

Effects of Mulch Materials on Growth Performance of Tomatoes

Result presented in table 3 revealed that significant differences were observed in all the growth parameters studied at 2, 4 and 6 WATP. The best performance was observed on plots with black polythene sheet mulch material (M1) while the lowest performance was observed in plots with no mulch (M3). Similar result has been reported by Babalola *et al.,* (2013). The findings is also in agreement with those of Anikwe *et al.,* (2004) and Anikwe *et al.,* (2007) who concluded that Black polythene sheet mulch enhanced growth and yield of plants in the arid and semiarid lands.

Table 3: Effects of Mulch Materials on the Growth of Tomatoes

Treatments	No of Branches at 2 WATP	No of Branches at 4 WATP	No of Branches at 6 WATP	No of Leaves at 2 WATP	No of Leaves at 4 WATP	No of Leaves at 6 WATP	Plant Height at 2 WATP	Plant Height at 4 WATP	Plant Height at 6 WATP
M1	2.66a	7.33a	11.44a	12.11a	33.11a	51.78a	16.36a	35.33a	52.11a
M2	2.22a	5.89b	10.67a	10.89b	30.22b	49.89a	15.34b	32.48b	49.13b
M3	1.25b	4.09c	7.29b	9.73b	26.24c	39.29b	13.59c	27.03c	40.59c
LSD	0.23	0.35	0.59	0.49	0.88	1.26	0.21	0.85	0.98

**WATP= weeks after transplanting*

** Mean followed by the same letter(s) within the same column and treatments are not significantly different at 5% level of probability*

Effects of Interaction of Variety X Mulch Materials on the Growth of Tomatoes

Result presented in table 4 showed that the interaction between variety and mulch was significant on the growth performance of tomatoes. There were significant differences in all the growth parameters studied at 2, 4 and 6 WATP.

The best performance was observed for number of leaves at plots with Harvester and Black polythene sheet mulch material (V1MI). For number of branches and plant height plots with Ibadan Local and Black polythene sheet performed best.

The lowest performance was recorded for Harvester and No mulch (V1M3), Bonny Best and No mulch (V2M3), Ibadan local and No mulch (V3M3). This observation is in agreement with effects of mulch materials on growth rate, reported earlier in this study. It is a known fact that the rate of evapotranspiration is higher during the dry season and with no mulch the process will be uninterrupted; this will have effect on the growth of crops.

Yield Response of Tomato Varieties

Result presented in table 5 revealed that there is significant difference among the yield of the three tomato varieties studied. Bonny Best (V2) has the best yield at 1st, 2nd and 3rd harvest. The lowest yield was obtained in V2; this could be as a result of the vegetative growth which may be at the expense of flowering and fruiting. Bonny Best (V2) had the highest number of leaves. It was also observed that the highest yield data was obtained at the 2nd harvest for all the varieties.

The result on the yield performance of the tomato varieties has shown that among the varieties studied,

farmers in the area will obtain optimum yield from the Bonny Best (V2), although it is not currently cultivated by farmers in the study area.

According to Shankara *et al*. (2005) selection of variety of tomato is dependent on local conditions and the purpose of growing. FFD (2011) recommends tomato varieties for each geographical zones of Nigeria. However Bonny Best was not recommended for any zone. The performance of bonny best in the study location could be due to favourable climate and soil condition coupled with the application of mulch materials.

Table 4: Interaction Effects of Variety X Mulch Materials on the Growth of Tomatoes

Treatments	No of Branches at 2 WATP	No of Branches at 4 WATP	No of Branches at 6 WATP	No of Leaves at 2 WATP	No of Leaves at 4 WATP	No of Leaves at 6 WATP	Plant Height at 2 WATP	Plant Height at 4 WATP	Plant Height at 6 WATP
V1M1	2.00bc	6.67b	10.67ab	11.67a	34.33a	53.33a	16.57a	34.93a	48.69b
V1M2	2.00bc	5.00cd	10.00b	11.00ab	31.67abc	51.67a	14.78c	30.85bc	48.62b
V1M3	0.60d	3.10e	6.69c	10.58abc	27.63cd	35.98b	13.28d	25.93d	39.92c
V2M1	2.67ab	6.67b	11.33ab	12.33a	32.67ab	51.67a	15.97ab	35.71a	54.71a
V2M2	2.00bc	6.00bc	11.00ab	11.00ab	29.33c	48.33a	15.55bc	33.55ab	52.84a
V2M3	1.48cd	4.18de	7.86c	9.29c	26.33c	41.20b	13.55d	27.42d	40.26c
V3M1	3.33a	8.67a	12.33a	12.33a	32.33abc	51.33a	16.56a	35.35a	52.91a
V3M2	2.67ab	6.67b	11.00ab	10.67abc	29.67bc	49.67a	15.70b	33.05ab	48.92b
V3M3	1.67cd	5.00cd	7.33c	9.33bc	25.00d	40.67b	13.94d	27.73cd	41.57c
LSD	0.47	1.43	1.21	1.02	1.79	2.59	0.44	1.74	1.98

