Recognition and Management of the Stem Splitting Disease in Artemisia – A field Guide



FIRST EDITION, 2012

Editors:
John Wasswa Mulumba
Fred Ssekiwoko
Peter Kiwuso
Moses Basoga

Address all inquiries and submissions to;
Plant Genetic Resources Centre
Entebbe Botanic Gardens



First Edition, 2012

Editors:

John Wasswa Mulumba

Fred Ssekiwoko

Peter Kiwuso

Moses Basoga

Address all inquiries and submissions to;

Plant Genetic Resources Centre
Entebbe Botanic Gardens

Recognition and Management of the Stem Splitting Disease in Artemisia – A field Guide.

First Edition, 2012

© National Agricultural Research Organization, 2012.

No part or whole of this information should be copied or reproduced in any way without authorization from NARO.

All rights are reserved to NARO

Address all inquiries and submissions to; The Plant Genetic Resources Center

Plant Genetic Resources Centre
Entebbe Botanic Gardens

P.O. Box 40 Entebbe.
Tel: +256 0414 320638
E. Mail: curator@infocom.co.ug

Foreword

Entrepreneurs continuously venture into new investment frontiers driven by their business acumen. However, proper and adequate technical support to enterprises development is central to their success. For an enterprise revolving around a new crop such as Artemisia, therefore, it is extremely important that technical support along the entire value chain is sought so that the different chain segments deliver optimally. The production of Artemisia has so far been adversely faced with a disease termed "**Artemisia Stem Split Disease**" which is caused by a bacterium, *Xanthomonas hortorum.* This is a new disease and little information is available. This field Guide for the recognition and management of the Stem Splitting Disease in Artemisia is intended to provide the basic technical knowledge which can be used to build skills required for the management of the disease. The agricultural production specialists, scientists, extension staff, nursery managers, farmers, produce traders and other stakeholders will find it useful. The disease being fairly new on a new crop in Uganda, there is yet a lot more to discover about it and its interaction with different factors of production. The National Agricultural Research Organization (NARO) will continue to undertake research on the disease and provide the necessary technical support to the wide stakeholder base.



Director General

NARO

Acknowledgements

The editorial team of this field guide "**Recognition and management of the Stem Splitting Disease in in Artemisia** "would like to extend their gratitude to the different stakeholders they interacted with during its development. In particular, the team appreciates the contributions of Artemisia farmers of Kabale and Kabarole Districts and Afro Alpine industries in Kabale. The team also acknowledges the two sister Institutes namely; the National Forestry Resources Research Institute (NaFORRI) and the National Agricultural Research Laboratories (NARL) for providing the supportive environment and human resources to undertake the studies that provided the scientific basis for this guide. Finally but not least the team would like to acknowledge the Government of Uganda for providing the financial support that enabled this work to be undertaken.

The above list is by no means exhaustive. All those who have assisted in this study are gratefully acknowledged.

List of abbreviations

NARO	National Agricultural Research Organization
ACTs	Artemisinin based Combination Therapies
masl	Meters Above Sea Level
NPK	Nitrogen Phosphorus Potassium
ha	Hactare
kg	Kilogram
ft	Feet

Table of Contents Page

Identification and management of m Xanthomonas hortorum in Artemisia annua..... *i*

Foreword.....iv

Acknowledgements.....v

List of Abbreviations.....vi

Tableof Contents.....vii

List of Figures.....viii

1: Introduction.....1

2: What is Xanthomonas hortorum.....1

3: Pathogen Transmission and Disease Spread.....1

4: Damage and Disease Symptoms.....2

5: Disease Distribution in Uganda.....3

6: Importance of the Disease.....3

7: Damage Assessment in the Field.....3

7.1: Technical Assessment of Damage.....3

8: Appropriate Control Options 7

List of figures

Figure 1: Artemisia annua seedling (a) 12 days after inoculation with Xanthomonas hortorum (b&c) naturally infected in the field.....2

List of plates

Plate1. Tool infection procedure.....8

1: Introduction

Artemisia annua(L.) is the plant from which artemisinin (the active compound in modern anti-malarial drugs) is extracted. It is commonly known as sweet wormwood, sweet annie or annual wormwood. *Artemisia annua* is known to have originated from China where it naturally occurs in Chahar and Suiyuan provinces at altitude 1000-1500 masl. Its use as a remedy for malaria- related fevers is known to date back to 340 AD. Very few pests and diseases have been reported on Artemisia worldwide. The most common pests are Aphids and Ants and the most reported diseases are; Root rot and the viral leaf curl induced disease. Introduction of *Artemisia annua* in Uganda for commercial production dates back to 2005 and like other exotic plants, there is always a possibility of pests and diseases not known before manifesting. The major disease observed on *Artemisia annua* in Uganda is the stem splitting disease caused by a bacterium, *Xanthomonas hortorum*. This disease was first noted in Kamuganguzi, seven miles on Kabale- Katuna road (at 7251ft; 1°20'20"S and 30°00'9"E) in August 2007.

