

Diversity of pathogens and symptoms associated with dieback on passion fruit in Kenya

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Abstract

Passion fruit is very important in Kenya as a source of nutrition and income. Currently, local demand for the fruit highly exceeds its supply. Diseases and pests are the most important constraints to passion fruit production. Among diseases, dieback has constantly been listed as one of the disease that requires highest priority in terms of management. The disease causes over 70% of total fruit losses in the country. With the goal of addressing the impact of dieback constraint on passion fruit production, research was carried out on the etiological and epidemiological aspects of the disease. The objective of this study was to identify the causal organisms of die-back. Samples of dieback infected passion fruit were collected from some passion fruit growing regions in Kenya and transported to the laboratory for pathogen isolation. The most frequently occurring fungi were tested for pathogenicity on passion fruit. Of the fungi found associated with diseased passion fruit, *Fusarium oxysporum*, *Fusarium semitectum*, *Fusarium solani*, *Phytophthora nicotianae*, *Alternaria passiflorae* and *Ascochyta spp.* caused symptoms similar to those in the fields. These findings lay a foundation for identifying the passion fruit die-back complex and designing its management approach.

Key words: Passion fruit dieback disease, pathogens, symptoms

Résumé

Le fruit de la passion est très important au Kenya en tant qu'une source de nutrition et de revenus. À l'heure actuelle, la demande locale pour le fruit dépasse de loin son offre. Les maladies et les ravageurs sont les contraintes les plus importantes pour la production des fruits de la passion. Parmi les maladies, le dépérissement a constamment été classé comme l'une des maladies qui exige la plus haute priorité en matière de gestion. La maladie provoque plus de 70% des pertes totales des fruits dans le pays. Dans le but d'atténuer l'impact de la contrainte de dépérissement sur la production des fruits de la passion, la

recherche a été menée sur les aspects étiologiques et épidémiologiques de la maladie. L'objectif de cette étude est d'identifier les organismes responsables du dépérissement. Des échantillons des fruits de passion infectés par le dépérissement ont été recueillis dans certaines régions de croissance des fruits de la passion au Kenya et transportés au laboratoire pour l'isolement des agents pathogènes. Les champignons les plus fréquemment rencontrés ont été testés pour la pathogénie sur les fruits de la passion. Des champignons trouvés associés avec les fruits de la passion malades, *Fusarium oxysporum*, *Fusarium semitectum*, *Fusarium solani*, *Phytophthora nicotianae*, *Alternaria passiflorae* et *Ascochyta* spp provoquent des symptômes semblables à ceux rencontrés dans les champs. Ces résultats jettent les bases de l'identification du complexe de dépérissement des fruits de la passion et la conception de son approche de gestion.

Mots clés: maladie de dépérissement des fruits de la passion, agents pathogènes, symptômes

Background

Kenya relies primarily on agriculture which contributes 24% of the GDP; hence government invests heavily in this sector (Ministry of Agriculture, 2010). However, production of most agricultural products, including passion fruit, has declined since the turn of the century due to several factors including those resulting from climate change (KAPAP, 2011). Passion fruit (*Passiflora edulis* Sims) was the third most important fruit in Kenya (at 8%) after avocado (62%) and mango (26%) in terms of foreign exchange earnings in the mid 2000's (Kahinga et al., 2006; HCDA, 2011). It is a pro-poor crop, being grown mostly by farmers owning 0.2 – 1 ha of land (Otipa et al., 2008). Farmers prefer growing passion fruit because of its fast maturity period of 9 months. It also requires minimum labor and land space (Kahinga et al., 2006). It therefore has enormous potential to generate wealth and improve livelihoods of its value chain actors.

Unfortunately, the passion fruit value chain is presently under immense stress primarily due to reduced productivity leading to scarcity of fruits to feed downstream chain activities (PSDA, 2011). Shortages in fruit supply have largely been attributed to pests and diseases. In Kenya, important passion fruit diseases include Fusarium wilt, Phytophthora canker, brown spot, the woodiness virus and the recently emerged die back disease (Mbaka et al., 2006). Die back results into over 70% fruit loss

(Wangungu *et al.*, 2010). The disease is fairly new in Kenya but its impacts have crippled the highly lucrative passion fruit industry and its value chain. Studies indicate that dieback is possibly a disease complex with diverse causal pathogens and disease symptoms (Kinyua *et al.*, 2008; Amata *et al.*, 2009).

Study Description

Samples of dieback infected purple passion fruit (*Passiflora edulis* var Sims) were collected from the major passion fruit growing regions in Eastern and Central Kenya (Gatundu, Meru and Murang'a areas). The samples were obtained from all parts of the plant (roots, vines, leaves, fruits and flowers) and transported to the laboratory for pathogen isolation. Dieback symptoms were observed and recorded under field conditions. Isolations were done under sterile conditions. Media used for isolation included Potato Dextrose Agar (PDA), Carnation leaf agar (CLA) and V8 juice. The most frequently occurring isolates i.e., isolates with $\geq 10\%$ occurrence in every 60 plates (replicated 3 times) were selected and subjected to pathogenicity tests. Pathogenicity tests involved inoculating the selected isolates on 4 months old purple passion fruit seedlings. Disease progress was assessed using a scoring chart developed specifically for dieback. The scoring chart has 1-5 scores/levels where 1 represents healthy plants while 5 represents a dying plant (Wangari and Mwangi, 2011). Symptoms elicited by each of the pathogens were observed and recorded for comparison with symptoms observed in the field. Isolates eliciting mean disease scores at level 2 and above were considered to have a role in occurrence of dieback and therefore selected for identification. Isolates were identified using various identification keys specific for their respective genera and from information obtained from the internet. Identified pathogens were then subjected to pathogenicity tests in combinations.

Research Application

Fourteen fungal isolates were obtained from the samples collected from the field but only eight occurred frequently in all culture plates. When these 8 isolates were subjected to pathogenicity tests, 6 elicited symptoms associated with dieback that include shoot dieback, brown and black spots, point death, fruit falls and vascular discoloration. The pathogens identified include *Fusarium oxysporum*, *Fusarium semitectum*, *Fusarium solani*, *Phytophthora nicotianae*, *Alternaria passiflorae* and *Ascochyta* spp. Dieback symptoms observed in the field and on seedlings subjected to individual and combined pathogens fell under four categories, i.e., dieback, point death, brown spot and vascular discoloration. These findings are

expected to lay the foundation for identifying effective dieback management options which will be crucial in reviving the passion fruit industry in Kenya.

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