**WATP= weeks after transplanting*

** Mean followed by the same letter(s) within the same column and treatments are not significantly different at 5% level of probability*

Table 5: Yield Performance of Tomato Varieties

Treatment	1st Harvest (grams)	2nd Harvest (grams)	3rd Harvest (grams)
V1	226.67b	323.33c	153.33ab
V2	446.70a	776.67a	426.67a
V3	310.00ab	566.67b	286.67ab
LSD	25.72	31.16	28.14

** Mean followed by the same letter(s) within the same column and treatments are not significantly different at 5% level of probability*

Effects of Mulch on the Yield of Tomatoes

Result presented in table 6 revealed that there are significant differences in the effect of mulch materials on the yield of tomatoes. The best yield was obtained at the plot with Black polythene sheet mulch (M1). This result is in agreement with result obtained on the effect of mulch on the growth performance of tomatoes in this study. The results are also in agreement with those of Sarkar and Singh (2007); Sarkar *et al.* (2007); Khurshid *et al*. (2006) and Seyfi and Rashidi (2007) who concluded that mulching reduced evaporation of soil water and increased water use efficiency. All these promote optimum and excellent crop growth and yield.

Table 6: Effects of Mulch on the Yield of Tomatoes

Treatment	1st Harvest (grams)	2nd Harvest (grams)	3rd Harvest (grams)
M1	466.67a	833.33a	433.33a
M2	333.33ab	500.00b	283.33ab
M3	183.33b	333.33b	150.00b
LSD	33.78	47.02	39.92

** Mean followed by the same letter(s) within the same column and treatments are not significantly different at 5% level of probability*

Effects of the Interaction of Variety X Mulch Materials on the Yield of Tomatoes

Results Obtained revealed that the interaction of variety x mulch materials have effect on the yield of tomatoes. The best yield was obtained at the plot that received Bonny Best x Black Black polythene sheet mulch (V2M1). This result is in agreement with the effects of variety and mulch on yield reported earlier in this study.

The lowest yield was reported at Ibadan Local x No mulch (V3M3), this indicates that dry season production of V3 under no mulch is not suitable in the study area. Farmers in the study area cultivate Ibadan local with no mulch.

Table 7: Effects of Interaction of Variety X Mulch Materials on the Yield of Tomatoes

Treatments	Yield (grams)
V1M1	363.33c
V1M2	206.67cd
V1M3	211.30cd
V2M1	780a
V2M2	563.33b
V2M3	233.74cd
V3M1	590b
V3M2	366.67c
V3M3	186.97d
LSD	74.62

Conclusion and Recommendation

In conclusion, for dry season tomato production at Oke-Ibukun and environ the best variety is Bony Best (V2) while the best mulch material is Black polythene sheet Mulch (M1).

It is therefore recommended that farmers should cultivate Bonny Best (V2) and adopt the use of Black polythene sheet Mulch (M1) mulch materials in the area.

Further studies on other agronomic characteristics for tomato production and profitability of the use of black polythene sheet mulch are also recommended. This will aid in developing a sustainable crop management system for optimum tomato production in the study area.

