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Reducing dieback disease incidence of passion fruit in Kenya through management practices

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Abstract Dieback disease is the most important constraint to Kenya's passion fruit industry. It is widespread in all passion fruit growing areas and causes over 70% of total fruit loss in the country. Farmer practices such as use of unsterilized tools during pruning and grafting spread the disease. Inadequate plant nutrition and prolonged drought periods associated with climate change have been linked to increased disease severity. Dieback management efforts have focused on integrated measures that include plant nutrition, irrigation and use of fungicides. This study was carried out to evaluate the effectiveness of selected farmer practices in reducing spread of dieback in Central and Eastern Kenya. Data were obtained through surveys and from observations of agronomic practices in farmer managed experimental units. Selected farmer practices were simulated in experiments to identify their roles in disease spread. A Completely Randomised Block Design-Field experiment was set up to test efficacy of selected plant nutrients and fungicides in managing dieback. Nutrients tested included phosphorus as Triple Superphosphate (TSP), Calcium Ammonium Nitrate (CAN) and Mavuno® fertiliser (contains NPK and micronutrients), all applied at rates recommended for passion fruit. Fungicides tested included Fosfite®, Milraz®, Ridomil® and Topsin® applied as recommended by the manufacturer. Results indicated slowed disease spread to uninfected vines through proper field sanitation, pruning and removal of infected plants and plant parts. In plants where infected vines were not pruned, disease severity increased from a moderate rating of between 2 and 3 to a more severe infection scores of 4 or 5 within 3 weeks. Disease spread was slower during the rainy season, suggesting that water stress increased severity of infection. Application of fertilisers appeared to limit severity by boosting plant health and triggering recovery through regeneration of new tissue if applied at the early stages of infection. Applying fertilisers on plants infected at severity level 4 and 5 had no significantly beneficial effect on plant health. If applied as recommended, the tested fungicides reduce disease progress, but none is curative.

Key words: Disease management, fungicides phosphorus, nutrients

Introduction

Passion fruit (*Passiflora edulis* Sims) is the third most important fruit in Kenya, after mango and avocado in terms of foreign exchange earnings (Kahinga *et al.*, 2006). The fruit was introduced in Kenya in the early 20th century. Today, the fruit is widespread both in the farming areas and in the wild, from the coastal regions to the highlands where it is adapted to diverse agroecological conditions. The key production areas include Central, Eastern, Western regions, the Central - North Rift and Kisii districts (Otipa *et al.*, 2009).

Pests and diseases are the major constraints to passion fruit production. The major diseases are caused by fungal pathogens among which dieback is the most important. As a result of the diseases, many industrial processors are operating below installed capacity while others are importing pulp (Otipa *et al.*, 2009). Farmers have shifted to low income earning activities like vegetable cultivation, lumbering and charcoal burning.

Dieback is a fairly new disease to passion fruit production in Kenya. It was first recorded in 2004 in Central Kenya (Mbaka *et al.*, 2006) and is currently widespread in most passion fruit producing areas. The disease is highly virulent, spreads rapidly causing excessive fruit loss and reduces orchard lifespan to less than 2 years (Otipa *et al.*, 2009).

Research indicates that dieback is a disease complex involving fungal pathogens such as *Fusarium* (*F. oxysporum, F. semitectum, F. pseudoanthophilum, F. subglutinans and F. solani*) and *Phytophthora* (P. *nicotianae*) and possibly others (Amata, 2009). It is estimated that it has contributed over 70% of the total fruit decline since 2007. The disease is not well understood and efforts are ongoing to generate information as well as devise effective management practices that will aid in curtailing further spread and alleviate production decline (Wangungu *et al.*, 2010).

This research was carried out in order to generate and document new knowledge on dieback and identify effective management practices that will contribute towards improving production.

Materials and Methods

Research activities were carried out in Meru 1800 metres above sea level (Meru Central - AEZs UH_1, UM_1, UM_2, and LH_1) Muranga 1400-2200 M.ASL (Mathioya- AEZs

UH_0, UM_1, UM_2, UM_3 UM_4, LM_1 and LH_1) and Thika 1200-800 M.ASL (Gatundu and Kenyatta Universtiy-LH_4, LH_5, UM_1, UM_2, UM_3, UM_4 and UM_5,) counties.

Besides being the major passion fruit production areas in Central and Eastern regions of Kenya, the counties had also experienced severe dieback pandemic with losses reaching 100% in some places. Research sites were identified in areas where both passion fruit production and dieback disease incidences were highest within the study areas with Thika County being an exemption (was represented by Kenyatta University research site).

