*Uganda Journal of Agricultural Sciences*, 2003, 8 : 75- 78 ISSN 1026-0919
Printed in Uganda


# The status of cotton wilt diseases in the seed multiplication areas in Uganda

***Takan J. P. and Akello B.***
Serere Agricultural and Animal Production Research Institute, (SAARI)
P. O. Soroti, Uganda

## Abstract

**A survey was carried out during the 1999/2000 cotton season in the seed multiplication areas to investigate the status of cotton wilts there. The initial cotton seed multiplication was carried in isolated areas referred to as segregated areas (Segs. 1). These were selected in Pallisa, Kamuli, Apac, Kasese, Lira and Soroti districts. It was found out that Fusarium wilt incidence was highest in Pallisa followed by Kamuli districts with 64.4% and 43.5% of the fields surveyed having *Fusarium* wilt. However the disease was not very severe, with most of the infested fields having small patches of less than 2% plants affected. The rest of the Segs. 1 areas had isolated incidences of wilts which was identified as *Verticillium* wilt. In Pallisa and Kamuli *Fusarium* wilt was found in predominantly sandy loam soils which also had high root knot nematode infestation. In view of the findings the paper discusses and proposes some key research areas in regard to the wilts problem.**

**Key words:** Cotton wilts, Fusarium, Verticillium, root knot nematodes, incidence

## Introduction

Vascular wilts are regarded as the second most important diseases of cotton in Uganda after bacterial blight. Wilt diseases are incited by 2 fungi, *Fusarium oxyporum f.sp. vasinfectum* and *Verticillium dahliae.* Cotton wilts are becoming increasingly important and where they occur, their effects are felt much more than those of bacterial blight. This is because in severe cases the wilts cause retardation and death of whole plants causing patches in the field. The two wilts have quite similar symptoms and can be confused. The descriptions of the two fungi are given in detail in Table 1.

Verticillium wilt was first reported in 1932 at Bukalasa in Central Uganda while Fusarium wilt was confirmed present first in 1957 at Bulopa in Kamuli district and Kisoko in Tororo (Wickens and Logan, 1960). Wickens and Logan, (1960) also found that Fusarium wilt was enhanced by the presence of root knot nematodes (RKN). The importance of the two wilt diseases was recognized and selection for their resistance was incorporated in the National Cotton Breeding Programme.

The problem of cotton wilts was long forgotten until the revival of active cotton research under the Smallholders Cotton Rehabilitation Project (SCRP) in 1994. In 1994, wilts were observed on cotton trials at Iki-Iki and Arapai Technology Verification Centres. In 1996/97 severe attacks of Fusarium wilt caused large patches in some cotton fields at SAARI. Since then many reports have been received from extension workers and farmers especially from Pallisa, Kamuli and Tororo districts who described or carried specimens indicating wilts.

Fusarium wilt is internally seed-borne, while Verticillium wilt is transmitted through surface contamination. The presence of Fusarium wilt in the seed multiplication areas poses a big threat to the cotton industry as a whole. Although the main concern in this study was on wilts, it was also necessary to find out the importance of RKN in the disease complex and as a limiting factor in cotton production in its own right.

The major objective of the study was to investigate the status of cotton wilts in areas of initial seed multiplication referred to as Segregated areas or Segs 1. This work was important because it added new knowledge to limited information about wilts dating to over 30 years ago. This information was necessary to identify research areas and approaches to curb the wilt problem thereby increasing cotton productivity. This would first of all improve the livelihood of the cotton farmers and also promote the cotton industry as whole, contributing to poverty reduction.

**Table 1: Symptoms and Features of Fusarium and Verticillium Wilts**

| Fusarium Wilt | Verticillium Wilt |
|---|---|
| Symptoms begin with chlorosis on leaves which tends to be in patches, without reddening of the leaf. | Symptoms begin with chlorisis at the margins, and sometimes reddening of the leaf. |
| Part of the leaf may be chlorotic and flaccid with the rest appearing healthy | Chlorosis develops between the veins causing kind of stripes on the leaves. |
| Infected leaves can start from any part of the plant, not necessarily the lower most. | Infected leaves usually start from the lower leaves progressing upwards. |
| In advanced stages extensive defoliation occurs. | The rate of defoliation depends on the strain of the pathogen |
| Vascular browning of the stem is very pronounced. | Vascular browning of the stem more deep seated in the stem and extending to the other stele tissues. Less pronounced compared to Fusqrium wilt. |
| Symptoms can appear at any stage of crop development but commonly from 4 weeks after planting. Plants are most susceptible at flowering. | Symptoms are common from about 6 weeks after planting and incidence increases towards the end of the season. |
| Favoured by light mainly sandy soils. | Favoured by heavy clay soils, neutral to alkaline pH. |
| Favoured by high temperatures, daily mean above 23°C | Favoured by cool temperatures daily mean of below 23°C |

## Materials and methods

A survey was undertaken in all the 6 districts where initial cotton seed multiplication is carried out after leaving the research institute. These areas are isolated or segregated from other cotton growing areas. These are located in Pallisa, Kamuli, Apac, Kasese, Lira and Soroti districts.