References

1. Aduayi, E.A., Chude, V.O., Adebusuyi, B.A. and Olayiwola, S.O., 2002. Fertilizer use and management practices for crops in Nigeria 3rd edition, produced by Federal Fertilizer Department of the Ministry of Agriculture and rural Development, Abuja Pp 86-90.
2. Aiboni, V.U., 2001. Characterization of Some Soil Under Different Land uses Along a Toposequence in Ibadan, Nigeria. *IN ASSET Series Agricultural Journal (1): 51 – 61*.
3. Aniekwe, N.L., Okereke, O.U. and Anikwe, M.A.N. 2004. Modulating effect of Block Black polythene sheet Mulch on the Environment, Growth and yield of cassava in a derived savannah belt of Nigeria. *Tropiculturea. Vol.22: 185-190*.
4. Anikwe, M.A.N., Mbah, C.N., Eyeaku, P.I. and Onyia, V.N., 2007. Tillage and Black polythene sheet mulch effects on soil properties and growth and yield of cocoyam (*Colocasia esculenta*) on an Ultisol in southeastern Nigeria. *Soil and Tillage Res*.93:264-272.
5. Babalola, T.S., Oloniruha, J.A., Ayodele, F.G., Kadiri, W.O.J. and Ogundare S. K, 2012. Assessingsoil quality of three land use types in Otite, Southern Guinea Savannah, Nigeria. *Biological and Environmental Sciences Journal for the Tropics* Vol. 9 (3): 99-102.
6. Babalola, T.S.**,** Ogundare, S.K., Oloniruha, J.A., Ayodele, O.J. and Ayodele FG, 2013. Effect of Mulch Materials on Soil Physical Properties, Yield and Yield Components of Tomato (*Lycorpersicon lycopersicum L.*) in Kabba,
7. Kogi State, Nigeria. Ojeniyi, S.O, Agbede, O.O, and Jayeoba, O.J (eds) Proceedings of the 37th Annual Conference of Soil Science Society of Nigeria, March 11th – 15th, 2013 Nassarawa. pp. 233-239.
8. Denton, L. and Swarup, V. 1983. Tomato cultivation and its potential in Nigeria. Acta Horticulturae. Sixth African symposium on Horticultural crops. Ibadan, 123: 257-265.
9. Fasina, A.S. 2001. An Evaluation of the Predictive Power of a Soil Map From Southwestern Nigeria, J. Sustain, Agric. Environ 3 (2):1-14.
10. Fawusi, M.O.A. 1978. Emergence and seedling growth of Pepper as influenced by soil compaction nutrient status and moisture regime. Horticultural Society. 9: 329-335.
11. Federal Fertilizer Department (FFD). 2011. Fertilizer use and management practices for crops in Nigeria. A report of the Federal Ministry of Agriculture. V.O Chude (eds). 4th Edition.
12. Gomez, K.A. and Gomez, A.A. 1983. Statistical procedure for Agricultural Research. 2nd Edition, New York, John Wiley and Sons. p. 680.
13. Haynes, R.J. 2000. Interactions between soil organic matter status. *Bio. Fertile soil*, 30:270-275.
14. Jones, M.J. and Wild A. 1975. Soils of the west African savannah. Technical Communication No.55, Commonwealth Bureau of Soils. Harpenden.
15. Khurshid, K., Iqbal, M., Arif, M.S. and Nawaz, A. 2006. Effect of tillage and mulch on soil physical properties and growth of maize. *International Journal of Agriculture and Biology*. 8: 593-596.
16. Ogunwale, J.A. and Ashaye, T.I. 1975. Sandstone derived Soils of a Catena at Iperu. *Nigerian Journal of Soil Science* 26:22-31.
17. Ojo Atere, J.A., Fagbemi, A. and Fayemi, A.A. 1978. The characteristics of some Iron pan soils in the Savannah area of south western, Nigeria. *Savannah Journal* **7:** 41-47.

18. Rashidi, M., Gholami. M. and Abbassi, S. 2010. Effect of Black polythene sheet mulch and tillage method on yield and yield components of tomato (*Lycopersicon esculentum*) *ARPN Journal of agricultural and Biological Science. Vol. 5(4): 5-11*.
19. Shankara N., van Lidt de Jeude, J., de Goffau, M., Hilmi, M. and van Dam, B. 2005. Cultivation of Tomato: production, processing and marketing. Agrodok series No 17. Agromisa Foundation and CTA, Wageningen.
20. Sarkar, S. and Singh, S.R. 2007. Interactive effect of tillage depth and mulch on soil temperature, productivity and water use pattern of rainfed barley (*Hordium vulgare* L.). *Soil and TillageRe*search 92: 79-86.
21. Sarkar, S., Paramanick, M., and Goswami, S.B. 2007. Soil temperature, water use and yield of yellow sarson (*Brassica napus* L. var. glauca) in relation to tillage intensity and mulchmanagement under rainfed lowland ecosystem in eastern India. *Soil and Tillage Research.* 93: 94-101.
22. Seyfi, K. and Rashidi, M. 2007. Effect of drip irrigation and Black polythene sheet mulch on cropyield and yield components of cantaloupe. *International Journal of Agriculture and Biology*9: 247-249.
23. Taylor, J.H. 1987. Text of lectures delivered at the national workshop on fruit and vegetable seedlings production held at NIHORT 9-13.

12/25/2016