Strategies for feeding smallholder dairy cattle in intensive maize forage production systems and implications for integrated pest management. (DFID/NRIL Project R7955/ZC0180)

The University of Reading

REPORT ON STAKEHOLDER MEETING 2 APRIL 2004

Venue: Agriculture Information Centre (AIC), Kibate, Nairobi, Kenya

Chair: Dr Jackson Njuguna and Prof Emyr Owen

The meeting commenced at around 0900 and closed around 1630. A copy of the Agenda is attached as Appendix 10. All participants were required to register on arrival. All were provided with a pack containing the agenda, a copy of the project's log frame, notepad and pen and a literature request form so that participants could request copies of the various reports and publications produced by the project.
The following leaflets were also provided:
- project information leaflet (revised 2004),
- leaflet for farmers on project's outputs (first produced 2004)
- an advisory leaflet on maize streak virus disease (revised 2004 from earlier version)
- leaflet for farmers from Freshco Seeds on the newly released maize cultivar, KH521.

Lunch and refreshments were provided at the AIC restaurant and if required, the expenses including per diems of Kenyan participants were reimbursed. A group photograph was taken during the day. A list of participants is attached in Appendix 1.

Session A. Introduction

1/2. Welcome
Dr Jackson Njuguna welcomed participants to the Stakeholder meeting and all participants introduced themselves by name and affiliation.

Dr Joseph Ochieng (Assistant Director of KARI in charge of food crops at KARI headquarters) welcomed participants on behalf of the Director of KARI to the KARI Agricultural Information Centre. He mentioned how the project followed on from previous work and highlighted the role of government policy. Pests damaged up to 46% of crop output impinging on grain and forage. The government and KARI see IPM as the way forward. Information on IPM must be disseminated to stakeholders and that must include policymakers – in particular the Parliamentary Select Committee on Agriculture. It is also essential for researchers to multiply dissemination routes rather than only dealing with small groups of farmers. He asked "What is your exit strategy?" and would like to be able to report on that to his superiors.

3. Objectives of project and meeting
Dr Alistair Murdoch highlighted the project's logframe and objectives. The immediate context of the project was in Kiambu District, which has a population of 744010, and where dairy livestock ownership is a crucial element in poverty alleviation. There is insufficient land for grazing so that 48% of 189709 households stall feed dairy cattle.

Importance of maize as forage for smallholders in Kenya was therefore emphasised leading to this project's studies of the impact of weeds and diseases on forage yield and quality. Impacts were assessed both from the point of view of farmers' perceptions and through experimental studies.

4. Description of methods. RRA, Longitudinal Study, On-station research, Participatory on-farm research, Training and Dissemination

Dr Jackson Njuguna explained the wide variety of methods used to achieve the project's outputs. The first of these was a Rapid Rural Appraisal, which set the scene for the rest of the project, highlighting the importance of maize as a source of forage, supplying 24% of forage or 29% if weeds from the maize crop are included. *Maize streak virus* disease was also identified as the main biotic constraint to maize production in Kiambu. Further socio-economic studies arose from that as a longitudinal study. This study provided supporting evidence for the parallel experimental programme on the maize production and crop protection system and data on the use and trade in resources. Most important was the use and trading of maize forage and manure and management for control of *Maize streak virus* disease and weeds. On station research was carried out in five growing seasons at KARI Muguga and at the Farmer Training Centre, Waruhui. Participatory on-farm research was also carried out in Githinguri and Kamburu. All activities had a training and dissemination component including farmer exchange visits – including one to Vihiga to see the Push-Pull habitat management system for maize stalk borer control in action. Farmer field days were held at Muguga in February 2002 and at Waruhui in January 2004. A training day specifically for extension staff was also held in January 2004.

The availability of the project's leaflets was emphasised and participants encouraged to return the literature request form included in their registration packs.

