CROP PROTECTION PROGRAMME

Promotion of an IPM Strategy for Maize Grey Leaf Spot (GLS) in East Africa

DFID Project Ref. R8453, NR Int. Code ZA0677

FINAL TECHNICAL REPORT

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CAB International – Africa Regional Centre

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Abbreviations

AIRC	Agricultural Information Resource Centre
ARI	Agricultural Research Institute
CABI	CAB International
CABI-ARC	CAB International Africa - Regional Centre
CIMMYT	International Maize and Wheat Improvement Centre
CPP	Crop Protection Programme
DFID	Department for International Development, UK
FAO	Food and Agricultural Organisation of the United Nations
FFS(s)	Farmer Field School(s)
GLS	Grey Leaf Spot (of maize)
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
IPPM	Integrated Pest and Production Management
KARI	Kenya Agricultural Research Institute
KARI-NARL	Kenya Agricultural Research Institute – National Agricultural Research Laboratories
KBC	Kenya Broadcasting Cooperation
MSV	Maize Streak Virus
NALEP	National Agriculture and Livestock Extension Programme
NARO	National Agricultural Research Organisation
NGO(s)	Non Governmental Organisation(s)
NHRC	National Horticultural Research Centre
OPVs	Open Pollinated Varieties
SIDA	Swedish International Development Cooperation Agency
SACCAR	Southern African Centre for Cooperation in Agricultural Research

Acknowledgements

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Secondly, I would like to thank the farmers (individuals and/or groups) in the FFSs who participated in the training; facilitators of FFSs (led by Mr Godrick Khisa, Coordinator IFAD/FAO IPPM FFSs in western Kenya), officials from the Ministry of Agriculture (particularly, among others, Mrs Isabel Nkonge and Mrs Tsilla Maguti, the District Agricultural Officers in Kiambu and Busia, respectively) in Kenya. In addition, I acknowledge the full support from the extensionists and the farmers who participated in the interactive training sessions in Uganda and Tanzania.

Thirdly, I would also like to acknowledge the support of staff (managers, breeders and technical staff) in Kenya Seed Company, Western Seed Company, SeedCo, Pioneer, Pannar, Monsanto and Highland Seed Growers Limited who provided us with information on available maize varieties with resistance/tolerance to GLS in the East African region. In addition, I acknowledge the support from those, who in one way or the other, were involved in designing, testing and production of the dissemination materials, which include leaflets, posters, radio and television (training video) documentaries (particularly Mr Jared Mukarebe and Mrs Herine Simbowo, Agricultural Information Resource Centre).

Finally, I wish to acknowledge the Department for International Development (DFID, Crop Protection Programme) for the financial support, and Dr John Terry, the Crop Protection Programme Advisor to this project (R8453).

Executive Summary

Maize Grey Leaf Spot (GLS) caused by the pathogen, *Cercospora zeae-maydis* Tehon and Daniels (1925) and to a lesser extent, *Cercospora sorghi* var. *maydis* Ellis and Everh., occurs on <75% smallholder maize (*Zea mays* L.) farms in East Africa, and is considered to pose a serious threat to food security. However, the occurrence and subsequent development of the disease, is dependent on the environmental conditions - a reason why the disease is not noticed, or the severity levels are low in some cropping seasons.

The knowledge generated by a previous project (R7566; Management strategies for maize grey leaf spot in Kenya and Zimbabwe) concerning the epidemiology of GLS led to the development of an integrated pest management strategy for GLS. However, two key issues emerged which urgently needed to be addressed: Firstly, awareness of the disease amongst smallholder maize farmers and extensionists in East Africa was surprisingly low; secondly, despite the widespread availability of maize varieties which are resistant to GLS, awareness of these or other GLS-management strategies continued to be poor. The current one-year project (R8453) was developed in response to a call from DFID's Crop Protection Programme in 2004. The purpose of this project was to promote an integrated management strategy for GLS on maize, to reduce the impact of pests on poor peoples' crops, and to improve the quality and yield from maize-based cropping systems in East Africa. This was achieved through the successful delivery of two key outputs of the project: First, awareness of the identity and importance of maize GLS was raised amongst key stakeholder groups in East Africa; secondly, an IPM strategy based on a 'basket of options' for the management of maize GLS by smallholder farmers was promoted throughout East Africa. This work was undertaken in collaboration with the Kenya Agricultural Research Institute, National Agricultural Research Organisation – Namulonge, Uganda and the Agricultural Research Institute – Uyole, Tanzania.

The current project produced and widely promoted a revised IPM strategy for maize GLS, based on sound cultural practices and the use of resistant/tolerant varieties developed locally for different agro-ecological zones in the East African region. Participatory training (of >300 agricultural extension staff and >20,000 smallholder farmers), development of leaflets (8,000), posters (>10,000), newspaper articles, radio documentaries/talk shows and training videos on maize GLS (all developed using farmer-participatory approaches in national and local languages) and subsequent dissemination to key stakeholders in the maize production systems was achieved. This has enhanced the regional capacity to monitor the occurrence and severity of GLS, in order to undertake timely and appropriate measures to minimise yield losses in maize crops throughout the region. Further work to strengthen the institutionalisation of the IPM strategy for maize GLS in the region is required. This can be achieved as a result of the strengthened linkages (established by this project) between key stakeholders in the maize production systems in East Africa, which include; farmers, pathologists, breeders, information and farmer participatory specialists, seed companies (private, public or community-based), national extension agents, agricultural information centres and media, non-governmental organisations, and regulatory authorities.

Background

Maize Grey Leaf Spot (GLS) caused by the pathogen, *Cercospora zeae-maydis* Tehon and Daniels (1925) and to a lesser extent, *Cercospora sorghi* var. *maydis* Ellis and Everh. occurs on <75% smallholder maize (*Zea mays* L.) farms in East Africa and is considered to pose a serious threat to food security (Pixley 1996; Nkonga, 1999; Bigirwa *et al*., 2001; Asea *et al*., 2002; Simons, 2003). The occurrence and subsequent development of this disease, is however, dependent on environmental conditions - a reason why the disease is not noticed, or the severity levels are low in some cropping seasons (Beckman and Payne, 1982; Rupe *et a*l., 1982). Hence, the weather patterns play a significant role in its impact on yield (Bigirwa *et al*., 2001).

The purpose of the recently-concluded, CPP-funded project entitled, 'Management strategies for maize grey leaf spot in Kenya and Zimbabwe' (R7566) was to provide effective management of GLS based on sound epidemiological principles (Simons, 2003). This was achieved through the successful delivery of five main project outputs: 1. Variability of the pathogen population determined using representative isolates from both Kenya and Zimbabwe; 2. Cultural practices affecting GLS incidence and severity identified; 3. Disease epidemiology established through field experimentation and supported by the use of molecular markers; 4. Effective host resistance screening based on pathogen variability; and 5. Improved cultural practices for disease control validated on farm (Simons, 2000; Simons, 2003).

