The effect of Mulching and Staking on the Development of Early and Late Blights of Tomato

Lyimo, H.F.J., T.D.M. Tiluhongelwa, A.P. Maerere and P. Njau
Department of Crop Science, Sokoine University of Agriculture, P.O.Box 3005, Morogoro, Tanzania

Abstract

*The effect of mulching and staking on the development of early and late leaf blight of tomato (**Lycopersicon esculentum** (Mill)) caused by **Alternaria solani** (Ell. & Mart.) and **Phythophthora infestans** (Mont.), respectively, were studied using a randomized complete block design replicated four times. Mulching and staking significantly (P = 0.05) reduced the incidence of early and late blights by 5 to 20% and increased fruit yield more than two folds compared to unmulched and unstaked controls. The apparent rate of infection of the two pathogens was also significantly lower (P = 0.05) in mulched and staked tomato than in the controls. Mulching was more effective than staking in suppressing early and late blight diseases in tomato. Mulching and staking when combined significantly (P = 0.05) reduced the incidence of the two diseases by 20% compared to when the two practices were used separately.*

Keywords: Mulching, staking, *Alternaria solani*, *Phytophthora infestans*, *Lycopersicon esculentum*.

Introduction

Mulching and staking are common cultural practices used in tomato production in Tanzania. Mulching is the practice of covering the soil with materials such as dry grasses, litter or plastic sheets while staking involves supporting growing tomato plants with standing poles to keep them off the ground. Sanchez and Salinas (1981) reported that mulching is an ideal practice in the tropics as it reduces soil temperatures and soil erosion. Pereiera and Jones (1954) reported that mulching increased the soil biological activities and water infiltration thus maintaining better soil water relations. Mulching has also been reported to increase the soil cation exchange capacity which allows soils to store more nutrients (Karl and Johannes, 1974).

Staking has been reported to minimize fruit rots in tomato. According to Kwapata (1990) staking modifies the soil moisture, air temperature, radiation and evapo-transpiration, an effect which lowers the incidence of tomato diseases. In addition, staking exposes the leaves to the sun and thus increases plant photosynthetic efficiency leading to higher tomato yield compared to unstaked controls.

Although there are many reports on the effect of staking and mulching on tomato yield (Chapman, 1964; Nganga, 1971; Quinn, 1974), very few studies have addressed the effect of staking and mulching on the development of tomato diseases.

*Corresponding author

Miller (1977) reported that the incidence of nematodes in tomato was higher in mulched than in unmulched plots. Staking significantly reduced the severity of blight (Quinn, 1974), however, Patterson (1990) reported that staking reduced the initiation of early blight in tomato.

The objective of the current study was therefore to investigate the effect of mulching and staking practiced alone and in combination on the development of early and late leaf blights of tomato which are the most serious diseases of tomato in Tanzania, especially during the long rain season (February to May).

Materials and Methods

Experiments were carried out in the Horticultural Unit at Sokoine University of Agriculture, Morogoro, Tanzania (Latitude 5.8ES, altitude 520 m a.s.l., Oxisol). The cultivar money maker which is susceptible to early and late blight of tomato was used. Seeds were first sown in the nursery in sterilized forest soil. Seedlings were transplanted in the field in March 1996, when they were about 15 cm tall. The spacing used was 50 cm between rows and 35 cm between plants in the rows.

The randomized complete block design with four replications was employed. Treatments in each replication were (i) mulching practised alone (ii) staking practised alone (iii) a combination of mulching and staking (iv) unmulched and unstaked plots were used as controls. Where mulching and staking treatments were applied, dried grasses were used as mulch and were applied to cover the whole plot. Bamboo poles were used as stakes and plants were tied to the poles with sisal twine. Triple super phosphate fertilizer (TSP) was applied during transplanting at the rate of 60 kg/ha (basal application) followed by Sulphate of ammonia (SA) 14 days after transplanting at the rate of 30 kg/ha.

The severity of early and late blight was assessed using a scale code of 0-9, where 0 = no disease 1 = 5-10% infection, 2 = 11-20%, 3 = 21-30%, 4 = 31-40%, 5 = 41-50%, 6 = 51-60%, 7 = 61-80%, 8 = 81-90%, 9 = 91-100% of the diseased leaf area. The rate of increase of disease was recorded in different treatments as apparent infection rates (r) which were calculated in different treatments using the equation

$$r = 2.302 \log_{10} \frac{X_2 - X_1}{t_2 - t_1}$$

(Vander de Plank, 1963);
where :
r = apparent infection rate,
X_1 = disease severity at time 1 (t_1),
X_2 = disease severity at time 2 (t_2).

Ripe fruits were harvested every week and the weight of marketable fruits (yield) were recorded for each treatment.