B. Scope for alleviating seasonal forage shortages using Crop Protection Technologies

5.1 Controlling maize streak virus disease to improve forage yield

Ben Lukuyu (ILRI graduate Research Associate on the project) summarised results of four seasons' research into effects of MSVD on forage yield and quality. His Powerpoint presention is appendix 3. Results on artificial infection trials showed benefits of the resistant cultivar KH521 and risks of early infection to susceptible cultivars. Delaying planting date in on-farm trials also showed advantages in some seasons showed some benefits of the resistant cultivar PAN67 when natural infection rates were high and there was some suggestion that delayed planting could lead to greater infection. Interestingly the local landrace Gikuyu showed tolerance of MSVD in terms of grain yield but not for forage.

5.2/3 Promotion and uptake of MSVD resistant cultivars in Kiambu

Following on from Mr Lukuyu's results demonstrating the benefits of cultivars resistant to MSVD Mr Bernard Omega of East African Seeds described the MSVD resistant cultivar PAN67, also known as "African Queen". On a question about forage, PAN67 is early maturing with fast dry down but long stay green characteristics. On a question about there being too many varieties and all are "the best", it was answered that the aim is to let farmers try a range of varieties and see what they think is best. Several then commented that there was no opportunity to compare and that disdtribution is a problem. Dr Njuguna indicated that KARI can help with distribution.

A leaflet on the characteristics of KH521 was also available.

Dr Jane Ininda from KARI Muguga then described the biological considerations and progress in breeding new cultivars emphasising the need to consider adaptation to agro-ecological zone and resistance to a range of pests and diseases including MSVD (Appendix 4).

6 Controlling weeds to improve forage yield

Dr Jedidah Maina summarised results from the longitudinal study and field experimental work on weeding regimes. A shortened version in included in Appendix 5.

Handweeding was often more expensive than herbicides but difference less evident at Kamburu and in Long rains 2003. Delaying second weeding to feed weeds to animals did not reduce forage or grain. Quality of weeds as forage was variable: high in short rains 2001 but not in the long rains 2002. But if weeding is delayed so they can be used as forage, caution is advisable to minimise weed seed influx. Leaving patches unweeded will cause greater problems in the next crop.

A stakeholder highlighted the need to ensure that any recommended treatments (especially those involving chemicals) are safe in terms of pesticide residues not only for humans but also for livestock - [the livestock eat crop products much earlier than humans].

7.1 Push-pull system for maize stem borer control and improving forage yield

Dr Francis Muyecko of ICIPE explained principles behind the push-pull habitat management system (see Appendix 7). Push- pull technology offers a useful contribution to control of stem borers (and weed suppression by the Desmodium) while crops produced address food and forage needs. Important points for farmers in Kiambu are:

Desmodium interrows are not needed between every pair of maize rows. The effect of *Desmodium* is retained with one row in every three or five. So other intercrops such as beans may be compatible with the system.

Desmodium provides a high quality forage which can be mixed with Napier. The Napier and *Desmodium* can be cut as required provided one tall row of Napier remains around the maize crop at all times.

The Napier cultivar does not appear to be important but this needs verifying for the Napier head smut resistant cultivar, Kakamega 1, and also for a wider range of agro-ecosystems.

7.2 Participatory studies of the push-pull system for maize stem borer control

Dr Sam Njihia explained the trials carried out by two farmer groups (appendix 7). The Kamari womens' group set up comparative trials at Waruhui Farmer Training Centre and the Karweti farmers' group on one of their own holdings. Establishing *Desmodium* proved unreliable by seed and transplanting of vines was found more appropriate on the sloping fields of Kiambu. A major challenge was adaptation of the system to the rotations practised in Kiambu. Stem borer incidence was low but there was some evidence of a reduction in stem borers in push-pull plots. Participatory budgets are reported under agenda item 9.

8 The potential of manure in transmission to subsequent crops of spores of maize head smut disease and weed seeds after feeding livestock & composting

Jackson Njuguna reported (Appendix 8) that the RRA and longitudinal studies indicated that some farmers fed flowering weeds to dairy animals while other farmers fed smutted maize forage to their dairy animals. The question was: will weed seeds and spores survive the ingestion and composting?

Three steers were fed a mixture of seeds of five common weeds and teliospores of maize head smut. Animals were being fed with a teaspoon daily. Dung was collected for composting and drying. Spore survival was assessed by applying dung/compost to soil in pots and assessing incidence of head smut in a susceptible maize cultivar growing in pots. Weed seed survival was assessed by assessing seedling emergence from dung/compost applied to soil in seed trays over six months.

