

Management of bacterial wilt of tomato using resistant rootstocks

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Abstract

Bacterial wilt (*Ralstonia solanacearum*) is a devastating disease of tomato that is quickly spreading and affecting many fields causing a reduction in yield and income to farmers. The objective of the study was to determine the effect of using tolerant tomato rootstock in wilt management. Field experiments were carried out in Kiambu, Ruiru, Karen and Isinya sites in farmers' greenhouses where previous crops were affected by the disease. A greenhouse variety Anna F1 was used as a scion and was grafted on rootstock varieties Cheong gang, Shin cheong gang and on a local wild tomato variety. Efficacy of biological product Rootgard® and a copper fungicide Nordox® were tested while non-grafted Anna F1 used as a control. Results strongly indicate that bacterial wilt disease severity and incidence was reduced when the susceptible Anna variety was grafted on Shin cheong gang. Grafting susceptible Anna F1 tomato variety on bacterial wilt tolerant Cheong gang variety reduced bacterial wilt incidence by 92%, Shin cheong gang by 95% and by 64% with the wild tomato variety. Plants grafted onto Cheong gang and Shin cheong gang had lowest disease incidence and produced high yield of tomato in quantity and quality when compared to non-grafted Anna F1. The study indicated that bacterial wilt can be effectively managed by grafting susceptible varieties on tolerant rootstocks. The grafted plants can be planted in fields that are infected with *R. solanacearum*.

Keywords: Cheong gang, Grafting, *Ralstonia solanacearum*, Shin cheong

Résumé

Le flétrissement bactérien (*Ralstonia solanacearum*) est une maladie dévastatrice de la tomate qui se propage rapidement et affecte de nombreux champs, entraînant une réduction du rendement et des revenus des agriculteurs. L'objectif de cette étude était de déterminer l'effet de l'utilisation de porte-greffes de tomate tolérants dans la gestion du flétrissement. Les expériences de terrain ont été menées dans les sites de Kiambu, Ruiru, Karen et Isinya dans les serres des agriculteurs où les cultures précédentes étaient affectées par la maladie. Une variété de serre Anna F1 a été utilisée comme rejeton et a été greffée sur les variétés porte-greffe Cheong gang, Shin cheong gang et sur une variété locale de tomate sauvage. L'efficacité du produit biologique Rootgard® et d'un fongicide à base de cuivre Nordox®

ont été testés alors que Anna F1 non greffé était utilisée comme témoin. Les résultats indiquent que la gravité et l'incidence de la flétrissure bactérienne ont été fortement réduites lorsque la variété Anna sensible a été greffée sur le gang Shin cheong. Le greffage de la variété de tomate Anna F1 sensible sur la variété Cheong tolérante au flétrissement bactérien a réduit l'incidence de flétrissement bactérien de 92%, le gang Shin cheong de 95% et la variété de tomate sauvage de 64%. Les plantes greffées sur le gang Cheong et le gang Shin Cheong présentaient la plus faible incidence de maladies et produisaient un rendement élevé en tomates en quantité et en qualité par rapport à Anna F1 non greffée. L'étude a indiqué que le flétrissement bactérien peut être efficacement géré en greffant des variétés sensibles sur des porte-greffes tolérants. Les plantes greffées peuvent être plantées dans des champs infectés par *R. solanacearum*

Mots-clés: Cheong gang, Grafting, *Ralstonia solanacearum*, Shin cheong

Introduction

Bacterial wilt of tomato caused by *Ralstonia solanacearum* is a soil borne disease and once it infests the soil, it easily spreads within the field as well as to adjacent fields not only affecting the crop but also rendering the farm unusable in the production of any solanaceous crops (Sequeira, 1993). The disease is known to spread very quickly through furrow irrigation as well as rain splashes (Taylor *et al.*, 2011). Control of the disease is challenging as use of chemical products is not effective in managing the disease (Hartman and Elphinstone, 1994). Use of cultural practices such as crop rotation is also not effective due to unpredictable survival of the pathogen (Sequeira, 1993). The pathogen has the ability to survive in the soil for a period of up to 10 years even in the absence of any vegetation (Sequeira, 1993; Smith *et al.*, 1995). The objective of this study was to evaluate the effectiveness of tomato rootstocks of resistant varieties in managing the bacterial wilt disease.

