Original Research Article

EFFICACY OF SOME PLANT MULCHES AND TOMATO CULTIVARS ON THE GROWTH PARAMETERS AND WILT OF TOMATO (*Lycopersicon esculentum MILL*) IN OWERRI, IMO STATE, SOUTH EAST, NIGERIA.

ABSTRACT

The experiment was conducted on the effects of some mulching materials and some tomato cultivars on the growth parameters and wilt disease of tomato. The design used was 3 x 4 factorial in Randomized Complete Block Design (RCBD), in four (4) replications. The work was carried out in 2015 cropping season at the Teaching and Research Farm and in the Crop Science and Technology Laboratory of the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Imo State, Nigeria. Data on growth parameters and disease incidence on tomato were collected and statistically analyzed, using Genstat Version 4 analytical Software, while the means were separated for difference using Fisher' Least Significant Difference Protocol. Wilt incidence was significantly ($P<0.05$) affected by tomato cultivars at the sixth week after transplanting (WAT). Wilt severity was lowest (1.75) at 2nd WAT. The number of fruits for Rio Grande cultivars significantly ($P<0.05$) increased at 8 WAT. For effective management of tomato wilt, ROMA VF cultivars should be grown under grass, while Tropimech tomato cultivars should be left unmulched.

KEY WORDS: Mulching materials, tomato cultivars, wilt, *Lycopersicon esculentum,* effects, south east, Nigeria, growth parameters.

INTRODUCTION

The cultivated tomato (*Lycopersicon esculentum* Mill*)* is a recently adopted food crop that has achieved prominence and popularity largely in the past century (Jones *et al, 1993*). Tomato's popularity, both in processed or fresh form and its ability to adapt to its environment has contributed significantly to its rapid wide - spread consumption. FAO (1985) reported that world tomato production and consumption has risen dramatically in the past two decades to more than 60 million metric tonnes. Despite the tomato's nutritional significance as a source of vitamins A and C, its consumption per capita is approximately four times as high in developed countries as in developing ones (Jones, 1993). This could be considered as a minor plant of luxury status in several areas of the world; significant room still exists to further increase its contributions to the nutrition and well-being of humans.

The production of tomato, both on small scale or in commercial quantity is fraught with some pathological problems. These factors can cause rapid deterioration and spoilage of the produce during post-harvest operations. The diseases are caused by either bacteria, fungi, viruses, parasitic flowering plants, nematodes and diverse environmental conditions.

The majority of plant diseases are incited by fungi, infecting all parts of tomato plant-leaves, stems, flowers, roots and fruits. Jones *et al* (1993) listed the pathogenic fungi implicated in the diseases of

tomato: *Fusarium oxysporium (*causing crown and root rot, and fusarium wilt*), Phytophthora infestans (*causing late blight*), AIternaria solani* (causing early blight), *Rhizoctonia solani* (causing rhizoctonia diseases), *Septoria lycopersici* (causing septoria leaf spot), etc.

Fusarium wilt is of world - wide importance, having been reported in at least 32 countries (Jones *et al*, 1993). It was regarded as the most common and destructive disease of tomato. Amati *et al* (1989), listed the symptoms to include, wilting of leaves from the bottom up, yellowing and curling of leaves at the edges, a brown stain when the stems or roots are cut.

These constraints have impacted negatively on the production of tomato in Owerri, leading to little or no production of the crop in the area. Consequently, farmers, sellers and buyers have solely depended on the purchases from some major production zones of the country. These problems could be contained when the crop is produced in the geographical areas of the south east of the country, including Owerri.

Many efforts have been made to achieve this through different disease control methods. Ploetz (2000) reported the availability of fungicidal control of diseases and its expensive nature and high risk of environmental pollution and hazards to humans. Thomason and Caswell (1978), reported the costly nature of synthetic chemical control of soil-borne pathogenic fungi and nematodes. Anastasia *et al* (1977) corroborated the foregoing, stating the side/residual effects of such chemicals.

The influence of cultural practices in the control of plant diseases has been studied. Obasi *et al* (2010) reported the use of resistant cultivars and application of mulch on seedbeds to control pathogenic fungi. In south east (including Owerri), there is dearth of scientific and research information regarding the effect of such cultural practices on fusarium wilt of tomato. This paper, therefore, seeks to bridge this gap and to proffer solutions to the problem.

MATERIALS AND METHODS

The experiments (in the field and in the laboratory) were carried out at the Teaching and Research Farm and at the Crop science and Technology of School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Imo State. The climate of the area is mainly tropical, and characterized by a heavy bimodal rainfall pattern (FDALR, 1985). Owerri is also characterized by mean annual rainfall of about 2500mm, which spans a period from early March to October, with a dry spell (August Break). The minimum and maximum mean annual temperatures are, respectively, 22.5^0C and 31.9^0C (Nwosu and Adeniyi, 1980).