Some seeds of *Amaranthus* survived consumption and composting for three months, but the other weed species and the spores of head smut, did not.

9. Forage conservation especially in relation to push-pull technology

Dr David Miano Mwangi gave an evaluation (Appendix 9) of the push-pull technology in conjunction with the Land O'Lakes' small scale (polythene tube) silage making system, based on participatory budgets carried out with Kamari and Karweti farmer groups.

Budgets showed the expected high start up costs of the push-pull system, but also that losses were associated with current strategy as well if all inputs including labour are costed. The push-pull system is expected to become viable in the longer-term once the Napier and *Desmodium* become more productive. Viability in the short-term could also be achieved when combined with ensiling the extra forage for use in the dry season due to the very high value of high quality forage in the dry season.

10. Summary

Dr Alistair Murdoch summarised the main scientific and technical conclusions of the project and Dr Peter Dorward their economic implications for small-scale farmers.

C. Dissemination and Training

11. Dissemination and training activities

Francis Musembi summarised dissemination and training activities including two farmer field days, farmer exchange visits, participatory on-farm research, training of extension workers and various publications, a project website and project leaflets.

The first farmer field day on 27/Feb/2002 at KARI-NARC-Muguga, was attended by about 70 farmers. The second, on 28/Jan/2004 at Waruhiu FTC was attended by 208 (including 185 farmers)

Field days exposed farmers to technologies promoted by the project and provided ongoing contact with the farmers who participated in the RRA and longitudinal surveys. Farmer feedback was obtained by questionnaires.

At the 2004 field day, 131 out of 185 farmers completed questionnaires. Farmers preferred cultivars KH521 and Pan67 on account of yield and MSVD resistance and Pioneer 3253 for smut resistance. For the push-pull system, farmers also preferred the Kakamega 1 Napier grass variety on account of its resistance to Napier Head Smut.

Twelve farmers from Githunguri were also taken to Vihiga on 6-8 Nov 2002 to see the push-pull system in action & assess its possible application to their farms in Kiambu district. Feedback from the farmers confirmed that stem borers were a problem in Kiambu district and that the push pull system was applicable because of the way it linked dairy and food production.

Farmer exchange visits also took place in Kiambu.

1. The farmers' group (20 farmers) in Kamburu visited the Kamari Women's Group at FTC Waruhui on 4/7/03 to view the push-pull plots they had set up after visiting Vihiga. The push-pull system and also *Desmodium* were new to farmers. After seeing the plots, the Kamburu farmers were interested in silage from Napier and requested *Desmodium* vines and headsmut resistant Napier

2. Kamari (13 farmers) & Karweti (9 farmers) farmers' groups made a reciprocal visit to the on farm weeding regimes/MSVD trials at Kamburu on 13 August 2003. They met nine farmers from the Kamburu group. Farmers could see that MSVD was more pronounced in H511 compared to Pan67, but were concerned about availability of seed of Pan67 in the market and the taste of resistant cultivars.

3. Participatory on-farm research was done with farmers into weeding regimes at Kamburu & FTC and into the push-pull system at FTC (Kamari) & Karweti.

Activities done jointly with farmers included planning - seasonal calendar highlighting activity, when, who, inputs needed & outputs obtained, laying out experimental plots, planting, weeding, harvesting, participatory budgeting, scoring for stem borers & MSVD, together with taste trials for consumer preference with Pan67 & H511.

Feedback included a preference for Pan67 compared to H511 for taste & grain size.

Uptake of technologies is evident in that farmers (Kamari & Karweti) have taken *Desmodium* and Kakamega1 canes for planting in their farms; purchased have bought 129 packets of KH521 to plant on their farms while 45 packets of KH521 were distributed during field day

4. Training of 26 extension officers from six divisions of Kiambu district extension workers took place on 27/Jan/2004 at Waruhiu FTC. Objectives were to sensitize them to technologies promoted by the project and then to encourage officers to pick & prepare an implementation strategy for the most relevant technologies in their respective area.

