Effect of Macro & Micro Nutrients on Occurrences of Fusarium Wilt (*Fusarium oxysporum)* in Tomato *(Lycopersicon esculentum Mill.)*

K.M.S Weerasinghe [a] A.H.K Balasooriya [b] S.L Ransinghe and L.C Wijethilka [n]

Keywords: *Fusarium* Wilt 1 / Micro Nutrients 2 / Macro Nutrients 3 / Tomato 4 / Tolerance 5

[a] [b] [c]Department of Agriculture and Plantation Engineering, Open University of Sri Lanka

Email kalindu_weerasinghe@yahoo.com
[n] Regional Agriculture Research Centre, Makadura

Background

Tomato (*Lycopersicon esculentum Mill.)* is a major horticultural crop with an estimated global production of over 120 million metric tons (F.A.O. 2007). Among the production constraints, many diseases and disorders affect tomatoes; Fusarium wilt caused by the fungus *Fusarium oxysporum* is one of the most devastating diseases affecting commercial tomato production .The disease caused by this fungus is characterized by wilted plants, yellowed leaves and minimal or absent crop yield. The disease is ranked as one of the top 6 important plant diseases in the world (Ploetz & Pegg, 1997).

Management of *Fusarium* wilt is mainly through chemical soil fumigation, crop rotation and using resistant varieties. Increasing use of chemicals causes several negative effects, development of pathogen resistance and environmental and health impacts .Thus, development and use of resistant cultivars and crop rotation is effective and eco-friendly for disease control. However, variable responses with cultivation conditions and time for breeding and rotating have been a matter of concern. Therefore, alternative treatments for control of plant diseases are needed.

According to literature availability of inorganic fertilizers has brought about the demise of many diseases through improved plant resistance. Some general references on nutrient-disease interactions include Datnoff et al. (2006), Engelhard (1989), Graham (1983), Graham and Webb (1991), Huber (1978, 1980), Huber and Graham (1999), and Huber and Watson (1974).

Popularity and demand for high quality, pesticide-free vegetables in Sri Lanka is increasing rapidly. & Growers prefer higher yield, and resistance to pest and disease. In order to increase the tomato production, it is essential to improve total yields and pest and disease tolerance.

Objectives

To evaluate the effect of macro and micro fertilizer combinations for tomato on occurrences of *Fusarium* wilt and improve tolerance of tomato for *Fusarium* wilt through proper nutrient management.

Research Design

This experiment was conducted at Regional Agricultural Research Center *Makadura* in alluvial soils during *Yala* season of 2011. Selected variety is *Thilina* Experimental design is Randomized Complete Block Design (RCBD).

Materials & Methods

There were seven treatments in this experiment and each treatment was replicated three times. Other than the DOA recommendation and without fertilizer there were five treatment combinations of Ontario recommended dosage of nutrients for tomato (Blom, et.al. 1989). Previously tomato planted and infested soils were used as a growing medium.

The mean data was subjected to the statistical analysis using SAS package and mean separation (Duncan's Multiple Range test at 5% probability level) procedures.

Counts of dead plants were made in 3 times weekly *Fusarium* wilt was identified by correlating symptoms either isolated cultures directly from dead plants.

Results and Findings

Effect of seven treatments on number of *Fusarium* wilt occurrences, total yield and root fresh and dry weight. Values are the means of three replications.

Treatment	Mean Values Root fresh Weight (g)	Mean Number of Fusarium Wilt Occurrences	Mean Values Total yield (kg)
T1	2.63 ^{C}	10 ^{A}	0 ^{F}
T2	3.63^{BC}	8 ^{AB}	7.39 ^{E}
T3	4.10 ^{B}	4 ^{C}	8.88 ^{CB}
T4	3.82 ^{B}	4 ^{C}	7.72 ^{ED}
T5	4.13 ^{B}	4 ^{C}	8.98 ^{B}
T6	10.76 ^{A}	3 ^{C}	10.07 ^{A}
T7	3.78^{B}	5 ^{C}	8.23 ^{CD}

T1 - Without Fertilizer

T2 - DOA Recommendation

T3 - DOA Recommended Dosage of Inorganic fertilizer and ORSMD for Tomato

T4 - DOA Recommended Dosage of Inorganic fertilizer and ORSMD for Tomato reduced by 25%

T5 - DOA Recommended Dosage of Inorganic fertilizer and ORSMD for Tomato increased by 25%

T6 - DOA Recommendation and ORSMD for Tomato

T7- Ontario Recommendation for Tomato

Note: Means with the same letters along the columns are not significantly different at $P > 0.05$. Measurements are the means of three replications.

T3, T4, T5 & T7 did not show a significant difference in terms of number of root fresh weight ; supply of boron was found to stimulate the root elongation (Pilbeam and Kirkby, 1985) this could be the reason for significantly higher root fresh weight in micronutrients containing treatments than T1(without fertilizer) & T2 (DOA recommendation). Adding organic manure with macro and micro nutrients may improve the soil physical properties this could be a one reason for higher root weight in T6. Increased root weight & surface increase the ability to absorb more amounts of nutrients from soil. Providing nutrient sufficiently is important for the full expression of genetic resistance.