Results

The incidences of early leaf blight (ELB) and late leaf blight (LLB) are summarised in (Table 1). The incidence of ELB was significantly high in unmulched and unstaked plots (75%) followed by mulched (70%) and staked (64%) tomato plots. The lowest incidence of ELB (56%) was recorded in plots where a combination of mulching and staking practices were applied. High incidence of LLB (48%) was recorded in unmulched and unstaked plots, followed by mulching (36%). The lowest incidence of LLB (28%) was observed in plots where mulching and staking were applied in combination, followed by staking alone (30%).

Table 1: Effect of mulching and staking on the incidence of early and late blight diseases on tomato

Treatment	Disease incidence (%)		Yield (kg/ha)
	Early blight	Late blight	
Unmulched and unstaked (control)	75a	48a	850a[1]
Mulching	70b	36b	1285b
Staking	64c	30c	1360bc
Mulching and Staking	56d	28d	2876d
Mean	66.2	36.0	1592.8
C.V.	0.36	1.57	23.3
S.E.	0.19	0.46	1.80

[1]Means followed by the same letters within columns are not significantly different (P = 0.05) by Duncan multiple range test

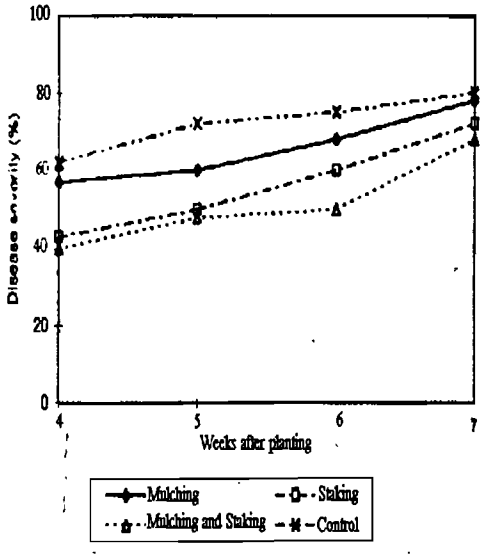

Figure 1: Effect of mulching and staking on the development of early blight of tomato

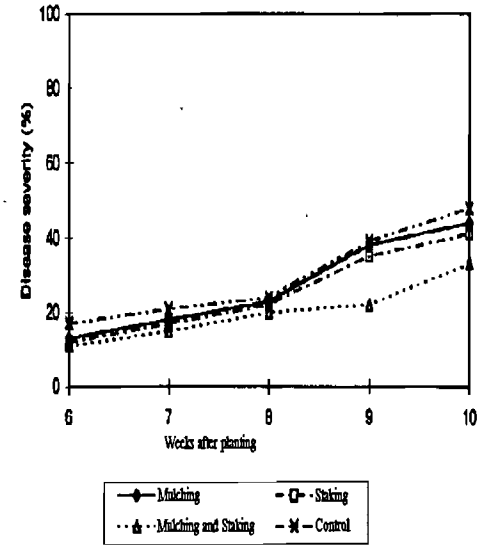

Figure 2: Effect of mulching and staking on the development of late leaf blight of tomato

The progress of ELB and LLB during the season is shown in Figures 1 and 2, respectively. The severity of ELB was higher in controls than in tomato plots where mulching and staking were applied, alone or in combination (Fig. 1). Initially, the severity of ELB was relatively low in plots which mulching or staking was applied alone, but later in the season the severity of ELB was high and did not differ significantly (P=0.05) with controls. The severity of LLB followed a similar trend (Fig. 2). Tomato plots where a combination of mulching and staking was applied had low levels of LLB throughout the period of the experiments. However, plots

Table 2: Apparent infection rates (r) of early and late leaf blights and yields of tomato under mulching and staking applied separately or in combination

Treatment	Apparent infection rate (r:unit/week)		Yield (kg/ha)
	Early blight	Late blight	
Mulching alone	0.27	0.039	1285b[z]
Staking alone	0.23	0.031	1360bc
Mulching and Staking	0.17	0.028	2876d
Unmulched and unstaked (Control)	0.35	0.040	850a

[z] Means followed by the same letters not significantly different (P = 0.05) by Duncan multip le range test

which received mulching treatment alone had higher severity of LLB than those where mulching and staking were applied in combination (Fig. 2).

The rate of increase of disease inicidence indicated as the apparent infection rates (unit/week) between treatments is summarised in Table 2. The rates of disease increase (r) for both ELB and LLB were high in controls (r = 0.35 and 0.040 units/week, respectively) than in tomato plots where mulching and staking were applied. The lowest rates of disease increase (r = 0.17 and 0.028 units/week for ELB and LLB, respectively) were recorded in plots where mulching and staking were applied in combination.

Tomato yield (kg/ha) differed significantly (P = 0.05) between treatments (Table 2). Mulching and staking produced higher yield (2876kg/ha) than unmulched and unstaked (850kg/ha) treatments (a difference of more than two folds). Staking resulted in better yield (1360kg/ha) than mulching (1285kg/ha), however the yield difference was not statistically different ($P \leq 0.05$) (Table 2).