The first ranked technologies by division were push-pull (Kiambaa and Kikuyu divisions), head smut of maize and Napier (Limuru and Githunguri divisions), forage conservation (Ndeiya division) and MSVD resistant cultivars (Lari division).

5. Outputs of the project are also being disseminated by various publications. MSc and PhD theses are in process; papers have been presented in international conferences; two project leaflets have been published and a project website has been set up.

12. Group discussions

Dr David Miano then led the group discussion session in which participants were split into three groups. Each group was asked to discuss the following three questions:
A. What are the key activities and issues for encouraging uptake?
B. What could you or your organisation do to encourage uptake?
C. Are there any other issues that need to be taken into account?
Each group then provided feedback in a plenary session.

Notes are given here in the order groups presented at the workshop.

GROUP 3

A. Key Issues (not listed in order of importance)

1. High MSVD – Action needed: plant resistant varieties
2. Forage shortage – Action needed: promote forage conservation
3. Napier headsmut – Actions needed: plant resistant variety; implement push-pull
4. Headsmut of maize – Action needed: compost animal manure
5. Stemborer control – Action needed: apply push-pull

B. Encouraging uptake

Demonstrations including field days, farmer/staff tours, farmer field schools

C. Other issues to be taken into account

Availability of resources including availability of demonstration materials, funds to establish FFS and transport and subsistence for extension staff.

Question: Given that the project is ending are there other links which you can use to carry on the work?

Question: To what extent will the seed companies take these technologies to farmers? (Note seed company representative had left by this stage)

Comment by KIOF representative: It will be easy for us to integrate the work into our on-going activities.

GROUP 2

A. Key Issues

Intensify Farmer Field Schools, demonstrations of technologies and training of extension

Establish bulking sites for fodder materials (Kakamega 1 and *Desmodium*)

B. Encouraging Uptake

Use of more media is needed to reach a wider audience including radio programmes, newspapers (e.g. Horizon in *The Nation*). Also, produce more leaflets and posters using more than one language.

Use FFS approach and CBOs to enhance farmer to farmer dissemination (para-professionals)

Link with other community awareness programmes such as those on HIV/Aids and gender issues.

Visit to research and demo sites, e.g. ICIPE and KARI/ILRI

Validation should be carried out for remaining work

Organisational issues to encourage uptake by particular organisations:

Extension

They need further sensitisation to technologies and other extension staff need to be trained.

They could distribute dissemination materials and link farmers with other farmers and organisations to obtain more information.

KARI/ICIPE

Could be involved in training others, backstopping activities, making planting materials available and producing additional dissemination materials.

C. Other issues to be taken into account

There is a need to involve a wider range of stakeholders, e.g. seed suppliers and higher level extension managers; provide facilitation for dissemination activities; build more capacity in terms of personnel by e.g. short courses, MSc programmes and international workshops

Pack sizes for various materials need to be reduced to make more affordable, e.g. maize, *Desmodium*.

Links with other community based awareness programmes should incorporate the activities in their programmes.

Question: How do we include/involve the high level extension managers, will a leaflet do?

Answer; The importance of the project contacting senior extension staff and of workshop participants feeding back was stressed.

Comment: Reference to 'para-professionals' means training farmers so that they can train others. They are para-professionals because they are not fully professional.

GROUP 1

A. Key Issues

More field days and demos for all stakeholders involved; encourage farmer-to-farmer visits; use of farmer groups/FFS; researcher follow-ups to identify researchable constraints; bulk and made available planting materials e.g. Desmodium, Napier variety Kakamega I, KH521.

B. Encouraging uptake (FTC, KIOF, MOA)

FTC - field days; residential courses; offer facilities for training.

KIOF - Incorporate technologies in the teaching curriculum for farmers and students

LAND-O-LAKES - demonstrations (forage production and conservation); examine soil fertility and environmental issues though 'push-pull'.

