Development of an integrated control of bacterial wilt of tomato

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Introduction

Bacterial wilt caused by *Ralstonia solanacearum* (syncnym *Pseudomonas solanacearum* Smith Yabuuchi *et al.*, 1992) is the major constraints limiting commercial tomato production in the lowland of Malaysia (Graham *et al.*, 1977). The pathogen is ubiquitous in Malaysian soils (Abdullah, 1993). Race 1, the most common in Malaysia, has a wide host range (Abdullah, 1992). Varieties said to be resistant to the disease in the countries of origin were susceptible to bacterial wilt when tested in Malaysia. This could possibly be due to the breakdown of resistance at high temperature (Ciampi and Sequiera, 1980), the conditions that are conducive to disease development in the tropics and/or the presence of the many strains of the pathogen in Malaysia (Abdullah, 1991, 1992 and 1993). Experiments conducted on the effect of Ca NO_3 on bacterial wilt disease development on *Capsicum annuum* and *Lycopersicon esculentum* indicated significant reduction of the disease of treated plants compared to the control (Abdullah and Rahman, 1997; Abdullah, 1999, unpublished). A tomato variety, MT 1 that was identified as highly resistant (Ho, 1988), do not have acceptable market value as it produces small fruits and low yield. Studies that were directed toward the control of the disease had only produce some level of control (Abdullah and Sijam,1992; Abdalla and Abdullah, 1998; Abdullah, 1998). Thus, to improve the resistance of moderately susceptible varieties, an integrated control measure seems to be the best solution to the problem. This study was therefore conducted to evaluate an integrated control management system, that uses moderately resistant variety, biological control and soil amendment in controlling the disease both in the greenhouse and the field.

Materials and Methods

Laboratory and greenhouse studies were conducted to determine the effect of different levels of Ca $(NO_3)_2$ on the growth of tomato seedlings. Seven rhizobacterial strains that showed antagonism against the pathogen were selected to determine their effect on the germination of tomato seeds and growth of the seedlings. Greenhouse trial was conducted to evaluate the effect of antagonist and nutrient enrichment on the incidence of bacterial wilt. A moderately susceptible tomato variety, MT 11 (Ho, 1988) was chosen for the experiment. Tomato seeds were treated with the two antagonists either individually or in combination at concentration of 10^8 cfu/ml in methyl cellulose. Seeds were primed for 2 days. Germinated seeds were planted in Jiffy pots containing potting mix up to 4 weeks after which they were transplanted into polybags containing sterilized soil mixture artificially infested with *R. solanacearum* at 10^6 cfu/g soil. Application of Ca $(NO_3)_2$ solution was done weekly prior to transplanting while 10g of granular Ca $(NO_3)_2$ was applied at weekly interval after transplanting. Stonier's medium was applied to the seedling at 4 days before transplanting. Recording of disease incidence was done at weekly intervals. The experiment was a completely randomized design with 4 replications and 5 plants representing one replicate. Analysis of data were done by the ANOVA and Tukey's Studentized test.

Field experiment was conducted to evaluate the effect of two varieties, MT 11 and Pearl Tomato (an imported hybrid variety), combination of two antagonist, $Ca(NO_3)_2$ with or without Stonier's medium, on the incidence of bacterial wilt. Tomato seeds were coated with combined strains of KTS 26 and AC 1, at a concentration of 10^8 cfu/ml in methyl cellulose. Seeds were primed for 2 days and germinated seeds were planted in Jiffy pots containing potting mix up to 4 weeks before they were transplanted to the field. Application of 0.5% Ca $(NO_3)_2$ were done twice weekly prior to transplanting and the Stonier's medium applied 4 days before transplanting. Field soil was inoculated with the pathogen by the soil drench method just before transplanting. After transplanting, seedlings were treated with Ca $(NO_3)_2$ granules at weekly intervals. The experiment was a factorial experiment with randomized complete block design, with 4 replications and one bed representing one replicate. Recordings of disease index were done at weekly intervals and data analyzed according to ANOVA and Tukey's Studentized Test.

Results and Discussion

Greenhouse studies showed that the application of Ca $(NO_3)_2$ solution prior to transplanting and Ca $(NO_3)_2$ granules after transplanting gave significant reduction of bacterial wilt disease on tomato seedlings planted in soils artificially infested with *R. solanacearum* at both inoculum levels of 10^4 and 10^6 cfu/g soil, when compared to the untreated control. Amongst the seven rhizobacterial strains tested, only two strains, KTS 26 and AC 1, gave significantly higher germination rate when compared to the methyl cellulose control. These two strains were therefore chosen for subsequent experiments which showed that strain KTS 26 significantly increased the fresh and dry weight of 4-weeks old tomato seedlings when compared to the untreated control while strain AC 1 did not give significant increase in the dry weight of the tomato seedlings.

Greenhouse trials indicated that all six treatments of antagonist, Ca $(NO_3)_2$ with or without Stonier's medium in different combinations were able to significantly reduce bacterial wilt disease compared to the control. However, no significant differences were observed between the treatments indicating that the Stonier's medium did not have significant effect in the control of the disease.

Field experiment indicated that treatments involving MT 11 were significantly different from those of the Pearl tomato variety, which did not have any surviving plants at the end of the experiment. The two treatments with the MT 11 could significantly reduce bacterial wilt incidence when compared to the control and subsequently their yield were also significantly higher. However, no significant difference was observed between the two treatments. This result corroborated the results of the greenhouse trial, which showed that the application of the Stonier's medium was unable to reduce disease incidence. This study also indicated that the antagonist and Ca $(NO_3)_2$ treatments were also unable to provide resistance to the very susceptible variety. Thus, some level of resistance to the disease in the variety used is essential for the integrated control measure to be effective.

Conclusions

Application of antagonist and Calcium nitrate was able to reduce incidence of bacterial wilt caused by *R. solanacearum* on Mt 11 variety but not the Pearl Tomato variety. The integrated control system was also able to significantly increase yield of the MT 11 tomato variety. This study, thus, indicated that control of bacterial wilt of tomato can be achieved in *R. solanacearum* infested soil by planting moderately bacterial wilt resistant variety treated with antagonist and application of calcium nitrate.

Benefits from the study:

Nil

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Nil

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