Knowledge generated by the project (R7566) concerning the epidemiology of GLS together with existing literature, was used to design, develop and promote an integrated pest management strategy for GLS (Kinyua, 2003; Simons, 2003). The strategy is based on a combination of 'raising awareness' of the disease, coupled with a 'basket of options' for effective management of the disease, including the use of cultural methods for the removal of crop debris, soil fertility and recommendations concerning host resistance. The management strategy was validated through a series of farmer-participatory training activities in selected areas in Kenya and Zimbabwe. Dissemination materials developed to 'raise awareness' of maize GLS and to promote the IPM strategy included the production of a poster on 'raising awareness of maize GLS,' a leaflet on 'options for managing maize grey leaf spot,' training videos and published reports.

Based on the findings of R7566, two key issues emerged which needed to be addressed: Firstly, awareness of the disease amongst smallholder maize farmers and extensionists in East Africa was surprisingly low; secondly, despite the widespread availability of maize varieties which are resistant to GLS, awareness of these or other management strategies was poor. In addition, through linkages with R7955, the importance of forage maize in the spread of diseases e.g. maize streak virus (MSV) was recognised, but the over-wintering of GLS needed to be addressed through follow-up activities.

In order to address the aforementioned constraints, it was proposed that the IPM Strategy for managing maize GLS, be adapted, and promoted to large numbers of target beneficiaries i.e. smallholder maize farmers, over a broader geographic region i.e. East Africa (Kenya, Tanzania and Uganda – all of which are Member countries of CAB International). This was achieved through a short-term, 'promotional project', which involved targeted training of trainers/extensionists (Governmental and non-Governmental), production of additional farmer-friendly dissemination materials e.g. production of leaflets showing potential management strategies for maize GLS (on food and forage crops), radio and national newspaper articles and by visiting and providing input into existing farmer-field schools and other farmer groups in key maize-growing areas in East Africa.

Project Purpose

Grey leaf spot remains a potential and looming threat to maize production in East Africa. The purpose of this project was, therefore, to develop and promote an integrated management strategy for GLS on maize, to reduce the impact of pests on poor peoples' crops, and to improve the quality and yield from maize-based cropping systems in East Africa. This contributed to the overall research goal, "benefits for poor people generated by application of new knowledge of crop protection in maize-based cropping systems".

Research Activities and Outputs

Output 1: Awareness of the identity and importance of maize GLS raised amongst key stakeholder groups in East Africa.

Activity 1.1: Posters and leaflets on maize GLS produced under R7566 will be reprinted in Swahili and English, and disseminated for use by scientists, extensionists and smallholder maize farmers in Kenya, Tanzania and Uganda.

A revision of the posters, "Raising awareness of maize GLS" (English and "Kiswahili" versions) and the leaflet on "Options for managing maize GLS" produced under the previous project R7566 was undertaken (see Annexes). The posters and leaflets were both reproduced in English (4,000 copies each) and "Kiswahili" (4,000 copies each) and disseminated to smallholder maize farmers, seed companies, agricultural extension officers, and agricultural research institutes (for use in their respective training programmes) in Kenya, Uganda and Tanzania (Plate 1), through a range of different dissemination channels (see Activities 1.3 and 2.6). In addition, the GLS-awareness poster was translated into ""Luganda"" (2,000 copies) and disseminated to farmers in Uganda.

Plate 1: An extensionist showing a grey leaf spot (GLS) poster held against a plot of GLS tolerant maize at Rungwe, Tanzania.

Activity 1.2: Production of feature articles on the symptoms of, and potential threat to food security posed by, maize GLS will be prepared for publication in one regional (The East African) and two National Newspapers (The Nation and Taifa) in English and Swahili respectively.

A feature article on maize GLS in East Africa was submitted for publication in regional, national and local (vernacular) newspapers in East Africa which include: Daily Nation, "Taifa" (Kenya), New vision, Farmers Voice, "Bukende" (Uganda); Daily News and

"Mwananchi" (Tanzania), and will be published in February 2006. In addition, the project contributed towards publishing articles on maize GLS and the associated economic impact on food security, on the "Africa Magazine", the CAB International Invasive Alien Species website (**www.cabi.org/ias.asp**) and the CPP Good Seed Initiative (R8480) project.

Activity 1.3: Participatory farmer-training sessions will be conducted for existing farmer groups in key maize-growing areas, especially those in GLS hot-spot areas to raise awareness of the importance of GLS to ensure that the trainers are able to identify the disease.

In order to raise the awareness of maize GLS, farmer-participatory training sessions were conducted in Kenya, Uganda and Tanzania in collaboration with non-governmental organisations (NGOs) and National Agricultural Research Stations (NARS) in the respective countries. In Kenya, follow-up of the facilitators (trained during the previous projects R7566 and R8299) and members (>20,000) of the IFAD/FAO Integrated Production and Pest Management - Farmer Field Schools (IPPM - FFS) in western Kenya (major areas of maize production and potential "hotspots" of GLS) was also undertaken by Drs Sammy Ajanga (KARI, Kakamega), Zachary Kinyua (KARI, Kabete – National Agricultural Research Laboratories) and Daniel Karanja (CABI - ARC) (Plate 2). In central Kenya, links were established with the on-going Ministry of Agriculture's National Agriculture and Livestock Extension Programme (NALEP), supported by SIDA (Swedish International Development Cooperation Agency), through the Kiambu District Agricultural Officer (Mrs Isabel Nkonge) and District Training and Extension Co-ordinator (Mr G K Ndung'u). More than 30,000 farmers and extensionists in Kenya, benefited from the training.

Plate 2: Participatory training of trainers/farmers on the management strategies of grey leaf spot (GLS) on maize in western Kenya.

In Uganda, participatory training (Plate 3), led by Dr George Bigirwa (Head of Maize Research Programme for the National Agricultural Research Organisation, Namulonge), was conducted in 19 Districts (selected on the basis of the economic importance of maize in the area) in different regions (Western: Masindi, Hoima, Kibaale, Kasese and Bushenyi; Central: Wakiso, Luweero, Masaka, Mubende, Kiboga and Mukono; Eastern: Jinja, Iganga, Kamuli, Mayuge, Tororo and Busia; Northern: Lira and Apac). A total of 3,515 farmers were trained and received GLS promotional materials developed under Activities 1.1 and 2.4. This activity added value to a maize project (funded by the Rockefeller Foundation) on, "Strengthening Maize Seed Supply Systems for Smallholder Farmers in Western Kenya and Uganda", conducted by NARO in collaboration with CIMMYT.

Plate 3: Farmers identifying symptoms of grey leaf spot on maize during a participatory training session at Iganga, Uganda.