C. Issues to be taken into account

Land sizes (relatively small in Kiambu);

Cost implications of the technologies including labour-issues

Extension back-up/human resource capacity building (currently staff/farmer ratio is 1:1000)

Development of training materials, e.g. leaflets, brochures, handbooks (easy to use by farmers)

Technology niche targeting (identify the problem and choose an appropriate technology to solve it). Niches could include pest control, forage supply or land size. For example in one area, push-pull may solve the problem of forage shortage but in another it may be appropriate for stemborer control.

Comment: Not many extension staff are trained or have adequate information on the technologies.

Question: What is the best way to bulk the planting materials?

Answer: The best way is for a farmer to volunteer some land under which to put the material. The issue is not obtaining the land but the seed. Another issue is the high cost of seed for Desmodium in seed companies.

Question: Who runs the bulking sites?

Answer: Farmers are being taught about cost sharing and therefore the issue of management is not an issue. Farmers are always willing to contribute. Even FTC is still available for farmers.

Answer: Introduction to the FFS would also be a good idea to explore instead of waiting for forces of supply and demand to take its course.

13. **Proposed ongoing dissemination in 2004 by R7955 team**

Dr Dorward announced that additional funding is likely for the following objectives:

1. To complete the dissemination process of outputs of R7955 to our current farmer groups in Kiambu district and to evaluate uptake, and

2. To train and support existing and potential promotion partners for sustainable and wider dissemination of outputs of R7955 to maize-dairy farmers in the Central Kenyan Highlands after the conclusion of the project.

- Activities would be focussed around a week-long training workshop for up to 20 participants from various promotion partners. Participants are expected to come from NGOs, government extension service, farmer field schools and producer groups, which should be willing to field-test IPM for maize-forage dairying with at least one farmer group.

The **workshop** will include training in IPM for maize forage dairying in order to alleviate seasonal forage shortages. Teaching methods would include taught sessions and seminars and field visits to one or two farmer groups linked with R7955 and demonstration trials. Content would include maize streak virus disease (control using resistant cultivars), maize stalk borer (control using push-pull habitat management system), weeds (chemical and non-chemical control options) and maize head smut (management options for control).
Additional supporting topics relevant to forage crops and alleviation of seasonal forage shortages will include propagation and management of *Desmodium* and small scale forage conservation methods using polythene bag technology.
Training in relevant **participatory approaches** including participatory budgeting for exploring how technologies can fit into complex cropping systems and for designing participatory trials.

14. **Closing remarks**

Dr Gitonga (Director of KARI-NARC-Muguga) closed the meeting emphasising the importance of the outputs of the project to small-scale maize-dairy farmers.

Citation details:
Murdoch, AJ., Njuguna J, Owen, E. and Dorward, P.T. 2004. Report of Stakeholder Meeting held at Nairobi, Kenya on 2 April 2004 for DFID/NRIL Project R7955/ZC0180 on *Strategies for feeding smallholder dairy cattle in intensive maize forage production systems and implications for integrated pest management*. KARI, Kenya and The University of Reading, Reading, UK.

Enquiries in the UK to: Dr Alistair Murdoch, Department of Agriculture, The University of Reading, Earley Gate, PO Box 237, READING RG6 6AR, UK.
Enquiries in Kenya to: Dr Jackson Njuguna, Kenya Agricultural Research Institute, National Agricultural Research Centre – Muguga, PO Box 30148, Nairobi, Kenya.

Acknowledgement and Disclaimer:
The meeting was sponsored by the United Kingdom Department for International Development (DFID) Project R7955, IPM of maize forage dairying, which is managed by The University of Reading, UK with collaborators in KARI, ILRI, PAN Livestock Services, Land O'Lakes and KIOF.
This report is an output from the research project which is funded by DFID for the benefit of developing countries. The views expressed are not necessarily those of DFID. Project R7955 is part of DFID's Renewable Natural Resources Knowledge Strategy (RNRKS) Livestock and Crop Protection Research Programmes.