Macro & micro nutrient containing treatments have significantly higher total yield than T1 & T2, T6 showed significantly highest total yield this can be due to favorable effect of macro and micro nutrient application with compost (favorable effects on the soil physical characteristics, and chemical properties not contained in chemical fertilizers) organic manure activates many species of living organisms, which release phytohormones and may stimulate the plant growth and absorption of nutrients (Arisha *et al.*, 2003).

Fusarium wilt occurrences were significantly higher in T1 and T2. In T1, this can be due to lack of essential elements. In the case of T2; this can be due to lack of essential secondary and micro elements supplementation. Dutta and Bremner (1981); Miller and Becker (1983) demonstrated that Mo applied to tomato roots reduced the symptoms of Verticillium wilt

T3, T4, T5, T6 and T7 did not significantly different in terms of occurrences of *Fusarium* wilt and show significantly more superior results than T1(without fertilizer) & T2 (DOA recommendation) This could be due to supplementations of secondary and micronutrient enhance the defense mechanisms in plant. An adequate supply of Mn and several other micronutrients are important in most of the active defense mechanisms. Mineral nutrients are the components of plants and regulate metabolic activity associated with resistance of a plant and virulence of a pathogen. Adequate nutrition is generally required to maintain a high level of disease resistance. Plants contain preformed anti-microbial compounds and have active response mechanisms where inhibitory phytoalexins, phenols, flavonoids, and other defense compounds accumulate around infection sites of resistant plants if the nutrients required for the synthesis or induction of those compounds are adequate Huber and Haneklaus (2007).Providing a sufficiency of Ca for nutrition greatly reduces *Erwinia carotovora*, *Fusarium solani*, *Pythium myriotylum, Rhizoctonia solani, Sclerotinia minor*, and *Sclerotium rolfsii* severity and increases resistance increase the structural integrity and resistance of the middle lamella, cell wall components, and cell membranes to the extracellular macerating enzymes produced by these pathogens Bateman and Basham, 1976; Kelman et al, (1989), Csinos and Bell (1989). Fusarium wilts of fruit and vegetable crops can be controlled by liming to increase soil pH and fertilizing with a nitrate source of N (Huber, 1989). In addition lowest mean numbers of Fusarium wilt occurrences were recorded in T6 which contain compost other than macro and micro nutrients this can be due to combine effect of all inorganic and organic elements. Compost improves soil properties. The high microbial activity in a healthy soil also may lead to general disease suppression. General suppression refers to a lessening of plant disease due to the high activity and dynamic interactions of many beneficial microorganisms within the soil community. Competition, parasitism and antibiosis between the plant pathogens and the beneficial soil microbes suppress disease. *Penicillium oxalicum* & *Trichoderma spp*. reduced the incidence of *F. oxysporum* De Cal et al., (1997), Bourbos etal., (1997). An effective method to encourage microbial activity and diversity is to increase the organic matter content of the soil; microbes in soil break down manure, compost, and other organic substances, which increase the available nutrients for plants. This process promotes healthier plants that are better equipped to survive and defend themselves against pathogen attack.

Conclusions

The study revealed that, macro & micro nutrient supplementation can significantly influence Fusarium wilt occurrences, total yield & root growth of tomato, pots amended with macro, secondary and micro nutrients performed significantly best in terms of resistance to Fusarium wilt & there was a significant increase in the total yield, & mean fresh & dry root weight to pots amended with DOA recommended dosage of fertilizer for tomato, without fertilizer treatment containing pots showed lack of tolerance this may be due to lack of nutrients in soil. The experiment revealed and highlights the requirements of essential macro, secondary and micro nutrient fertilizer package for tomato farming. Balance nutrition is one of the major factor affect Fusarium wilt occurrence in tomato.

References

Datnoff, L.E., Elmer, W., and Huber, D.M. (eds.). 2006. Mineral Nutrition and Plant Disease. APS Press, St. Paul, MN.

Engelhard, A.W. (1989) (ed.). Soilborne Plant Pathogens: Management of Diseases with Macro-and Microelements. APS Press, St. Paul, MN

Graham, R.D. 1983. Effect of nutrient stress on susceptibility of plants to disease with particular reference to the trace elements. Adv. Bot. Res. 10:221-276.

Graham, R.D. and Webb, M.J. 1991. Micronutrients and disease resistance and tolerance in plants. Pp 329-370. In J.J. Mortvedt, F.R. Cox, L.M. Schuman, and R.M. Welch (eds.). Micronutrients in Agriculture, Second Edition, Soil Sci. Soc. America, Madison, WI

Huber, D.M. and Arny, D.C. 1985. Interactions of potassium with plant disease. Pp 467-488. In R.D. Munson (ed.). Potassium in Agriculture. American Soc. Agron., Madison, WI.

Huber, D.M. and Haneklaus, S. 2007. Managing nutrition to control plant disease. Landbauforschung Volkenrode 57:4:313-322.

Huber, D.M. and Watson, R.D. 1974. Nitrogen form and plant disease. Annu. Rev. Phytopathol. 12:139-165.

Ploetz, R. C., Pegg, K. G., 1997. *Fusarium* wilt of banana and Wallace's line: Was the disease originally restricted to his Indo-Malayan region? Australasian Plant Pathology 26,239-249