In Tanzania, this activity (led by Dr Nick Lyimo and Mr Anderson Temu, both from ARI – Uyole) was carried out through field day/farmer group meetings (Plate 4), in May/June 2005 in four districts (Mbozi, Iringa/Kilolo, Mbarali and Njombe) in collaboration with the CPP funded project R8406 (Improving farmers' access to and management of disease resistant maize cultivars in the Southern Highlands of Tanzania – Phase II), as part of the ARI - Uyole District maize promotion strategies. GLS was one of the key issues covered during these events, and >5,000 farmers/extensionists benefited.

Plate 4: Mr Nzowa (Counselor, Igunda Village) opening a field day event at Mbozi, Tanzania.

Activity 1.4: Produce a documentary on identifying the symptoms of maize GLS for use by English and Swahili Radio Stations in Kenya, Uganda and Tanzania.

The use of mass media and information technology (ICT) is considered to be an important tool in supporting participatory extension, channelling feedback from rural communities to researchers and extensionists and providing information to farmers (Girard, 2001). In order to have more impact, the project linked up with the "Accelerated Uptake of CPP Research Outputs (R8454) in undertaking Activity 1.4. Two radio programmes; "Kulima kwa Kushauriana No. 4" in "Kiswahili", and "Khurecheresanie No. 4" in a local vernacular language, ""Luhya"" (on the identification of the symptoms and management of Maize

GLS) were produced (audio CDs are available on request, see Annexes) by CABI-ARC in collaboration with KARI, Agricultural Information Resource Centre (Radio Services Unit), and maize farmers in western Kenya. The program was generated in a community-based and participatory method (Plate 5), and produced in a magazine format i.e. featuring topical talks and discussions, interspersed with jingles and traditional music.

Plate 5: A radio interview of farmers during the recording of a radio programme on the management of grey leaf spot in western Kenya.

The programme was recorded towards the end of the 2005/06 maize cropping season (in November, 2005) in western Kenya (when GLS disease symptoms were evident on the maize crop). Final editing of the programmes was completed in mid-January, and the programmes are scheduled to be broadcast in February 2006, on the Kenya Broadcasting Cooperation (KBC) national radio i.e. "Kiswahili" Radio Services (at 20:00hrs on 09 February 2006), and the Western Region Service (at 14:30hrs on 11 February 2006), for the ""Kiswahili"" and ""Luhya"" programmes, respectively. Sensitisation of the KBC radio listeners of the upcoming radio programme (on maize GLS) was done during a radio broadcast of a first series of the radio programmes (produced under R8454) aired on 19 January 2006 (20:00hrs) and 21 January 2006 (14:30hrs) on the KBC "Kiswahili" Radio Services and Western Region Service, respectively. In addition, two radio talk shows were held in local FM stations in Uganda i.e. on Rock FM (5 October 2005) in Tororo, and Bunyoro Broadcasting Station (BBS) (13 October, 2005) in Masindi. These were interactive shows where farmers were calling in asking questions about maize GLS.

Output 2: An IPM strategy based on a 'basket of options' for the management of maize GLS by smallholder farmers promoted throughout East Africa.

Activity 2.1: Seed companies and breeders in Kenya, Uganda and Tanzania will be consulted to obtain the latest (and independent) information on appropriate maize-GLS resistant seed available in each country.

Seed companies in Kenya, Uganda and Tanzania which include, Kenya Seed Company, Western Seed Company, SeedCo, Pioneer, Pannar and Monsanto were consulted and information on available maize varieties with resistance/tolerance to GLS recorded. In Kenya, information from the maize breeders (Drs M Regwa and J A W Ochieng) at KARI Seed Unit indicated that the maize varieties Kakamega Synthetic I and II, KH634A and KH600-14E developed at KARI – Kakamega are tolerant/resistant to GLS. Other varieties include; KH631Q and EMB204 (both developed by KARI/CIMMYT), and SC DUMA 41 (SC 407), SC DUMA 43 (SC 407) and SC Simba 61 (SC 627) from SeedCo.

In Uganda, through consultations with the maize breeders at NARO – Namulonge, it was established that maize varieties with resistance/tolerance to GLS approved by the National Variety Release Committee included: DK8031, DK8051 and DK8071 (from Monsanto); SC Simba 61 and SC Duma 41 (from SeedCo); PAN67, PAN77 PAN15 and PAN691 (from Pannar); H517, H520 and H624 (from Kenya Seed Company). In addition, maize breeders at NARO in collaboration with CIMMYT have released the Open Pollinated Varieties (OPVs) Longe 3H and Longe 6H which have relatively high tolerance to GLS (see Plate 6).

Plate 6: Evaluation of maize varieties for tolerance/resistance to grey leaf spot at the National Agricultural Research Station – Namulonge, Uganda.

In Tanzania, consultation with breeders and agronomists at ARI-Uyole was undertaken during the 2004/05 maize cropping season, to gather information on the existence of maize varieties that are resistant to GLS. In addition, it was deemed necessary to find out whether mechanisms were in place to ensure quality seed production, and distribution of such GLS resistant cultivars. One local seed company, Highland Seed Growers Limited, was contacted and it was established that this enterprise had already initiated plans to carry out large-scale seed production for two GLS resistant maize hybrids (UH 615 and UH 6303 shown in Plate 7), so as to meet the requirements of improved seed maize in the Southern Highlands of Tanzania, a zone in which the disease is most prevalent.

A B

Plate 7: GLS-resistant maize hybrids (A = UH 615 and B = UH 6303), bred and released by the Agricultural Research Institute – Uyole for high and intermediate altitude maize producing areas in Tanzania.

In addition, the maize variety, SC Simba 61 from SeedCo was validated in collaboration with Tanzanian farmers (alongside the Uyole hybrids), as being tolerant to GLS.

Activity 2.2: Develop a component depicting the importance of forage maize in the spread and over-wintering of maize GLS.

GLS-infected foliage maize is a potential source of inoculum of GLS, particularly in areas where farmers transport maize stovers over relatively long distances (>20km in central Kenya). Although there was no component on over-wintering of maize GLS under the previous CPP funded project R7955: IPM of maize forage for dairying, the current project focussed on advising farmers on the potential threat of infected maize stovers (Plate 8) and off-season maize, as sources of inoculum for a subsequent maize crop. The practice of proper management of maize crop residues was considered to be a key component of the revised "broad" integrated management strategy of GLS discussed in Activity 2.4., and promoted under Activities 2.5 and 2.6.

Plate 8: Livestock grazing on maize stovers from a previous crop affected by grey leaf spot (a potential source of inoculum for the next crop) in Mt. Elgon, western Kenya.

Activity 2.3: Revise the contents of the existing IPM strategy for maize GLS to incorporate the issue of forage maize and customise any recommendations concerning maize-GLS varieties, as appropriate for each country, into the 'broader' IPM strategy.