The survey team comprised a team of ten people from SAARI and one field extension staff. The whole team walked through all the cotton fields they were able to cover in a period of 2- 3 days. During the inspection for wilts, all the 10 members walked up and down the field, each member covering 2 – 4 rows depending on age of crop, observing every plant for wilt symptoms. After going through the whole field an overall scale was given to each field using a scale of 0 - 6 as described below:-

0 - No wilt symptoms observed.
1 - one to a few scattered plants affected.
2 - one or more small patches up to 2% plants affected.
3 - One or more larger patches up to 5% plants affected.
4 - One or more large patches up to 10% plants affected.
5 - Patches of 11 – 25% plants affected.
6 - Patches of over 25% plants affected.

In fields with wilted plants, 5 affected plants were sampled randomly, carefully dug out and the roots were observed for RKN or galls. In the fields with no wilted plants only one plant was checked and also weeds of Ageratum conyzoides to check for RKN. Root knot nematodes infestation was assessed on a scale of 0-4 as follows:-

0 - No knots on the roots.
1 - Knots only on small roots but clearly visible, with main roots clean.
2 - Small knots and some large ones visible on small roots but main roots clean.
3 - Large knots predominate on main roots but not on tap root.
4 - Large knots predominate on main roots including the tap root.

## Results and discussion

From the survey it was found that Pallisa district had the highest incidence (64.4%) and severity of Fusarium wilt followed by Kamuli district (43.5%). The details are found in Tables 2 and 3. Notably the two districts also had the highest levels of infestation by RKN (Table 4). The predominant soil type in both areas is the sandy loams.

**Table 2: Incidence of wilts and Root Knot nematodes in the Seg 1 Areas**

| Location of Seg 1 | | No. of fields surveyed in seg 1 | Cotton Variety cultivated | Percentage fields with wilt | No. of fields infested with RKN root | Wilt Pathogen confirmed present | Predominant soil type | Predominant cotton cropping system |
|---|---|---|---|---|---|---|---|---|
| District | Sub-county | | | | | | | |
| Palisa | Gogonyo | 107 | BPA 97 | 64.4 | 82.2 | Fusarium | Sandy loans | Intercroping/ sole cropping (50%) |
| Kamuli | Namwiwa | 108 | BPA 89 | 43.5 | 44.2 | Fusarium | Sandy loans | Intercropping ( 57%) |
| A pac | Loro | 88 | BPA 97 | 22.7 | 9.0 | Fusarium Verticillium | Clay loams | Intercropping (66%) |
| Kasese | Karungibati | 81 | BPA 97 | | | Fusarium | Clay loans | Intercropping |
| Kasese | Karungibati | 81 | BAPA 97 | 8.6 | 1.2 | Verticilliu | Loamy | Intercropping (75%) |
| Lira | Muntu | 78 | BPA 97 | 5.0 | 0.0 | Verticillium | Caly loam | Intercropping 82%) |
| soroti | Pingire | 105 | BPA 97 SATU 95 | 3.8 | 2.8 | Verticillium | Clay loam | Sole cotton (64%) |

**Table 3: Percentage of wilt-infested fields at different wilt severity levels**

| Seg 1 Area | Wilt Score | | | | Total % of wilt infested fields |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| Palisa | 29.9 | 26.2 | 6.5 | 1.8 | 64.4 |
| Kamuli | 18.5 | 13.0 | 8.3 | 3.7 | 43.5 |
| Apac | 9.0 | 11.4 | 2.3 | 0.0 | 22.7 |
| Kasese | 8.6 | 0.0 | 0.0 | 0.0 | 8.6 |
| Lira | 2.5 | 2.5 | 0.0 | 0.0 | 5.0 |
| Soroti | 0.9 | 0.9 | 1.9 | 0.0 | 3.8 |

**Table 4: Percent of fields at different roots knot Nematode**

| Seg 1 area Area | Nematode Infestation levels (scale 0-4) | | | | |
|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 |
| Palisa | 19.7 | 20.0 | 31.0 | 14.5 | 14.8 |
| Kamuli | 39.0 | 8.0 | 9.3 | 26.3 | 17.4 |
| Apac | 94.0 | 4.5 | 0.8 | 0.7 | 0.0 |
| Kasese | 98.8 | 0.0 | 0.0 | 1.2 | 0.0 |
| Lira | 100 | 0.0 | 0.0 | 0.0 | 0.0 |
| Soroti | 94.8 | 0.9 | 1.7 | 1.7 | 0.9 |

Fusarium wilt was found in most of the fields where cotton was grown on sandy soils although most of them had low disease incidence assessed at lower than 2% of plants affected. Wilt decreased as proportion of clay in the soil increased. In almost all cases where Fusarium wilt was found, it was associated with RKN. Root knot nematodes were recorded in fields even in the absence of wilts except in fields with heavy clay soils. These findings confirm other findings that Fusarium wilt is predominant on sandy soils and is also associated with RKN (Wickens and Logan, 1960).