Purple passion (*Passiflora edulis* Sims) fruit plants were identified in an infected orchard and tagged. Follow ups were made through a dry and a wet season which stretched over a 7 months period. Disease severity was recorded using the dieback disease score chart. A disease curve was plotted against that of rainfall data (obtained from the District Agricultural offices) for the 7 months.

Three fertilizers, i.e. Calcium Ammonium Nitrate (CAN), Triple Superphosphate (TSP) and Mavuno® fertiliser for fruits and trees (contains NPK and important micronutrients required by plants) were assessed for their ability to contribute to the well being of the plants, hence, contributing to lowered disease incidence. Sixteen replicate plants per treatment were used. The fertilisers were applied in rates recommended by the manufacturer after every 3 months. The dieback disease scoring chart, measurements of bud length increase every 21 days and leaf count every 21 days were used to assess the disease incidence at plant level on treated plants.

The efficacy of 4 fungicides in controlling dieback was assessed under field conditions. These were metalaxyl (Ridomil MZ 68 WG), phosphonate (Phosphite 53 SL), propineb and cymoxanil (Milraz WP 76) and thiophanate (Topsin M) all applied at rates and duration recommended by the manufacturer i.e. (Ridomil 2.5g^{-1}L; Fosfite 3mls^{-1}L; Milraz 2g^{-1}L; Topsin 2mls^{-1}L).

Two farmer managed sites (Site A and Site B) were identified in Meru Central. Farmer practices assessed include prunning and desuckering, weeding, water supply, plant nutrition and use of fungicides. Field visits were carried out after every 6 weeks for a period of 6 months and data on disease progress and orchard maintenance level recorded. The appropriateness of the practices was gauged based on disease severity/incidence.

The dieback disease scoring chart used to assess disease severity for all the experimental units is categorised as in Table 1.

Results and Discussion

Effects of rainfall on dieback disease severity. High disease incidences (Fig. 1a) during the low rainfall seasons (Fig. 1b) may have resulted from water stress. This supports reports on effects of drought increasing dieback incidences (Otipa unpublished 2008).

Effects of fertiliser use on dieback disease. The calculated P for average disease score while using the three fertilisers was P=0.042 which was significant at P=0.05. Mean separation with LSD showed that there was significant difference between the treatments (Table 2). There was however no significant differences between average leaf bud length and average leaf number increase every 21 days across the 3 fertiliser treatments.

Mean scores for all the fertilisers was above 2.0. When inferences are made from the dieback disease chart (Table 1), this is a moderate level of disease severity which often escalates in case of plant stress such as water unavailability. The fertilisers, therefore, do not cure dieback but only minimise its impacts.

Effects of fungicide use on dieback disease severity. Calculated P for average disease scores while using

Table 1. Dieback disease scoring chart.

Disease score/level	Disease aspects on infected plants or orchard
1	0% (no infections on plant)
2	1 – 15% (slight infection)
3	16 – 40% (plant ½ infected)
4	41-75% (plant ¾ infected)
5	e”76% (plant dying up or dead)