In order to develop a revised integrated management strategy for maize GLS, participatory discussions with key stakeholders in maize production systems (scientists, breeders, seed companies, farmers, agricultural extension agents and regulatory authorities of the release of maize seeds) in Kenya, Uganda and Tanzania were undertaken. The revised management strategy was published in the GLS leaflet developed under Activity 2.4. Practices such as burning of infected maize debris (although effective in reducing the level of inoculum of Maize GLS) were considered to have a negative environmental impact hence, not promoted as a management option for GLS in East Africa. In addition, previous findings that the use of excessive levels of Nitrogen in maize fields increases the severity of GLS were considered inappropriate as a management strategy for GLS in smallholders' farms, where low levels of Nitrogen are commonly encountered. The recommended application rates of Nitrogen fertiliser on maize plants are low (in the East African Region) and may not affect the severity of GLS. However, more validation studies are required. As

a result of increasing awareness of the impact of GLS on maize production among the farming community, it is a prerequisite that new maize seed varieties (developed by seed companies/breeders) in the East African region have a relatively high tolerance/resistance to GLS, before their release by the national variety release committees in the respective participating countries.

Activity 2.4: Produce dissemination materials to promote the 'revised' IPM strategy for maize GLS.

A leaflet on the revised integrated management strategy on maize GLS entitled; "Grey Leaf Spot: A threat to maize production in East Africa (see Annexes) was developed. The leaflet incorporated information on the management strategies identified under Activity 2.2. Information on some specific maize varieties, which are tolerant/resistant to GLS (identified under Activity 2.1), and available in the respective countries was incorporated in the leaflet. The leaflets were produced in English (4000 copies) and "Kiswahili" (4000 copies). Translation of the English version into "Kiswahili" was done in collaboration with INADES-Formation in Tanzania. The leaflets were disseminated under Activity 1.3 and 2.6.

Activity 2.5: Produce training video(s) to demonstrate the symptoms of maize GLS and the potential strategies available for managing the disease.

A team of scientists from CABI-ARC and KARI, in collaboration with IFAD/FAO FFSs' District coordinators and a video production crew from the Ministry of Agriculture's Agricultural Information Resource Centre (Video Services Unit), conducted a scoping study in western Kenya (Bungoma, Kakamega, Busia, Mount Elgon and Trans Nzoia Districts) in August 2005. Several maize fields and 30 FFSs were visited to identify appropriate maize fields affected by GLS, for the video shooting. Participatory discussions with farmers (the key target group of viewers) were held during the scoping study to ensure that the video shooting and the final product (training video), provided both the reach and relevance to the farmers. The video shooting (Plate 9) was done towards the end of 2005/06 cropping season (November 2005), a time when the GLS symptoms were more pronounced on the maize crop at the selected sites.

Plate 9: Filming during production of a documentary (training video) on the identification of symptoms and management of grey leaf spot on maize in western Kenya.

The final editing of the training video (produced in the national language, ""Kiswahili"" was completed in mid-January. VHS tapes are available (on request, see Annexes) for screening in different farmer meetings. Copies (DV-CAMPs) of the training video were issued to Regional Reach Limited (a one-stop rural advertising and promotion company in Kenya, which targets rural people who do not have access to television, by screening recorded video programmes on outdoor monitors in rural market centres) for screening to the public. The screening commenced on 28 January 2006, and will continue for seven consecutive days in 200 rural market centres located in 10 Districts of Kenya (i.e. Kakamega, Meru, Nyeri, Murang'a, Kirinyaga, Nakuru, Kisumu, Vihiga, Kisii/Nyamira, and Keiyo/Koibatek). The Kenya Broadcasting Cooperation (KBC) will also broadcast the recorded training video (documentary) in February 2006. In addition, copies of the training video were availed to the collaborators (NARS) in Uganda and Tanzania, and will be used as one of the key training materials in their local extension services, besides broadcasting through other National Television media houses (in the respective countries), with minimal adaptations.

Activity 2.6: Conduct participatory training sessions in options for managing maize GLS, for trainers/extensionists involved in ongoing farmer field schools, and supply posters/leaflets as appropriate for onward dissemination at farmer field schools.

In Kenya and Uganda, farmer-participatory training sessions (>30) on options for managing GLS disease on maize were conducted (see Plates 10 and 11) in collaboration with non-governmental organisations (NGOs) and National Agricultural Research Stations (NARS) in the respective countries. This Activity (2.6) was conducted together with Activity 1.3., where >150 trainers/extensionists and >30,000 farmers in both countries benefited. The promotional materials (developed under Activities 1.1 and 2.4) were disseminated during these training sessions/farmers group meetings.

Plate 10: Participatory training of trainers and farmers on the management strategies of grey leaf spot on maize in western Kenya.

In addition, training and dissemination of promotional materials was done during other fora, which include: National Agricultural Show (July 2005, Jinja, Uganda), SEEDCO Regional Field Day (18 August 2005, KARI-NHRC, Thika District, Kenya), World Food Day (16 October 2005, Bugiri, Uganda), Workshop on Improving the Productivity of Smallholder Farmers in Southern Africa, (27 - 29 September 2005, Harare, Zimbabwe) and The Southern Highlands Maize Innovation System Stakeholders Workshop (9 – 10 November 2005, VETA, Iringa, Tanzania). On all these occasions, the posters and leaflets were well received, and there is an increasing demand for more copies.

Plate 11: A group of farmers involved in a participatory training sessions on grey leaf spot on maize at Iganga, Uganda.

In Tanzania this activity was scheduled to be undertaken during the 2005/06 maize cropping season and linked up with the CPP project R8406 ("Improving farmers' access to and management of disease resistant maize cultivars in the Southern Highlands of Tanzania – Phase II). A one-month training course for trainers/extensionists (200) in Tanzania, commenced on 9 January 2006, at the Uyole Agricultural Training Institute in Mbeya, involving participants form Iringa, Mbeya, Ruvuma and Rukwa (the four regions which comprise the Southern Highlands Zone of Tanzania).

Contribution of Outputs to Developmental Impact

The achievement of the two project outputs made a significant contribution towards the overall project goal, "benefits for poor people generated by application of new knowledge of crop protection in maize-based cropping systems". The wide dissemination of promotional and training materials (leaflets, posters, radio documentaries and training videos on maize GLS, all developed through farmer-participatory approaches) to ten key stakeholders groups in the maize production systems (in the East African Region), coupled with participatory training has enhanced the regional capacity to monitor the occurrence and severity of GLS, in order to undertake timely and appropriate measures to minimise yield losses of the maize crop. With the upcoming harmonisation of phytosanitary regulations in the region, the outputs of this project will make a positive contribution towards policy development on issues concerning the production of maize seed.