Materials and methods

Experiments were carried out in greenhouses in Kiambu and Karen representing a higher rainfall cooler region and Ruiru and Isinya sites representing lower rainfall warmer region. All the experiments were conducted in farmers owned greenhouses with *R. solanacearum* incidence levels of up to 50%. During land preparation thorough mixing of the soil was done to ensure uniform distribution of the pathogen. A greenhouse variety Anna F1 was grafted to rootstock varieties Cheong gang and Shin Cheong gang reported to have high resistance to bacterial wilt. Commercial products Rootgard® and Nordox® and ungrafted Anna F1 were included in the study as controls. The crop was managed as recommended for tomato. When disease set in, the numbers of wilted and dead plants were counted and recorded every week. Assessment of disease severity was carried out by cutting stems of wilted and dead plants and scoring for stem browning using a score of 0 – 3. Fruit weight per harvest was recorded and the yield per plot extrapolated to tons per hectare.

Results

Bacterial wilt severity scores were significantly lower in grafted tomatoes. On Cheong

Gang and Shin Cheong Gang rootstocks, disease severity was reduced up to 94%. No significant differences were observed in wilt severity of ungrafted tomatoes, Rootgard® and Nordox® treatments. All had high stem browning scores. Highest bacterial oozing score was observed on Anna F1, Anna F1 treated with Rootgard® and Anna F1 treated with Nordox®. On average, fruit yield was higher in grafted tomato (Table 1).

Table 1. Bacterial wilt scores and yield on tomato varieties grafted on different root stocks and treated with commercial chemical formulations in green house experiments conducted over two seasons

Treatment	First season		Second season	
	Wilt score	Fruit yield (t/ha)	Wilt score	Fruit yield (t/ha)
Anna F1	2.1 d	38.4 c	2.1 d	40.6 b
Anna F1 + wild tomato	0.5 b	24.8d	0.5 b	20.0 d
Cheong Gang	0.1 a	18.0 d	0.0 a	19.6d
Shin Cheong gang	0.0 a	18.2d	0.0 a	16.8 d
Anna F1 + Cheong gang	0.5 b	48.6 b	0.3 ab	40.8 a
Anna F1 + S. Cheong Gang	0.1 a	63.6 a	0.1 ab	59.2 a
Anna F1 + Rootgard®	1.5 c	40.0 c	1.8 c	29.2 c
Anna F1+ Nordox®	2.2 d	38.8 c	1.6 c	29.0 c
L.S.D. (P 0.05)	0.3	5.0	0.4	5.2
C.V. (%)	5.7	4.2	6.6	3.1

Discussion

Rootstock varieties Shin cheong gang and Cheong gang reduced disease incidence by over 94%. High tolerance of these varieties to bacterial wilt was also reported by McAvoy *et al.* (2012). Tomato varieties grafted on other rootstock varieties such as Dai Honmei have also showed low bacterial wilt incidence compared with non-grafted susceptible tomato (Cardoso *et al.*, 2012; Rivard *et al.*, 2012). King *et al.* (2010) had also reported that grafting susceptible tomato on resistant rootstocks can enhance disease tolerance and that their use in management of wilt disease has greatly increased in the recent past.

Grafting susceptible Anna F1 on to wild cherry tomato reduced bacterial wilt up to 87% indicating that the wild cherry tomato has bacterial wilt tolerance. This wild tomato can thus be used in improving susceptible tomato varieties. High bacterial wilt tolerance was also reported by Lu *et al.* (2003) in wild Chinese tomato cultivars. Tomatoes grafted on these varieties had a reduction in disease incidence of up to 100% and delayed symptoms development compared with non-grafted susceptible varieties. Rootgard® was not effective in reducing bacterial wilt disease. Higher fruit yield were recorded in Anna F1 grafted on Shin Cheong gang and Cheong gang rootstocks. Higher yield in these treatments was as a result of all the plants surviving to the end of the harvest period and enhanced root system.

The interaction between rootstocks and scions improves vigour of the root system for higher uptake of water and minerals leading to increased yield (McAvoy *et al.*, 2012).

Conclusions

Use of Shin cheong gang and Cheong gang as rootstocks for tomatoes can help to reclaim already abandoned land parcels that were unsuitable for production of tomato due to bacterial wilt disease. These rootstock varieties if used in combination with good agricultural practices and field hygiene can greatly reduce effect of the disease and reduce spread. Use of copper product Nordox® and Rootgard® was found not to be effective in managing bacterial wilt. High tolerance to the disease exhibited by the wild tomato indicates that indigenous wild tomato has inherent tolerance traits for the disease and thus can also be used as a rootstock or used for resistance breeding.

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