EFFECT OF MACRO AND MICRO NUTRIENT ON INCIDENCES OF BLOSSOM END ROT IN TOMATO *(LYCOPERSICON ESCULENTUM MILL.)*

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

Introduction

Tomato (*Lycopersicon esculentum Mill.)* is a major horticultural crop with an estimated global production of over 120 million metric tons (F.A.O. 2007). In Sri Lanka 2009 the total production of tomato was 41,930 tons (Department of Census and Statistics 2009). Among the production constraints, many diseases and disorders affect tomatoes; Blossom end rot (BER) is one of the most deleterious physiological nutritional disorders that is common in all the tomato producing areas of the world and has been shown to create losses up to 50% (Winsor & Adams, 1987). In soil culture as well as hydroponic culture BER can dramatically reduce both quality and quantity of tomato fruit yield. BER is easily identified as a brown, leathery rot developing on or near the blossom-end of the fruit. Initial symptoms starts with small, light brown patches generally increasing in diameter and as the condition worsens the affected tissue become dark brown, sunken and leathery. Affected fruit may ripen prematurely. In time, lesions often become covered with a black mold. Management of BER is done mainly through application of calcium. However many studies revealed that BER is not caused by one single factor but by a combination of one or more factors which aggravate the effect, including: low soluble Ca (Kirby and Pilbeam, 1984); water stress, irrigation frequency, excessive rainfall (Adams & Ho, 1992); high and low transpiration (Paiva et al., 1998) and high Mg, Na, NH4 and K concentration (Ikeda & Oskawa, 1988) excessive use of fresh manure, susceptible cultivars (Saure, 2001) and damages to roots. Large number of researchers showed that poor supplementation or uptake of Ca as well as low transport of Ca to fruits can cause BER in tomato (Bradfield & Guttridge, 1984; Ho et.al., 1995; Marcelis & Ho, 1998; Grattan & Grive, 1999) therefore BER is also referred as a Ca- related disorder. Although there are also some strong contradictions that Ca deficiencies is not the main causative factor of BER (Nonami et.al., 1995; Saure, 2001; Franco et.al., 1999; Evans & Troxler, 1953) Sanure (2001) concluded that additional metabolic stress factors might be involved. Researchers suggest that incidence of BER in tomato is lower under high day time relative humidity (RH) than low RH. Although there are also some contradictions by Banuloes et.al., (1985) that increasing RH of the air close to the fruit enhanced the incidence of BER. Aktas et.al, (2005) reported that oxidative stress contributes to BER initiation but fruit Ca concentration was not affected by oxidative stress, but manganese concentrations in fruits were significantly reduced. It is a well known fact that micronutrients are mainly involved in plant enzymatic process and required to obtain high quality yields. Therefore the plant nutritionists face a new challenge to further understand the interactions between Ca and other essential elements and to investigate the influence of Ca and other essential elements on BER induction. Although secondary nutrients and micronutrients are not mainly considered in the department of agriculture recommendation for tomato, many authors report on micronutrient deficiencies in soil and beneficial effects of micronutrients when its supply to various cultivated plants is enhanced.

Objectives: The objectives of this study were to evaluate the effect of macro and micro fertilizer combinations and DOA fertilizer recommendation for tomato on incidences of BER and reduction/elimination of BER incidences through proper nutrient management.

Methods:*Thilina* Tomato plants were grown in bags filled with alluvial soil in open field at Regional Agricultural Research Center *Makadura* (Low country Intermediate zone). Experimental design is Randomized Complete Block Design (RCBD). There were seven treatments in this experiment and each treatment was replicated three times. Other than the DOA recommendation and without fertilizer treatment there were five treatment combinations of Ontario recommended dosage of nutrients for tomato (Blom et.al., 1989).The effects of fertilizer application on the number of BER incidences was counted and analyzed statistically using SAS statistical package. The treatment mean were compared by Duncan's Multiple Range test at 5% probability level (Duncan, 1955).

Results and Discussion

Results indicate that Tomato fruits with BER were found in both T2 and T5. In T2, DOA recommendation this can be due to lack of Ca supplementations. In the case of T5; this can be due to high amount of NH_4^+ -Nitrogen-supplementation than the Ontario recommended dosage for tomato. Ammonium dominated nitrogen supply may markedly increase the incidence of fruits with BER an effect which is ascribed to a depression of Ca uptake by the enhanced external NH_4^+ levels (Kirkby and Mengel 1967; Siddiqi et al. 2002; Akl et al. 2003; Heeb et al. 2005). T3, T4, T6 and T7 treatments were not significantly different in terms of incidences of BER and showed significantly more superior results than T2 and T5. This could be due to use of NO_3-N as a main N source; Taylor and Locascio (2004) claimed that Ca uptake is stimulated by the use of NO_3-N rather than NH_4-N or according to the findings of Silber et.al (2005); Aktas et.al. (2005); Turhan et.al 2006 this can be due to supplementations of micronutrients like Mn, B, Zn etc., may help to reduce the incidences of BER.

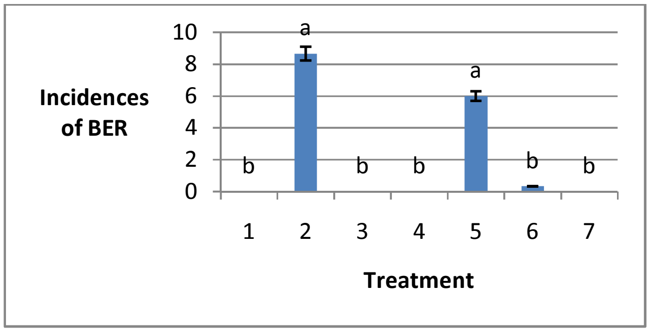

Figure: Effect of seven treatments on incidences of Blossom end rot in Tomato. Values are the means of three replicates.

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.
(ORSMD - Ontario Recommended Secondarily and Micronutrient Dosage)

This study clearly shows a strong relationship between essential plant nutrients and BER. BER is known to occur due to local Ca deficiency, and based on results it can be concluded BER is not depending on the Ca supplementation alone. Supplementation of all essential elements clearly decreased the incidence and severity of blossom end rot. As previous studies have shown Ammonium-N-dominated treatments showed higher incidences of blossom-end-rot (BER)-infected fruits; Calcium uptake rate can comparatively depressed by the presence of NH4+ since roots usually take this up more rapidly than Ca^{2+}. Supplementations of micronutrients like Mn and B dramatically reduce the percentage of BER incidences in tomato. Therefore future studies are required to better understanding of the mechanisms which represent the final control level of fruit susceptibility to BER disorder. And further investigations of the interactive effects of Ca, N, Mn, B and Zn on BER could be carried out.

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