List of Publications

Progress Reports:

- Simons, S. A. *First Progress Report (PPR-1) April - September 2005*
- Simons, S. A. *Project Completion Summary Sheet: 1 April - 31 January 2006*

Internal Reports:

Back to Office Reports

- Karanja, D. K. (2005). *Back-to-Office Report on a visit to Tanzania to discuss workplan and follow-up on project activities, 29 May – 02 June 2005*. CAB International – Africa Regional Centre. 2pp.
- Karanja, D. K. (2005). *Back-to-Office Report on a visit to Uganda to discuss workplan and follow-up on project activities, 19 – 22 June 2005*. CAB International – Africa Regional Centre. 2pp.
- Karanja, D. K. (2005). *Back-to-Office Report on a visit to Tanzania to participate in, "The Southern Highlands Maize Innovation System Stakeholders Workshop", 9 – 10 November 2005, VETA, Iringa, Tanzania*. CAB International – Africa Regional Centre. 2pp.
- Karanja, D. K. and Nkonu, M. (2005). *Back-to-Office Report on a visit to western Kenya to participate in the video shooting and radio documentary interviews and training of farmers/extensionists on identification and management of Grey Leaf Spot (GLS) on Maize, November 2005*. CAB International – Africa Regional Centre. 2pp.
- Bigirwa, G. (2006). Report on the progress of maize GLS project activities in Uganda.
- Lyimo, N. (2006). Report on the progress of maize GLS project activities in Tanzania.

Other Dissemination of Results:

Leaflets

- Grey Leaf Spot: A Threat to Maize Production in East Africa. *A leaflet for smallholder farmers in East Africa (English version)*. CAB International - Africa Regional Centre (CABI-ARC), Kenya Agricultural Research Institute (KARI), Agricultural Research Institute - Uyole (ARI-Uyole) and National Agricultural Research Organisation - Namulonge (NARO-Namulonge).
- Grey Leaf Spot: A Threat to Maize Production in East Africa. *A leaflet for smallholder farmers in East Africa (revised English version)*. CAB International - Africa Regional Centre (CABI-ARC), Kenya Agricultural Research Institute (KARI), Agricultural Research Institute - Uyole (ARI-Uyole) and National Agricultural Research Organisation-Namulonge (NARO-Namulonge).
- Ugonjwa wa Ukungu: Tishio kwa Uzalishaji wa Mahindi Africa Mashariki. *A leaflet for smallholder farmers in East Africa ("Kiswahili" version)*. CAB International - Africa Regional Centre (CABI-ARC), Kenya Agricultural Research Institute (KARI), Agricultural Research Institute - Uyole (ARI-Uyole) and National Agricultural Research Organisation - Namulonge (NARO-Namulonge).

Posters

- Maize Grey Leaf Spot (GLS): *A poster for smallholder farmers in East Africa (English version)*. CAB International - Africa Regional Centre (CABI-ARC), Kenya Agricultural Research Institute (KARI), Agricultural Research Institute- Uyole (ARI-Uyole) and National Agricultural Research Organisation - Namulonge (NARO-Namulonge).
- Ugonjwa wa Madoa ya Kijivu kwenye Majani ya Mahindi (GLS): *A poster for smallholder farmers in East Africa ("Kiswahili" version)*. CAB International - Africa Regional Centre (CABI-ARC), Kenya Agricultural Research Institute (KARI), Agricultural Research Institute - Uyole (ARI-Uyole) and National Agricultural Research Organisation - Namulonge (NARO-Namulonge).
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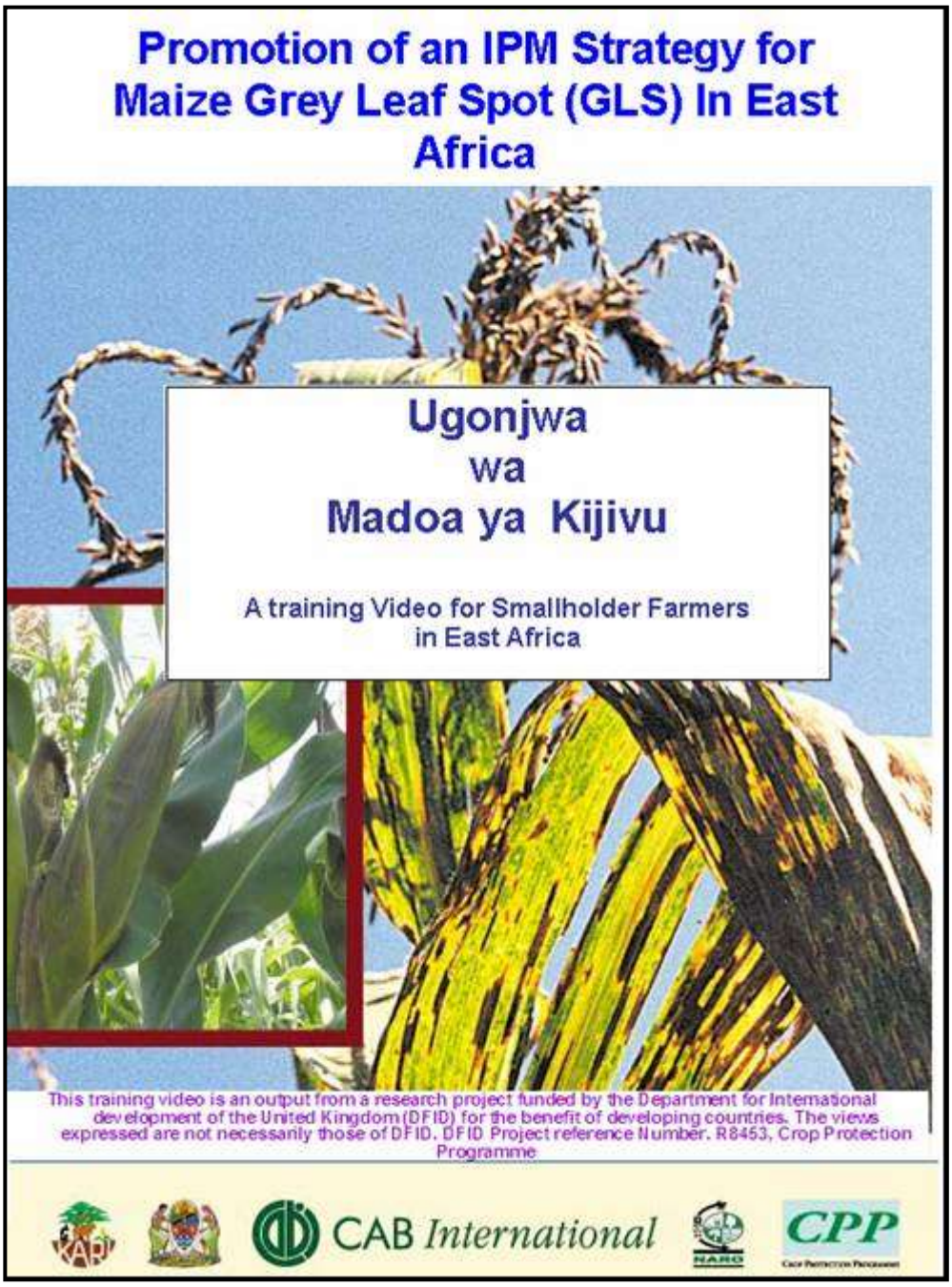
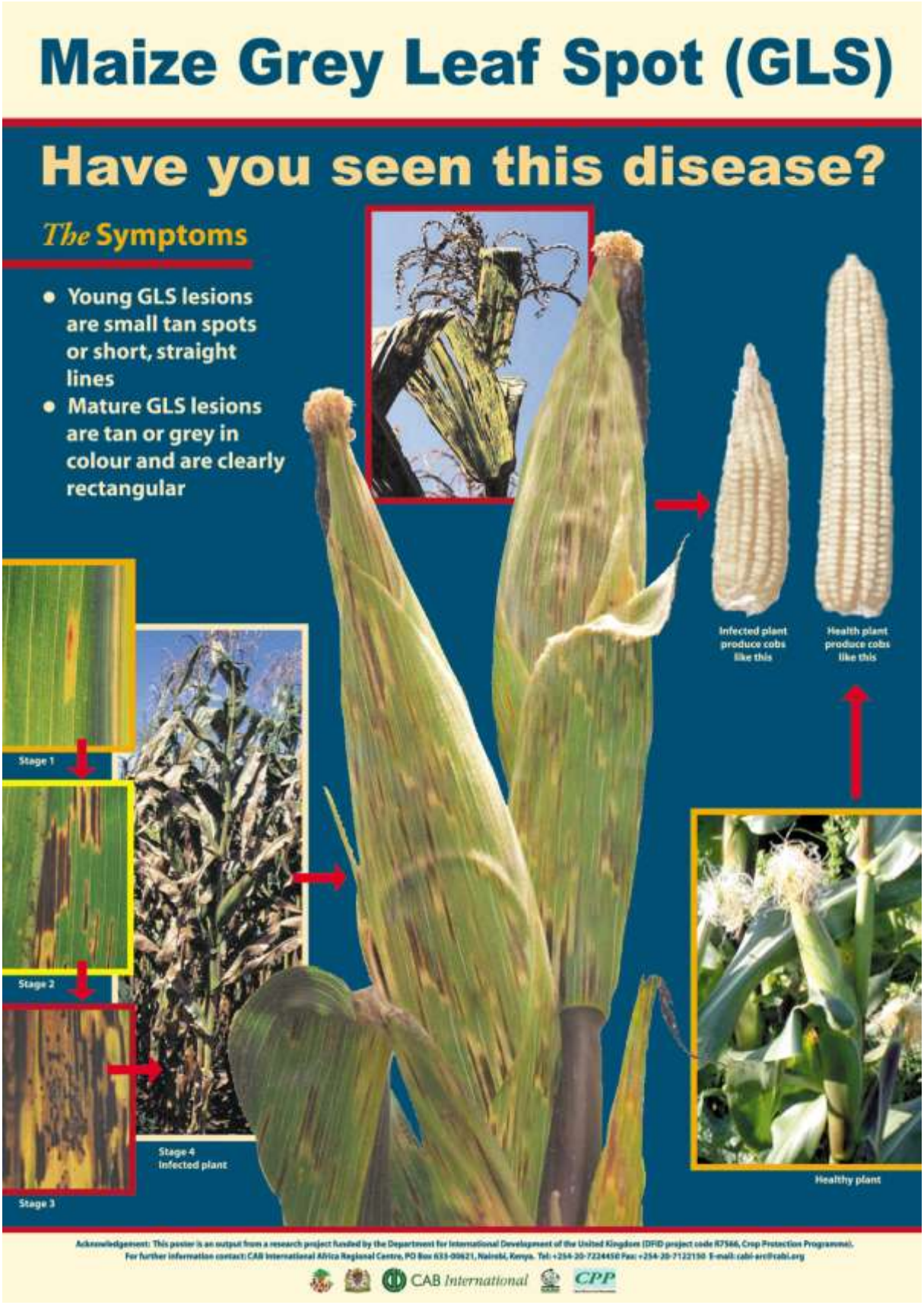
Annexes

