The role of contaminated garden tools in mechanical transmission of Xanthomonas wilt in banana and enset (*Ensete ventricosum*) in Ethiopia

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Introduction

Xanthomonas wilt caused by *Xanthomonas campestris* pv. *musacearum* (*Xcm*) is a devastating disease of enset and banana in Ethiopia and the East African region. The disease due to its similarity in epidemiology to other banana bacterial wilts such as Moko, Blood disease and Bugtok that are transmitted by insect vectors and garden tools, is believed to be transmitted in a similar manner. Research studies have so far confirmed the role of insect vectors in spreading the disease through the male banana inflorescence. Studies on banana and enset on the role of garden tools in spreading Xanthomonas Wilt were thus deemed important because even in areas of severe infection, farmers continue to loan or borrow farming and processing tools. In addition, the majority of farmers who control the disease by cutting, uprooting and discarding the infected banana or enset plants hardly sterilize their tools.

Materials and Methods

A study to determine the role of garden tools in the transmission of Xcm was carried out on enset in a greenhouse at the Southern Agricultural Research Institute (SARI), Awassa, Ethiopia. In addition, field trials on 'Pisang Awak' (*Musa* AABB group) were carried out in the Amaro district of Southern Ethiopia. The treatments (using a contaminated knife) on enset in the greenhouse trial comprised: cut green leaves (T1), cut broken green leaves (*i.e.* break the leaf petiole and cut off the leaf at the leaf lamina side of the point of breakage) (T2), cut dry leaves (T3), a cut in the pseudostem (T4), cut roots (T5) and a control per treatment (using a clean machete). A total of 24 plants over three replications were assessed per treatment. For 'Pisang Awak 'in the field trials, the treatments comprised T1 (45 plants over three replications), T2 (45 plants over three replications), T3 (45 plants over three replications), T4 (10 plants over two replications), T5 (10 plants over two replications) and de-suckering (T6) (10 plants over two replications). As a control cutting of the leaves, pseudostem and roots, and de-suckering was done with a clean machete on a similar number of plants. The banana de-budding experiment comprised 45 plants for each of the two treatments; cutting off the male bud with a contaminated machete (T7) and breaking off the male bud with forked stick (T8) (control). In addition, bacterial ooze was smeared on 10 fresh (T9) and 10 dry (T10) flower scars and 10 fresh (T11) and 10 dry (T12) bract scars at the male part of inflorescences. The treatments were observed for 120 days. Data was analyzed using Microsoft excel for windows.

*Fig. 1. Xcm inoculation using a contaminated knife to cut; **A** green leaf, **B** broken green leaf*

Results and Discussions

All plants (100%) of enset and banana when cut in the pseudostem (T4) with a contaminated machete, and all banana plants (100%) when de-budded with a contaminated machete (T7) got infected. Similarly, T1 and T2 resulted in a high Xcm transmission of respectively 67% and 62% in banana and 58% and 54% in enset. Similar high transmission rates (90%) were obtained for T6 on banana. On the other hand, cutting roots (T5) with a contaminated machete resulted in low transmission levels, with 20% in bananas and 25% in enset. This suggests that garden tool infections mainly occur above ground and rarely through the roots. Similar observations had been made in Uganda by Ssekiwoko (personal com.) after he failed to isolate the Xanthomonas Wilt pathogen from roots collected from banana plants with advanced disease symptoms. Cutting of dry leaves and all the control treatments did not result in any Xanthomonas Wilt symptoms. Further more, smearing bacterial ooze on fresh banana bract and flower scars resulted in 100% infection. The results suggest that garden tools play a major role in the mechanical transmission of Xanthomonas Wilt, and that for mechanical transmission to occur, fresh injuries are necessary.

***Table 1:** Xcm inoculation in 'Pisang Awak'*

Treatments	No. treated	No. infected	% infected
T1	45	30	67
T2	45	28	62
T3	45	0	0
T4	10	10	100
T5	10	2	20
T6	10	9	90
T7	45	45	100
T8	45	0	0
T9	10	10	100
T10	10	0	0
T11	10	10	100
T12	10	0	0

*Fig. 2. Xanthomonas wilt symptoms on; **A** artificially inoculated enset sucker, **B** bunch de-budded with a Xcm contaminated machete*

***Table 2:** Xcm inoculation in 'Genticha' (Ensete ventricosum) (* Number (%) of infected plants)*

Treatment	Days after inoculation								
	7*	15	21	30	45	60	75	90	120
T1	0	1(4)	3(12.5	7(29.2	12(50)	12(50)	14 (58)	14(58)	14(58)
T2	0	0(0)	0(0)	0(0)	10(42)	13(54)	13 (54)	13(54)	13(54)
T3	0	0	0	0	0	0	0	0	0
T4	0	0(0)	0(0)	10(42)	24(100	24(100	24(100	24(100	24(100)
T5	0	0(0)	2(8)	4(17)	6(25)	6 (25)	6 (25)	6(25)	6(25)
Control	0	0	0	0	0	0	0	0	0

Conclusions and Recommendations

Contaminated garden tools transmit BXW from infected enset or banana plants to healthy ones. Therefore de-suckering and cutting of green leaves (de-leafing) in highly infected fields should be avoided, while de-budding should be carried out with a forked stick. De-leafing, if is to be done, should be restricted to dry leaves only (de-trashing). Rigorous tool disinfection (through flaming in fire or by using disinfectants) is also recommended.

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