In Apac, Lira, Kasese and Soroti districts the predominant soil types were clay loams and loam with isolated cases of wilts especially Verticillium wilt. The isolated patches of wilts were found confined in areas around trees where the shades provided cool soil temperatures enough to favour disease development. Root knot nematodes were not recorded in Lira; but in the other districts they were localized to areas with higher sand content.

The relatively low severity of Fusarium and Verticillium wilts seen in this survey suggests that BPA cotton may have some resistance to the wilts. However, it seems Verticillium wilt is widely distributed in the clay soils and any change from the BPA cotton types may lead to it becoming a more serious problem.

Although the incidence of wilts in the Segs. 1 is still low, there is every indication that incidence and severity will continue to increase. Interactions with the farmers revealed that they had little knowledge and/or wrong perceptions about the cause of the wilts. Some of them thought it was due to drought, some had never even noticed it while others attributed it to "curses" on the land. There is therefore an urgent need to sensitize the farmers about the wilts.

From this study, losses due to wilts could not be quantified. Nevertheless, yields are lowered due to wilts and nematodes. This is because plants affected early are killed off and those which survive are retarded, preventing the plants from achieving their maximum potential yield.

Although the losses due to wilt may not be great nationally, losses on individual fields are substantial. The effects of wilts are noticeable especially on small plots of less than one hectare owned by many farmers. First, this has an indirect effect of discouraging the farmers from growing cotton. Secondly and more importantly, the plants that are attacked late in the season yield some seed cotton which is harvested along with the clean seed cotton. Seed obtained from infected plants is the means by which the disease is introduced to disease free areas. This therefore means that wilts will continue to increase nationally.

The rate at which wilts will increase will depend on a number of factors. One of them is the amount of research done on wilts and the use of a combination of management options. As for now, the spread of Fusarium wilt can be prevented by an efficient seed certification scheme. This has challenges because wilts are already present in the Segs 1. These are areas that have been carefully selected because of their isolation from other cotton growing areas. In the case of Pallisa and Kamuli, if the wilt problem continues to increase (which is most likely), there will be no alternative but to look for alternative seed multiplication areas. The two districts are among the major cotton producing areas in Uganda and if cotton production is reduced there, then the economy will be greatly affected.

Root knot nematodes damage is severe where cotton is grown on sandy soils and the long-term approach to the Fusarium wilt/root knot nematode problem as a whole could be to improve resistance against RKN in the BPAs. In view of a wide spread occurrence of the nematodes on sandy soils on cotton in Eastern Uganda, improved resistance might result in substantial yield gains from cotton grown on sandy soils in districts such as Kamuli, Pallisa and Tororo. Improvement of the sandy soils may be one of the approaches to reducing the wilt problem. Work done elsewhere, e.g. in Tanzania and Egypt, has shown that application of the right amount of fertilizers in poor soils reduced wilt incidence (Hillocks, 1992).

The first step towards solving the wilt problems is to learn from other countries that have made some headway in a similar situation. For instance, in Tanzania, Fusarium wilt seems to be more severe with estimated cotton losses of more than 20% (Hillocks, 1984). It is reported that in the Western Cotton Growing Zone where 90% of the cotton is grown in Tanzania, about 30% of the area is affected by Fusarium wilt. Many surveys have been undertaken and work has been done on inter-cropping with cassava and maize with positive results (Kibani, 1995).

In conclusion, this study has given insight into the wilts/nematode situation in the seed multiplication areas. A similar study is necessary to enable an assessment of the situation countrywide. From already available information, the problem is great enough to warrant management interventions. If the wilts/nematodes problem is addressed, then cotton productivity will improve and poverty, especially among the smallscale farmers, will be reduced.

## Acknowledgment

This work was done with the financial support from DFID through Natural Resources Institute

## References

Hillocks, R, J. 1984 Production of cotton plant resistant to *Fusarium wilt with special reference to Tanzania.* Tropical Pest Management 30: 234-46.

*Kibani T.H., 1995.* Inoculum sources and control of *Fusarium* wilt disease in cotton Ph.D. thesis, University of Reading 206 pp.

*Wi*ckens, G.M. and Logna, C. 1960 Fusarium wilt and Root knot of Cotton in Uganda.

Hillocks, R.J. (Ed.) 1992 *Fusarium* wilt In: Cotton disease. CAB International, wallingford, U.K. pp 127-160.