Annex 1: Audio CDs for the maize grey leaf spot radio documentary ("Kiswahili" and "Luhya" versions)

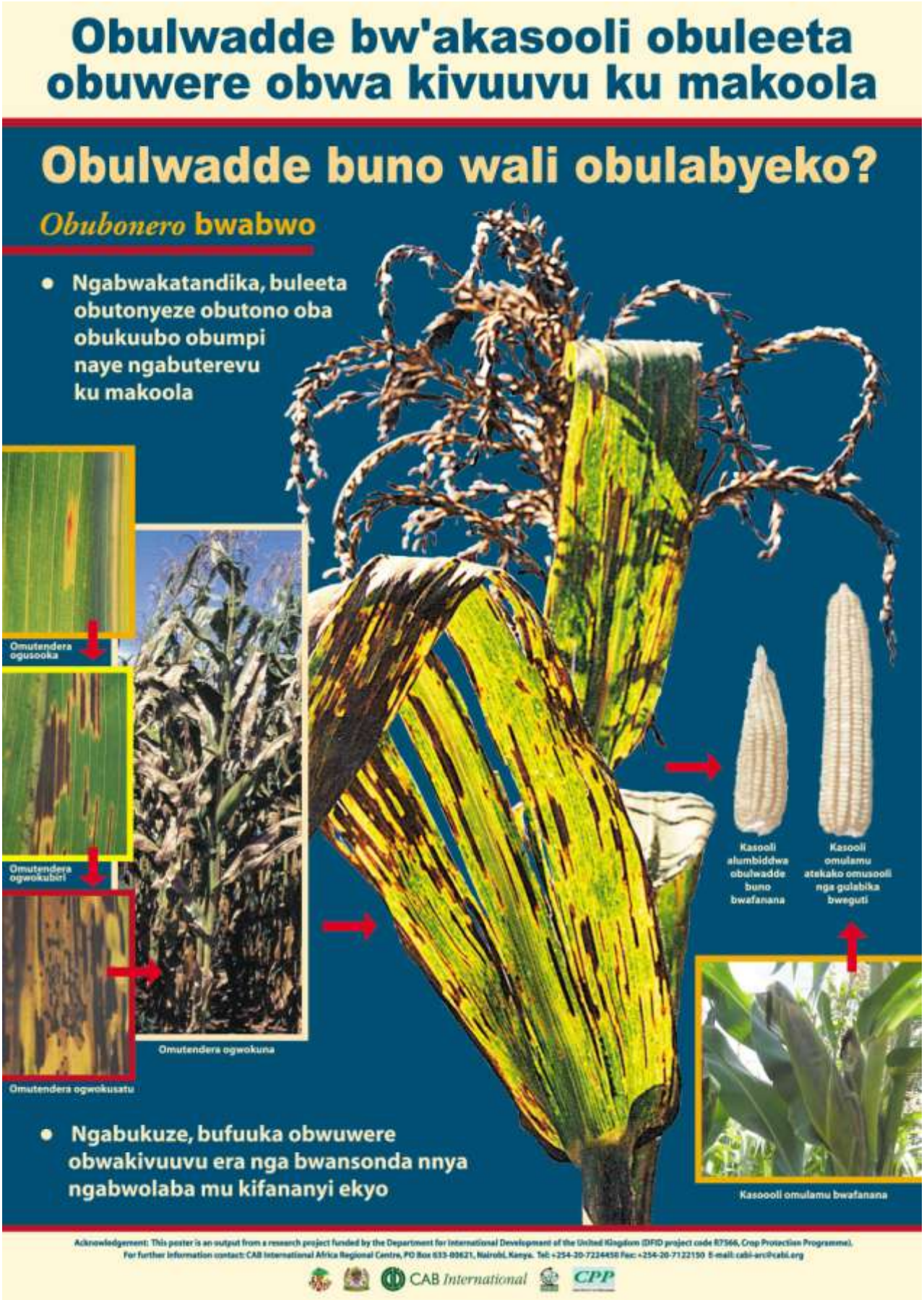
Annex 2: VHS tape for a training video on maize grey leaf spot ("Kiswahili" version)