2: What is *Xanthomonas hortorum*

This is one of the species of bacteria that are known to cause diseases in plants. Many of its types (pathovars) attack other crops/plants and have been found economically important on; Carrots, Coriander, Aralias and Pelargoniums. The type *(pathovar)* which attacks *Artemisia annua* in Uganda has only been found to also infect *Artemisia pallens* but not Carrots, Coriander, Aralias, *Pelargoniums Southern cone marigold , Artemisia afra* or Cannabis.

3: Pathogen Transmission and Disease Spread

The disease causing organism (pathogen) is so far known to be transmitted on cutting implements (such as knives, pangas and hoes). Therefore in the process of preparing cuttings, the pathogen can be transmitted from one plant to another including the detached cuttings.

The disease also spreads in cuttings used as planting materials if sourced from infected plants. In an effort to maintain pure lines of the varieties, *Artemisia annua* is propagated by cuttings and if the mother plant is affected, then the subsequent shoots arising from these cuttings are also affected. This mode of material multiplication is responsible for the introduction of the disease in Kabarore District when infected planting materials were distributed to farmers.

So far, no insect vectors have been identified to be involved in the transmission and spread of this disease.

Healthy plants have developed disease symptoms when planted in soil containing previously infected plant residues suggesting that the bacterium survives in crop residues in soil for some time. It is not known how long the bacterium can persist in there, but soil containing infected crop residues is a potential source of new infections.

4: Damage and Disease Symptoms

The disease severely defoliates the plants including destroying whole branches and in extreme cases kills the whole plant (fig 1b and fig 1c). In such a case, the quantity of leaf material harvested per plant for artemisisnin extraction significantly reduces.

The disease often starts as small water soaked spots (lesions) on the stem/ branch. The lesions expand, join up and dry (necrotic streaks) along some length of the stem which eventually splits exposing the inner parts (pith). The plant begins to rot at that point. All parts beyond this point die (fig 1a). Plant growth is retarded and in extreme cases the whole plant dies.



(a) (b) (c)

Figure 1: *Artemisia annua* seedling (a) 12 days after inoculation with *Xanthomonas hortorum* (b&c) naturally infected in the field

5: Disease Distribution in Uganda

The disease has so far been observed in parts of Southwestern (Kabale District) and Western Uganda (Kabarole District). In 2007, the disease was reported present on various farms in Kamuganguzi village in Kabale District. By July 2010, the disease was observed in Bwenderwa village (Luteete Sub-county) and in Burungu Village (Karambi sub-county) in Kabarole district.

6: Importance of the Disease.

The disease severely defoliates affected plants and may cause whole plant death. It is known to affect all *A. annua* varieties currently grown in Uganda except for the related *Artemisia afra*.

Quantification of yield loses due to this disease has not been done. However bearing in mind that the disease can be transmitted through propagating material, it is capable of causing substantial losses particularly if the planting material was already infected at the time of propagation and planting.

7: Damage Assessment in the Field

Farmers may make a rough estimate of damage in the field by counting the number of affected plants. If there are a few plants affected, they are advised to uproot and burn them and contact their extension officer about it. If the farmer considers the number of infected plants to be high, they should straight away contact an extension officer for advice on appropriate action.

7.1: Technical Assessment of Damage

The level of damage caused by *Xanthomonas hortorum* infection can be estimated and expressed as the proportion of infected plants on a particular farm/field. This is called disease incidence and can be estimated from below;

1. Count the number of disease affected plants including empty spots whose plants were confirmed to have died from the same disease

2. Also count all the plants initially in the field before the disease (includes the healthy, the affected, and the missing due to disease)

3. Feed into the formula below to obtain the incidence of disease.

$$\text{Disease incidence} = \frac{\text{Number of plants affected in a field}}{\text{Total number of plants in a field}} \times 100$$

The result is a percentage which can be used to make an appropriate action

Incidence (%)	**Remark**	**Recommended action**
0	Healthy	Continue monitoring
1-30	Low-medium	Remove affected plants Contact extension officer
Above 30%	High -Extremely high	Contact extension officer

Disease incidence does not inform the degree of disease on individual plants. A more informative measure would be a measure of the surface area of the affected part of individual plants. This would give the Severity of infection on individual plants and would be calculated from below

$$\text{Disease severity} = \frac{\text{Area of affected parts } (cm^2)}{\text{Total plant area } (cm^2)} \times 100$$

However, since *Xanthomonas hortorum* infection causes defoliation and stunting, it leads to underestimation of the surface area of the affected parts. Severity is often given as a descriptive estimation of the proportion of affected parts. Each description can be scored on a scale of 0-5 where 0= no infection, 1=1-20% plant area affected, 2=21-40% plant area affected, 3= 41-60% plant area affected, 4= 61-80% plant area affected and 5=81-100% plant area affected. The number of plants in each scale score is noted and from these scores a disease severity index for each farm can be calculated from

$$\text{Disease Severity index} = \frac{(0xa)+ (1xb) + (2xc) + (3xd) + (4xe) + (5xf)}{x5n} \times 100$$

Where (0-5) is the scale score, (a-f) is the number of plants in the corresponding scale score and n is the total number of plants in the field.