Appendix 1 List of Participants

	NAME	INSTITUTION
1	Joseph Ochieng	KARI Hqts.
2	Francis Muyekho	ICIPE
3	Grace Mbure	KARI, Muguga
4	David N. Kamau	KARI, Muguga
5	Martin Kimani	CABI-ARC
6	Simon M. Muchigiri	Min. of Agriculture, Kiambaa, Kiambu
7	Emyr Owen	University of Reading
8	Alistair Murdoch	University of Reading
9	Peter Dorward	University of Reading
10	Ahmed Jama	University of Reading
11	David G. Ikua	Waruhiu Farmers Training Centre
12	Michael Waweru	KIOF
13	Margaret Lukuyu-Wambugu	ILRI/MOA&F
14	Ben Lukuyu	KARI, Muguga
15	James Ndungu	K.F.G.
16	Samuel Njihia	KARI, Muguga
17	Gilbert Kibata	KARI, NARL Kabete
18	Jedidah M. Maina	KARI, NARL Kabete
19	F.J. Musembi	KARI, Muguga
20	Waweru Gitonga	KARI, Muguga
21	Dannie Romney	ILRI
22	David Miano	KARI, Muguga
24	Jane Ininda	KARI, Muguga
25	G.K.Ngigi	MOA, Ndeiya
26	Susan Moywaywa	MOA, Limuru
27	Charity Muchira	KARI, NARL Kabete
28	Nancy Nguru	KARI, Muguga
29	G.N. Ngae	KARI, Muguga
30	Bernard Lihase Omega	East African Seed Co. Ltd
31	Josephine Kirui	Land O'Lakes'
32	F.W. Gikonyo	MOA, Lari
33	J.G. Kibuika	MLD, Kikuyu
34	Mary Wanyoike	Farmer, Githunguri
35	Benjamin M. Kivuva	KARI, Muguga
36	John Keli	Frescho
37	Mary Mburu	University of Nairobi
38	Jackson Njuguna	KARI, Muguga

Photo below of participants by Prof Emyr Owen

Appendix 2: Presentation by AJ Murdoch – agenda item 3

Project's aims include...

- To assess effects of
  - maize streak virus disease and weeding regimes on forage yield and quality
  - the animal on disease and weed transmission
- To quantify
  - Economic implications of diseases and weeding regimes on maize grain and forage.
- To promote
  - Sustainable IPM in maize forage smallholder dairying in the central Kenyan highlands.

Contracted Project Outputs

Original

a. Effects of maize genotypes, diseases and weeding regimes, on total forage yield, forage quality and seasonal forage availability, quantified.

b. Effectiveness of improved pest management strategies (i.e. "routing" maize, and weed forage through ruminants [feed & manure compost]) in reducing foliar necrotic diseases, stem borer and weed seed transmission between seasons & increasing forage production, quantified.

c. Economic implications of maize diseases and farmer-acceptable weeding regimes on grain & forage yield, quality and seasonal availability for smallholder maize-dairy farmers and for landless women livestock farmers, quantified.

d. Extensionists and farmers trained to promote sustainable maize-dairying, including how integrated pest management (IPM) may affect the availability of forage.

Supplementary in add-on from September 2002

a. MSVD and weed control strategies developed in R7955 and R7405 and where appropriate the ICIPE habitat management system for maize stem borer control for maize validated by and promoted to resource-poor smallholder maize-dairy farmers in a range of agro-ecosystems

b. Appropriate methods of maize-based forage conservation promoted to resource-poor smallholder maize-dairy farmers.

c. Extensionists and farmers trained to promote sustainable maize-dairying including how integrated pest management may affect grain and forage yields of maize and seasonal availability of forage and livelihoods of resource-poor, smallholder farmers.

Appendix 3: Presentation by Ben Lukuyu – agenda item 5.1

Effects of Maize Streak Virus disease (MSVD) and maize cultivars on forage yield and quality

Presentation

- The problem - MSVD
  - effect on crop
  - how to control ?
- Solutions investigated
- Impact of solutions on economics
- Messages to farmers

- On smallholder farms, maize not only important source of food, but also source of forage

Background

- Growing maize for food and forage has changed cropping practices:
  - relay cropping
  - harvesting green maize for sale
  - high density planting
  - delayed weeding
- Therefore increasing MSVD