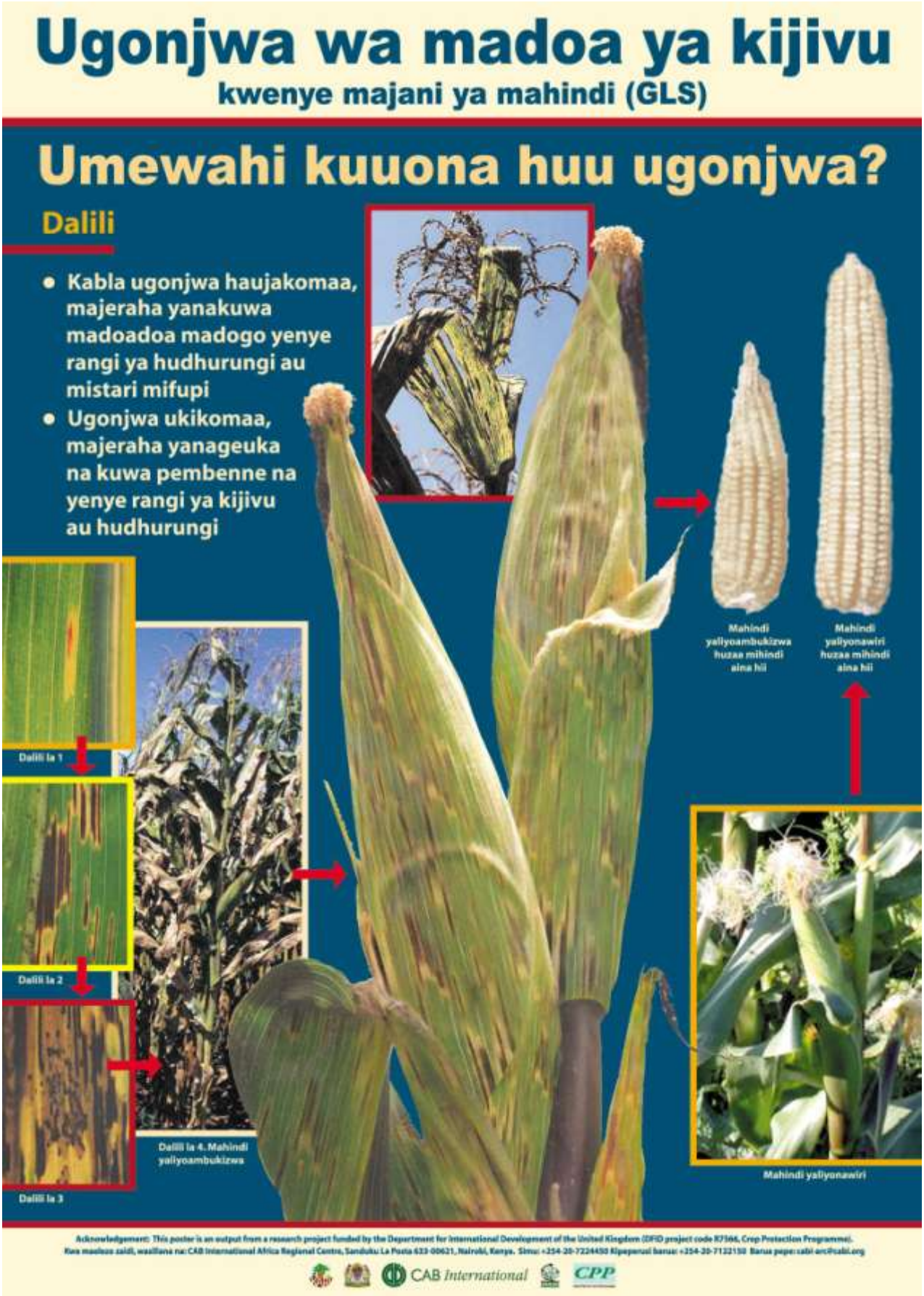
Annex 3: Maize Grey Leaf Spot Poster (English version)



Annex 4: Maize Grey Leaf Spot Poster (“Luganda” version)



Annex 5: Maize Grey Leaf Spot Poster ("Kiswahili" version)



Annex 6: Maize Grey Leaf Spot Leaflet (cover page, English version)

Management options

- Harvest severely damaged maize early, before it lodges.
- A combination of the following strategies is recommended for the management of GLS in subsequent plantings:

1. Clearing diseased maize residues from the field after harvest.
2. Burying of infected plant debris to enhance the break down of crop residue, thereby reducing the survival of the fungus.
3. Rotating infested fields to non-maize plantings for 1-2 years. Crop rotation is most effective when surrounding fields are also rotated.
4. Avoiding the use of infected maize stovers as mulching material near maize plantings.
5. Planting maize varieties that are tolerant/ resistant to GLS eg:

Kenya: Kakamega Synthetic I & II, KH634A, H614, SC Duma 41, SC Simba 61.
Uganda: Longe 3H, Longe 6H, SC Duma 41, SC Simba 61.
Tanzania: UH 6303, UH 615 and SC Simba 61.

NOTE:

- Consult local agricultural extension officers and agricultural research stations.
- Chemical treatments are not recommended.

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Grey Leaf Spot

A Threat to Maize Production in East Africa

CAB International CPP

Annex 7: Maize Grey Leaf Spot Leaflet (inner page, English version)

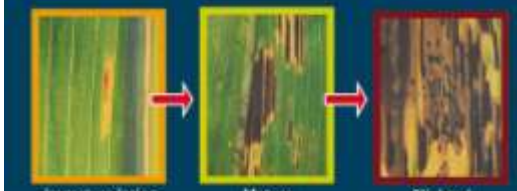
The Disease

Grey Leaf Spot (GLS), caused by the fungus *Cercospora zeae-maydis*, is an economically important disease of maize that occurs in many countries globally.