Discussion

Mulching with grasses, sawdust or banana leaves around tomato plants is a common practice in Tanzania. It primarily aims at reducing excessive soil moisture loss during the hot season, to suppress weed growth and helps to check soil erosion, maintain better soil temperatures and to improve soil fertility (Pereiera and Jones, 1954; Karl and Johannes, 1974). Results of the present study have shown that mulching could also reduce the incidence of early and late leaf blight diseases in tomato. Mulching applied over the whole plot significantly ($P \leq 0.05$) reduced the severity of early and late leaf blights of tomato compared to the unmulched and unstaked controls. The sporangia of A. *solani* and *P. infestans* which overseason in the soil are normally dispersed and deposited on young plants by rain splash. This constitutes the main source of primary inoculum at the beginning of the season capable of causing infection that can develop to epidemic levels if conditions are favourable (Singh and Bhattacharya, 1990; Agrios, 1998).

Ground cover provided by mulching in the present trials might have reduced the dispersal of sporangia of *A. solani* and *P. infestans* by rain splash, consequently decreasing the amount

of spores reaching the tomato leaves soon after transplanting. Therefore, despite the existence of conducive environmental conditions for the development of ELB and LLB diseases during the current study, low levels of blight diseases were generally recorded in mulched compared to unmulched treatments. This can be attributed to low level of initial inoculum from the soil reaching the plants at the beginning of the season which kept the disease at low levels.

The rate of increase of blight diseases shown as the apparent infection rate (r) was also low in mulched plots. The mulching material on the soil acted as a sponge which absorbed rain drops without causing soil splashing. This reduced rapid spread of sporangia from the soil, eventually leading to a very slow pace of building up of the diseases in mulched compared to the unmulched tomato plots. Where staking was used, there were also lower levels of blight diseases than in unstaked control (Table 1). Staking is reported to improve air movement around the plants preventing the build up of high relative humidity which favour development of fungal diseases (Quinn, 1974; Kwapata, 1990; Patterson, 1990). Thus low disease incidence in staked tomato plants in this study agrees with such previous reports. Moreover, both diseases were much reduced when staking and mulching were practiced together (Table 1). The current study has shown that mulching combined with staking can be used to suppress the incidence of and severity of fungal diseases such as early and late leaf blights.

The costs of spraying fungicides to control early and late blight diseases in tomato can be reduced by adopting mulching and staking practices. Mulching will moreover, enhance the improvement of soil properties (moisture retention, fertility, temperature and structure), thus ensuring high tomato yield. In these trials, there was an increase in tomato yield of more than two folds in mulched and staked plots which was caused by the low incidence of early and late blight diseases but also to the improved soil conditions due to mulching. Staking on the other hand, increased aeration thus reducing moisture levels in the tomato crop. Studies are needed to determine the effect of staking on moisture retention on tomato.

Acknowledgement

The authors acknowledge the Horticulture Unit, Sokoine University of Agriculture for providing the experimental materials.

References

Agrios, G.N.1998. Plant Pathology, 4th ed. Academic Press, New York, London, 635 p.

Chapman, T. 1964. Some observations on the effect of mulching in tomato. *Journal Agriculture Society Trinidad, Tobago*. 64: 197-206.

Karl, M.M.S. and Johannes, K. 1994. Sustaining growth, soil fertility management in Tropics small holdings. Morgrafverlag Wekershiim, Germany 702 p.

Kwapata, M.B. 1990. Response of contrasting to tomato cultivars to depth of applied mulch and irrigation frequency under hot dry tropical condition. *Butterworth-West India* 68: 301-303.

Miller, P.M. 1977. Interaction of plastic, hay and grass mulches and meta-sodium on control of *Pratylenchus penetrans* in tomato. *J. of Nematology* 9: 350-351.

Nganga, S.K. 1971. Some physiological and cultural investigations with fresh market tomatoes in Kenya. PhD thesis, Makerere University, Kampala. pp 67-68.

Patterson, C.L. 1990. Effect of cultural system on initiation, progression and severity of early blight. *Phytopathology* 80: 438-440.

Pereiera, H.C. and Jones, P.A. 1954. Field responses by Kenya coffee to fertilizers, manure and mulches. *Empire J. Experimental Agriculture* 22: 23-36.

Sanchesz, P.A. and Salinas, J.G. 1981. Low input technology for managing oxisols and ultisols in Tropics. *America Advances in Agronomy* 34: 279-406.

Singh, B.P and Bhattacharya, J. 1990. Appearance, build up and spread of late blight in relation to source of inoculum. *Indian Phytopathology* 43: 393-400.

Quinn, J.G. 1974. An evaluation of the method of mulching and staking tomato grown during rains in Samuri, Nigeria. *Horticulture Research* 13: 97-104.

Vander der Plank, 1963. Plant diseases epidemic and control. Academic Press, New York and London, 349 p.