The result is also a percentage which can be used to take appropriate action. Decision will additionally depend on the end use of the field (seed, mother garden or leaf harvest) and on the stage of plant growth particularly for leaf harvest.

Severity Index (%)	**Remark**	**Recommended action**
0	Healthy	Continue monitoring
1-30	Low-medium	Action to take will depend on; • Purpose of field (seed / cuttings generation for planting or leaf harvest for artemisinin). If the infected field serves as mother garden for generation of planting materials, then care must be taken to avoid/destroy diseased plants • Stage of plant growth (plants

		affected towards harvest may be harvested, otherwise it is advised to destroy such plants
Above 30	High - Extremely high	Action to take will depend on; • Purpose of field (seed / cuttings generation for planting or leaf harvest for artemisinin). If the infected field serves as mother garden for generation of planting materials, then such field is worthless and should be destroyed • Stage of plant growth(plants affected towards harvest may be harvested, otherwise it is advised to destroy such fields • May include change of enterprise/rotation but close relatives of Artemisia such as *Artemisia pallens* should be avoided

8: Appropriate Control Options

1. Cut and burn all affected plants.
2. Practice crop rotation.

   After harvesting the existing Artemisia crop, grow other non Artemisia crops in the next two seasons. It is highly recommended that the rotational crops are not relatives of Artemisia as they may be alternative hosts for *Xanthomonas hortorum*. It is strongly recomemded not to plant such crops like; Carrots, Coriander, Aralias and Pelargoniums as the potential for *Xanthomonas hortorum* to survive on the same still exists.
3. Do not grow Artemisia in soil containing crop residues or soil that previously held a diseased crop. *Xanthomonas hortorum* survives on volunteer crops and in non decomposed debris. Establishment of new crop in a field that recently held diseased crop therefore risks infection to the new crop. If the field previously held a diseased crop, ensure that **no Artemisia is growing in that field for at least two seasons** and that **all debris has fully decomposed** before replanting.
4. Never propagate (seed or cuttings) from infected materials. As noted earlier that *Xanthomonas hortorum* can be transmitted/spread in seed and cuttings from disease plants, it is

strongly advised never to propagate/ obtain planting material from diseased plants, or even from infested fields.

5. **Disinfect cutting tools for every new plant cut**

Always ensure that all cutting tools are free of contaminating microbes by immersing them for at least 5 minutes in a suitable disinfectant. The most common disinfected recommended is household bleach commonly sold as Jik, Blik etc. Before using the disinfectant, dilute it with water by picking one unit of the un diluted Jik and adding it to five similar units of water (mix 1:5) as shown in Plate 1 below. Completely immerse the tool/cutting implements for 3-5 minutes. When working with plants, **Always disinfect for every new plant cut** even when such plants do not show symptoms. Remember that plants could be infected with *Xanthomonas hortorum* but do not yet show symptoms and could be sources of infection to healthy plants during cutting.

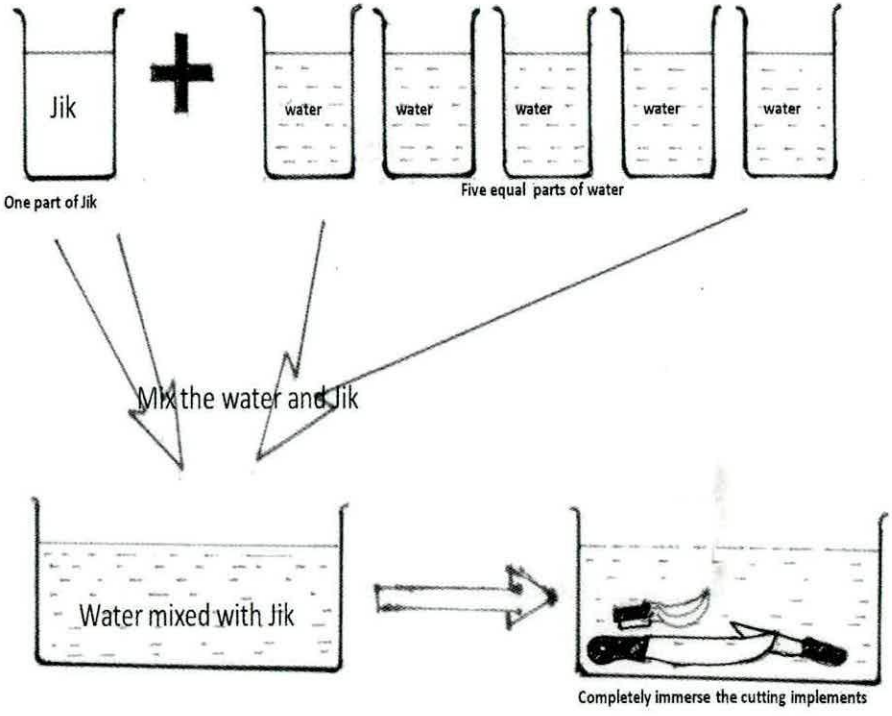


Plate 1: Tool disinfection procedure.



P.O. Box 40 Entebbe.
Tel: +256 0414 320638
E. Mail: curator@infocom.co.ug