In Africa, the disease was first reported in South Africa in 1988 and subsequently spread northwards throughout the continent. Outbreaks of GLS in East Africa were initially reported in 1994 in Uganda (Mubende district); in 1994/95 in Tanzania in Ruvuma Region (Mbingo district) in the Southern Highlands; in 1995 in Kenya (Western Region). GLS has since spread to all the major maize-producing areas in East Africa, although the severity varies from one season to the next.

Disease symptoms

GLS symptoms are typically first observed on the lower leaves and appear as follows:



Immature lesion | Mature coalescing lesions | Blighted appearance

- Immature lesions appear as small tan-coloured spots, 0.5-1.0cm long, rectangular to irregular in shape with chlorotic (yellowish) borders.
- Mature lesions are long and narrow (2.0- 5.0cm long, 0.3-0.6cm wide), brown or greyish in colour, and appear opaque when viewed against light.
- Enlarging lesions may coalesce, leading to extensive necrosis and blighting of the entire leaf, when conditions are optimal for disease development.
  - The distinguishing feature of GLS is that lesions are typically rectangular and run parallel to the leaf veins.
  - The size, colour and number of lesions may vary on different varieties.

Conditions favouring disease

Development of GLS is favoured by prolonged periods of warm, humid weather. This disease is potentially very severe in:

a) fields where maize follows maize (no rotation);
b) low-lying areas where fog and heavy dews are common;
c) fields where reduced tillage is commonly practised;
d) High areas with long moist wet conditions often with several foggy days and nights.

Impact on maize production

- Early development of GLS (before flowering) and high severity cause yield losses ranging between 30-60% in East Africa.
- Severe leaf blight predisposes maize plants to stem-rot, which leads to increased lodging of infected plants and subsequent ear rot diseases.

- Grain fill may be reduced, resulting in lightweight grain.
- Yield losses may be low if the symptoms of GLS appear on the crop after grain-fill or if the severity is low (<10% leaf area diseased).

What to do

The following are tips to assist in timely interventions:

- Scout maize fields to determine the presence of severe GLS levels that can cause significant yield loss.
- Observe maize crop residues for GLS symptoms. Infested residues that remain on the soil surface can lead to high disease severity and serious yield losses in subsequent seasons.
- Adopt the recommended management options described in this leaflet, alongside other strategies from reliable sources.

Annex 8: Maize Grey Leaf Spot Leaflet (cover page, "Kiswahili" version)

Annex 9: Maize Grey Leaf Spot Leaflet (Inner page, “Kiswahili” version)

Ugonjwa wenyewe

Barani Afrika, taarifa za kuwepo kwa ugonjwa huu huko Afrika Kusini zilipatikana mnamo mwaka 1988 na kuanzia huko, ugonjwa huu ulianza kuenea kuelekea kaskazini mwa bara zima.

Taarifa za ugonjwa huu Afrika Mashariki zilitolewa kwa mara ya kwanza nchini Uganda (wilaya ya Mubende) mwaka 1994, mwaka 1994/95 nchini Tanzania katika mkoa wa Ruvuma (Wilaya ya Mbinga) ukanda wa Nyanda za Juu Kusini, na mwaka 1995 nchini Kenya (Mkoa wa Magharibi). Baada ya hapo, ugonjwa huu ulienea maeneo yote muhimu ya uzalishaji wa mahindi Afrika Mashariki, ingawa ukubwa wa tatizo hili unatofautiana kutoka msimu mmoja hadi mwingine.

Dalili za ugonjwa

Dalili za ugonjwa kwa kawaida huanzia katika majani ya chini ya mmea, na huonekana kama inavyoonekana hapa chini.

Doa ambalo halijakomaa | Madoa yaliyokomaa yakianza Kusambaa kwenye Majani | Hali ya kukauka kwa majani kufuatia madoa kusambaa kwa wingi.

- Madoa ambayo hayajakomaa yana rangi ya kahawia, yenye umbo la pembe mraba iliyorefuka kufikia kati ya 0.5 hadi 1.0 centimita. Madoa haya huonekana yamezungukwa na
- Madoa yaliyokomaa huwa marefu na membamba (cm 2.0 hadi 5.0) urefu, na 0.3-0.6 cm upana), yana rangi ya kahawia au kijivu na yanaonekana hata majani yakishikwa kwa kukinga mwanga.
- Hali ya hewa inaporuhusu ugonjwa kuenea, madoa huongezeka, huwa makubwa na kuungana, hivyo kusababisha kukauka kwa majani.
  - Dalili mahsusi ya ugonjwa wa ukungu ni kuwa madoa yana umbo la mstatili linalokwenda sambamba na chelewa za majani.
  - Ukubwa, rangi na idadi ya madoa ya ugonjwa huu vinaweza kutofautiana kati ya aina mbali mbali za mbegu za mahindi.

Mazingira yanayosaidia kuenea kwa ugonjwa.

Ugonjwa wa ukungu unastawishwa na hali ya hewa ya joto yenye unyevu mwingi. Ugonjwa huu unaweza ukawa mkali zaidi katika mazingira yafuatayo:

a) Mashamba ambayo hupandwa mahindi kila msimu bila kuwepo mzunguko wa mazao.
b) Maeneo yaliyo kwenye mabonde ambako ukungu na umande hutokea mara kwa mara.
c) Mashamba ambayo hayakwatuliwi mara kwa mara.
d) Maeneo ya ukanda wa juu yenye hali ya unyevu na ukungu wa muda mrefu usiku na mchana.

Athari za ugonjwa huu kwa uzalishaji wa mahindi

- Kujitokeza mapema kwa ugonjwa (kabla mimea haijachanua) na kuwepo kwa mashambulizi makubwa ya ugonjwa kunaweza kusababisha kupungua kwa mavuno kwa kiasi cha asilimia 30 hadi 60 katika nchi za Afkrika Mashariki.
- Mashambulizi makubwa ya ugonjwa huongeza uwezekana wa kuoza kwa mabua, hali nayofuatiwa na kuanguka kwa mimea na hatimaye, kuoza kwa mahindi.
- Kushindwa kujaa vizuri kwa masuke, hali ambayo husababisha punje kuwa hafifu na nyepesi.
- Hata hivyo, upungufu wa mavuno huwa siyo mkubwa iwapo ugonjwa utajitokeza baada ya masuke kujaza punje, au iwapo ugonjwa utaathiri chini ya asilimia 10 ya eneo la majani kwenye mmea.

Cob from infected plant | Cob from healthy plant

Nini cha kufanya

Vifuatavyo ni vidokezo vya nini cha kufanya ili kudhibiti ugonjwa huu mapema.

- Kagua shamba ili kubaini dalili na kiwango cha ugonjwa wa ukungu ambacho kinaweza kusababisha upungufu wa mavuno.
- Kagua mabua na mabaki mengine ya mahindi ili kutanabahi dalili za ugonjwa wa ukungu, kwani mabaki ya mimea yanayobakia kwenye udongo yanaweza kusababisha upungufu mkubwa wa mavuno katika misimu inayofuata.