The experimental design used was a 3 x 4 factorial in Randomized Complete Block Design (RCBD), replicated four (4) times. The treatments included (i) three levels of factor A: three tomato cultivars – ROMA VF cultivars (A_1), RIO GRANDE cultivar (A_2) and TROPIMECH cultivar (A_3). (ii) Four levels of factor B: four mulch materials – No mulch (B_O) – the control, Grass mulch (B_1), Wood shavings (B_2) and Palm kernel shells (B_3). There were a total of 48 treatment combinations (that is 12 treatments per block). The treatments were randomly assigned to the experimental plots by the use of random numbers (Wahua, 1999). Randomization was done separately for each block.

TRANSPLANTING TO THE EXPERIMENTAL PLOTS

Transplanting of the three tomato cultivars seedlings (ROMA VF, RIO DRANDE and TROPIMECH) was done to the experimental plots at six (6) weeks. The spacing distance was 0.75 x 0.50m, between and within rows, respectively, giving a plant population of 12 plants per plot. Transplanting was done in the month of May, 2015. Nursery trays were adequately watered before the crops were lifted. Enough soil lumps were included in the trowel as the seedlings were uprooted to ensure minimal root distortion and damage, and high survival percentage in the field. Transplanting was done in the early hours of the morning and late in the evening to reduce transplanting shock due to hash field conditions.

APPLICATION OF MULCHING MATERIALS

The treatments, comprising the dry grass, wood shavings and palm kernel shells, were randomly applied to the various plots. The control plot did not receive any mulch application. Mulching was done one week after transplanting (WAT). Each plot was closely monitored to determine the incidence and severity of fungal diseases.

DETERMINATION OF DISEASE INCIDENCE AND SEVERITY

Disease incidence was assessed by visually counting the number of infected plants in a plot and multiplying by one hundred (100).

Thus,

Disease incidence (DI) =

$$\frac{\text{Number of infected plants}}{\text{Total number of (healthy and infected) plants}} \times 100$$

Disease incidence was assessed per plot and recorded in percentage.

Disease severity (DS): This is the proportion of the plant affected by the disease; this was estimated using the observation and scoring method according to the format described by Ford and Herwitt, (1980).

Table 1: Ford and Hewitt (1980) = Rating Scale of Disease Severity

Disease severity	Scale	Interpretation
1-20	1	Slight infection
21-40	2	Moderate infection
41- 60	3	Severe infection
61- 80	4	Very severe infection

81- 100 5 Leaves completely infected

Disease assessment was based per plot.

RESULTS AND DICUSSION

Table 2 shows the effect of plant mulches and tomato cultivars on the number of tomato leaves per plant. The result indicated significant (P<0.05) differences in the mean number of leaves due to effects of plant mulches and tomato cultivars used in the experiments at 2 week after transplanting. Similarly, plant mulches significantly (P<0.05) affected tomato leaves production in the 4th and 6th week after transplanting. Habtamu *et al (*2016*),* reported the influence of mulching and varieties on growth and yield parameters of tomato. The tomato cultivar that recorded the highest mean number of leaves was Tropimech (8.26), mulched with wood shavings. Tomato cultivars significantly (P<0.05) affected tomato number of leaves in 2nd week and 6th week after transplanting respectively. The effect of grass mulch on tomato growth performance was attributed to its favourable effect on soil temperature and soil moisture (Habtamu *et al, 2016*).

Table 2: Effect of plant mulches and tomato cultivars on the number of tomato leaves per plant in 2015

Tomato cultivar/ Mulch type	2 WAT					4 WAT					6 WAT				
	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean
ROMA VF	4.92	5.08	5.58	5.42	5.25	7.83	6.00	5.83	5.67	6.33	3.25	1.50	1.50	1.50	1.94
RIO GRANDE	5.42	5.84	5.83	5.34	5.61	5.75	8.00	6.38	6.42	6.64	0.00	0.00	1.25	0.00	0.31
TROPIMECH	8.08	6.84	6.75	7.42	7.27	8.38	8.00	8.54	8.04	8.24	7.79	7.50	0.00	5.25	5.14
Mean	6.14	5.92	6.05	6.06		7.32	7.36	6.92	6.71		3.68	3.00	0.92	2.25	
LSD (0.05) Cultivar:	0.66					1.02					2.94				
LSD (0.05) Mulch:	0.76					1.18					3.39				
LSD (0.05) Cultivar x Mulch:	1.32					2.05					5.87				

Table 3 indicates the effect of plant mulches and cultivars on the height of tomato plant. The mean heights of tomato plant was significantly (P<0.05) affected by the tomato cultivars at 2nd and 4th weeks

after planting. Tropimech recorded the highest height at 4th week after transplanting (24.17) mulched with wood shavings. The effects of mulches on soil properties (temperature and moisture) and tomato production have been studied (Schonbeck and Evanylo, 2008). Rwezaula *et al (*2015*)* observed that different mulch types have varying effectiveness for enhancing performance because of different capacities in absorbing moisture due to their aggregate nature and in allowing air circulating.