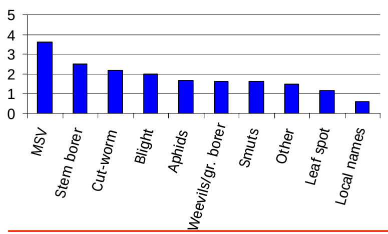
Maize Streak Virus disease

- MSVD is the most important disease limiting maize production in central Kenya
- Grain yield losses due to MSVD range from 25 - 55 %

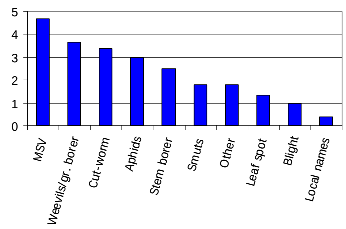
Leafhopper (*Cicadulina mbila)*

- the vector of Maize Streak Virus disease

Farmer perceptions of impact of pests & diseases on stover yield



Farmer scores for difficulty of controlling pests & diseases

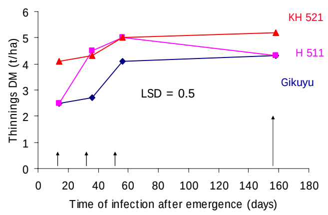


Objectives of study

- Effects of time of infection, cultivar and planting dates on:
  - forage yield
    - » thinnings (90% tasselling)
    - » stover
  - forage quality
    - » leaf:stem
    - » crude protein
    - » fibre
  - grain yield

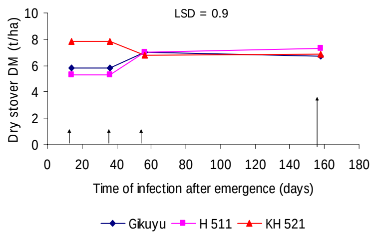
	2001 Short	2002 Long	2002 Short	2003 Long
Infection time	√	√	√	√
Infection level	√	√		
Cultivar	√	√	√	√ on farm
Planting date			√ on farm	√ on farm
Planting density		√	√	
Fertiliser	√	√	√	

Impact of MSVD and cultivar on thinnings

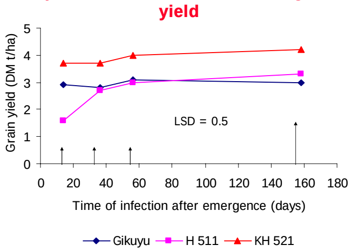


Arrows are infection times (14, 35 and 56 days after emergence, plus control)

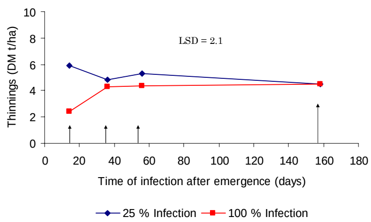
Impact of MSVD and cultivar on maize stover



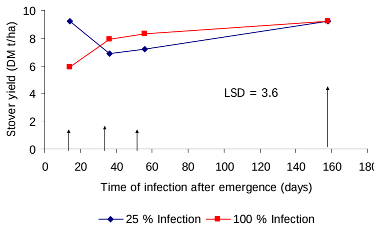
Impact of MSVD and cultivar on grain yield