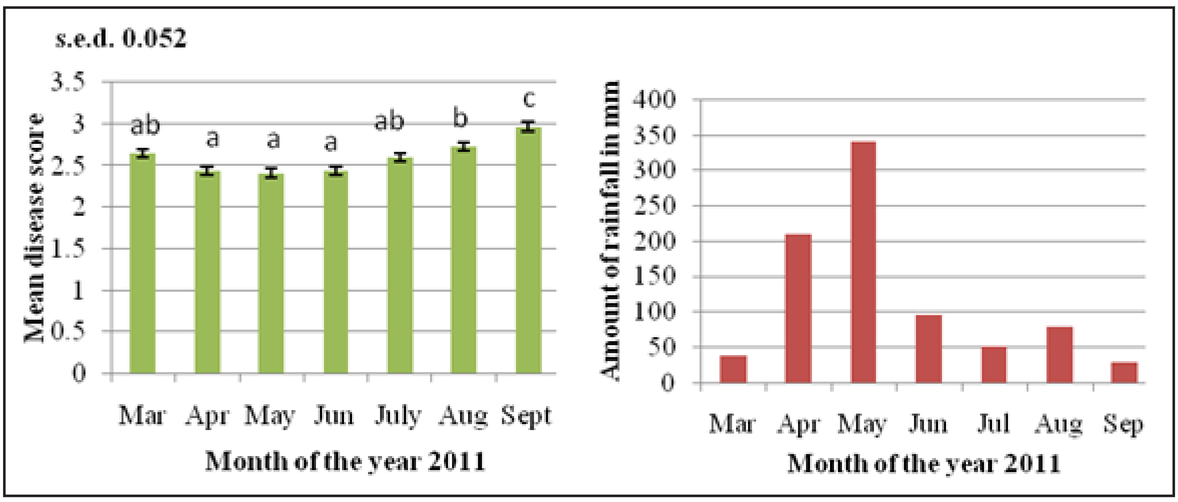

Figure 1. Dieback disease curve (a) against rainfall curve (b) for 7 months.

Table 2. Results of the plants response to fertiliser application.

Fertiliser	Average disease score†
Mavuno	2.1919[a]
TSP	2.2656[a]
CAN	2.4475[ab]
Control	2.9231[b]

† Means followed by same letter are not significantly different (P>0.05).

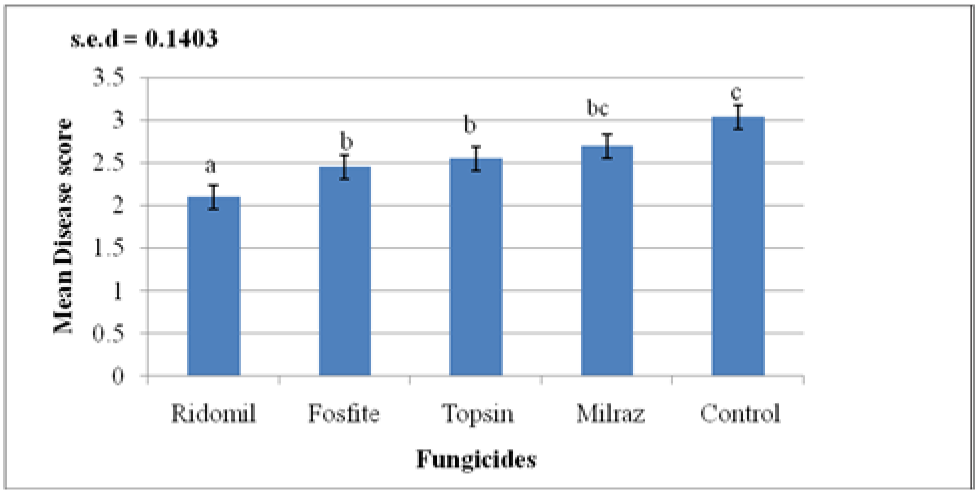

Figure 2. Results of fungicide use on dieback disease severity.

Table 3. Dieback disease incidence in site A= 55% while B = 12%.

Visit	D/Score	Prunning	Nutrition	Weeding	Water	Pesticides
Site A						
1	2	0	XXX	0	0	XXX
2	2	XXX	0	0	XXX	XXX
3	3	XXX	XX	X	0	0
4	3	XXX	XX	0	0	XXX
5	4	0	XX	0	XXX	XXX
Site B						
1	1	XXX	X	XXX	XXX	XXX
2	1	XXX	X	XXX	XXX	XXX
3	2	0	XXX	XXX	XXX	XXX
4	2	0	XXX	XXX	XXX	XXX
5	2	XXX	XXX	0	XXX	XXX

fungicides was not significant; where P = 0.152. Calculated P for leaf bud length and leaf number increase every 21 days was P = 0.771 and P = 0.883 respectively; hence non significant at (P = 0.05).

Fungicides only stopped or slowed down disease progress momentarily. Ridomil showed the lowest dieback disease score (Fig. 2). These findings support reports that there is currently no known cure for dieback (Maina, 2009 *unpublished*).

Assessing the appropriateness of selected farmer practices in managing dieback. Site A which attained lower scores on the assessed farmer practices recorded higher dieback disease scores (55%) while site B which attained higher scores recorded low disease scores (12%). This indicates that proper agronomic practices are an integral part in effective dieback disease management options.

Recommendations

Farmers should apply integrated dieback control measures before infections are noticed in the orchard. These should be coupled with frequent monitoring and scouting where stringent measures should be applied to infected plants and/or tissues regardless to whether they are at the initial stages of infection.

Studies aiming at devising feasible curative measures for dieback should be carried out so as to identify long term and sustainable dieback disease management measures.

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