In general, mulching seemed to promote better performance of the tomato variety in most of the yield components, including plant height (Rwezaula *et al,* 2015*)*.

Table3: Effect of mulch materials and tomato cultivars on the height (cm) of tomato plant in 2015

Tomato cultivar/ Mulch type	2 WAT					4 WAT					6 WAT				
	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean
ROMA VF	14.33	12.75	14.33	13.83	13.81	13.58	14.33	12.92	13.84	13.67	6.50	4.00	0.00	0.00	2.63
RIO GRANDE	16.5	14.25	15.83	15.83	15.60	13.17	19.79	17.42	18.09	17.12	0.00	8.75	0.00	0.00	2.19
TROPIMECH	19.84	17.67	19.08	17.5	18.52	20.46	22.25	24.17	20.29	21.79	14.00	15.00	0.00	7.00	9.00
Mean	16.89	14.89	16.41	15.72		15.74	18.79	18.17	17.41		6.83	9.25	0.00	2.33	
LSD (0.05) Cultivar:	1.07					3.72					8.78				
LSD (0.05) Mulch:	1.24					4.30					10.14				
LSD (0.05) Cultivar x Mulch:	2.14					7.44					17.57				

Table 4: Effect of mulch materials and tomato cultivars on tomato wilt disease incidence (%). The percentage wilt disease incidence was significantly (P<0.05) affected by tomato cultivars at 6th week after transplanting. Observed differences in the wilt disease incidence in the various cultivars may be attributed to the innate resistant quality of various cultivars to the wilt pathogen. Agbenin *et al (*2000*),* observed the difference in the levels of resistance by various tomato cultivars and varieties.

A variety of effects on plant diseases, positive and negative, result from the use of mulches. Mulches contribute to disease management in various ways. Reduction or prevention of soil splashing is an important function of mulches in the management of some plant pathogens (Fitt and McCartnry, 1986; Gilbert, 1956). However, mulches do not always reduce disease incidence (Turston, 1992). This is evidenced from the high disease incidence observed in the cultivars mulched with palm kernel shell.

Table 4: Effect of mulch materials and tomato cultivars on tomato Wilt Disease incidence (%) per plot in 2015

Tomato cultivar/ Mulch type	2 WAT					4 WAT					6 WAT				
	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean
ROMA VF	27.08	25.00	20.83	25.00	24.48	72.92	68.75	77.08	68.75	71.88	93.75	93.75	97.92	97.92	95.84
RIO GRANDE	20.83	20.83	27.08	22.92	22.92	68.75	79.17	70.75	70.83	72.38	97.92	100.00	97.92	97.92	98.44
TROPIMECH	22.92	16.67	10.41	12.50	15.63	64.58	77.08	77.08	75	73.44	85.42	93.75	97.92	93.75	92.71

Mean	23.61	20.83	19.44	20.14		68.75	75.00	74.97	71.53		92.36	95.83	97.92	96.53	
$LSD_{(0.05)}$ Cultivar:	7.62					6.24					4.04				
$LSD_{(0.05)}$ Mulch:	8.80					7.21					4.67				
$LSD_{(0.05)}$ Cultivar x Mulch:	15.25					12.49					8.09				

Table 5: Effects of mulch materials and tomato cultivars on the wilt disease severity per plot.

The results of the tomato wilt disease severity per plot are presented in table 5 above. Tomato cultivars significantly ($P<0.05$) affected the tomato wilt disease severity only in the 2nd weeks after transplanting. Plant disease is the limiting factor in tomato production in many parts of the world when cultivars with resistance to numerous diseases are not planted (Jones *et al., 1993*). This was also confirmed by the assessment in the field of study. Agbenin *et al* (2000), observed the difference in levels of resistance by various tomato cultivars and varieties. Wilt disease severity was highest in ROMA VF which was mulched with palm kernel shell. Cook *et al*., (1978) reported the effect of crop residues, including organic mulches, on plant diseases as providing food and a place to live and reproduce for the various pathogens that cause the diseases. Plant residues and mulches also intensify microbial activity of the soil and this, along with a variety of decomposition of products (some phyto-toxic or fungi-toxic), may affect pathogens, susceptibility of the host plants or both (Cook *et al,* 1978).

Table 5: Effect of mulch materials and tomato cultivars on tomato Wilt Disease severity per plot in 2015

Tomato cultivar/ Mulch type	2 WAT					4 WAT					6 WAT				
	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean	No mulch	Grass mulch	Wood shavings	Palm kernel shell	Mean
ROMA VF	3.00	2.50	2.75	3.25	2.88	4.25	4.00	4.25	4.00	4.13	5.00	5.00	5.00	5.00	5.00
RIO GRANDE	2.25	2.25	2.00	2.50	2.25	4.00	4.25	4.50	4.25	4.25	5.00	5.00	5.00	5.00	5.00
TROPIMECH	2.25	1.75	2.00	2.00	2.00	4.50	4.75	4.25	4.25	4.44	5.00	5.00	5.00	5.00	5.00
Mean	2.50	2.17	2.25	2.58		4.25	4.33	4.33	4.17		5.00	5.00	5.00	5.00	
$LSD_{(0.05)}$ Cultivar:	0.49					0.33									
$LSD_{(0.05)}$	0.50					0.33									

Mulch:	7	8
$LSD_{(0.05)}$		
Cultivar x	0.9	0.6
Mulch:	9	6

CONCLUSION

The result of this present experiment has provided a deep insight into the effect of specified mulch materials and tomato cultivars on the incidence and severity of wilt disease of the tomato. It can also be used to formulate effective disease management strategy against the wilt of *Lycopersicon esculentum.*

REFERENCES

Agbenin, N.O., Erinile, A.M. and Marley, P.C. (2000). Effect of population pressure of *Meloidogyne incognita* on stability resistance to Fusarium wilt in tomato. Proc. 18th Hortson Conference IAR ABU, Zaria. May, 28 – June 1, 2000. Pp. 143- 150.

Amati, M., Dekker, E., Lingen, T.V., Pinners, E. and Ram, S.C.A. (1989). How to grow tomatoes and peppers (p. 6-60).

Anasraciah, N., Ngigi, P. and Ndalut, P.K. (1977). Evaluation of Natural Products as Possible Alternatives

Cook, R.J., Boosalis, M.G. and Doupilnik, B. (1978). Influence of crop residues on plant disease. Pp. 147- 163. In: Crop Residue Management Systems. *Am. Soc. Agron. Sec. Publ. 31*. Madison, WI.

FDALR (Federal Department of Agriculture and Rural Land Resources) (1985). The Reconnaissance Soil Survey of Imo State. Soil Report. 133p.

Fitt, B.D.L.and McCartney, H.A. (1986). Spore dispersal in splash droplets. Pp. 87-104. *In: Water, Fungi*

and Plants. Univ. Press., Ayres, P.G. and L. Boddy, edu., Cambridge.

Gilbert, J.C. (1956). Soil mulches of local material. *Hawaii Farm Sc.* 4(4): 4-5.

Jones, J.B., Jones, J.P., Stall, R.E. and Zitter, T.A. (1993). Compendium of Tomato Diseases. The American Phyto-pathological Society. Minnesota. USA. 34P

Nwosu, A.C. and Adeniyi, E.O. (1980). A Survey of Resources for Development, NISER, Ibadan, 310p.

Obasi, C.O., Muoneke, C.O. and Olojede, A.O. (2010). Effects of Nitrogen rates and maize/sweet potato intercrop on the growth and yield of maize.

Poetz, R. (2000). Diseases and Pests: A review of their importance and management. In INFORMUSA. *International Journal on Banana and Plantain.* Vol. 13, No. 2, Dec. 2004, 11-16.

Rwezaula, G.J., Loth, S., Mulungu,C. G., Ishengoma, S.O.M., Reuben, S.N., Msolla, A.P., Maerere, Paul J.R., Njau, G.C., Ashimogo, T., Tjisekwa, T. Mvena and Henry S. Laswai (2015). Effects of organic mulch types on common biotic and abiotic factors and components of yield in determinate and indeterminate tomato (*Lycopersicon esculentum* Mill) commercial cultvars. *Asian Journal of Plant Science.* Vol. 4; Issue 6; Page No. 580 – 588.

Schonbeck, M.W. and Evanylo, G.K. (2008). Effects of mulches on soil properties and tomato production 1. (Soil temperature, soil moisture and marketable yield). *Journal of Sustainable Agriculture. Vol. 13, 1998 issue-1.*

Thomason, I.J. and Caswell, E.P. (1978).Principles of nematode control. In Principles and practice of Nematode control in crops. R.H. Brown and Kerry, B.R. (Eds.) Acad. Press. Australia. 447p.

Thurston, H.D. (1992). Bacterial Wilt of Potatoes in Colombia. *Ann. Potato J.* 40: 381- 390.

Wahua, T.A.T. (1999). Applied Statistics for Scientific Studies. 347p.