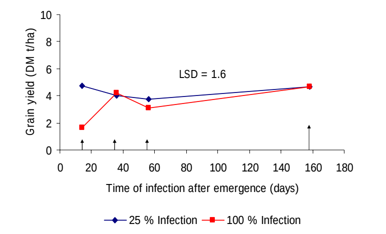
Impact of % infection on thinnings



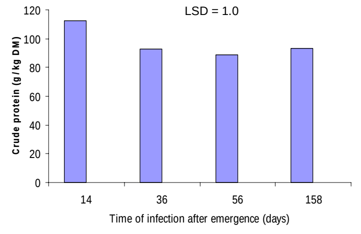
Impact of % infection on stover



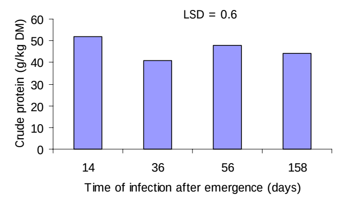
Impact of % infection on grain yield



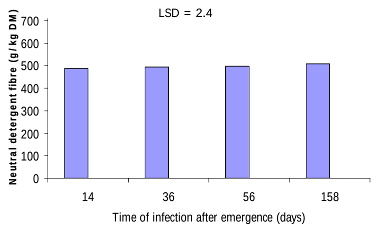
Impact of MSVD on thinning protein



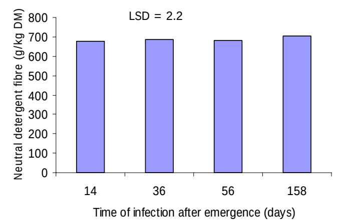
Impact of MSVD on stover protein



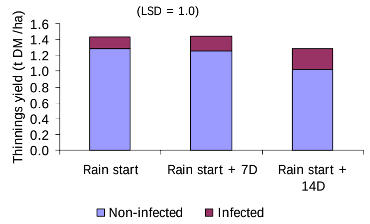
Impact of MSVD on thinning fibre



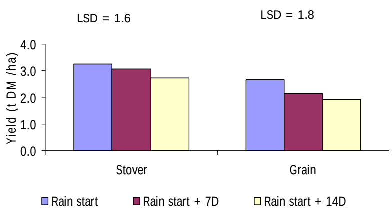
Impact of MSVD on stover fibre



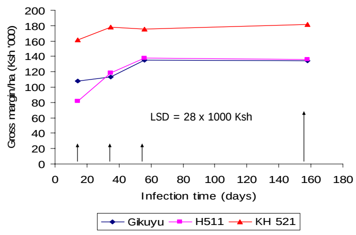
Planting date effect on thinnings



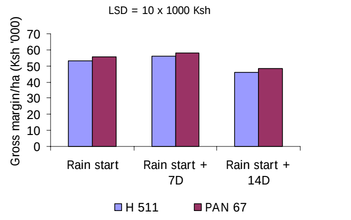
Planting date effect on yield



Effect of cultivar and MSVD on gross margins



Effect of planting date on gross margin



On farm trial

Conclusions 1

- MSVD effect much less with KH 521 than Gikuyu & H 511
- For Gikuyu, MSVD affects grain yield less than forage

Conclusions 2

- Early infection more damaging to forage yield than late infection
- If 100% infection early – disaster!
- If 25% infection early - not a disaster
- MSVD does not decrease forage quality

Conclusions 3

- Later planting - higher MSVD
- Later planting – less forage, less grain

Conclusions 4

- Higher gross margins from KH 521 than H 511 & Gikuyu
- MSVD reduced gross margins more with 25% infection than 100%

Messages for farmers

- Plant MSVD resistant cultivars
- Plant early to reduce risk of MSVD
- If you do have MSVD, yield will be less but forage quality not affected

Appendix 4: Summary of presentation by Dr Jane Ininda – agenda item 5.2

Development of Maize Varieties Resistant to Pests and Diseases in Kenya

Dr. Jane Ininda
Kenya Agricultural Research Institute, P.O. Box 30148, Nairobi, Kenya

Over 80% of Kenyan population depends on maize as the major food crop. The per capita consumption is 125 kg per annum. The total production is about 2.3 million tons, with 70-80% of maize produced by small scale farmers Kenya. Several factors that include biotic and abiotic constraints; and limited utilization of agricultural technologies and improved seeds threaten maize production in Kenya. Pests and diseases account for 35% of the total yield losses in maize in the world while more recent studies show insects alone account for 35% yield losses in Kenya.

For the past forty years, maize improvement in Kenya has emphasised high yielding varieties. This produced the popular 500 and 600 series hybrids. Hence disease and pest resistance was not given adequate attention. Consequently epidemics of *Maize streak virus* disease (MSVD), turcicum blight have resulted and the land area with severe incidences of head smut has increased. The response by the Kenya Agricultural Research Institute has been to breed for resistance to priority pests and diseases of maize in order to develop new cultivars with resistance to foliar diseases. Resistance is perceived as the most cost-effective control option for the risk-prone resource poor farmers in Kenya.

Figure 1. Three year average performance of KH521 (MU99301) for MSVD, yield (t/ha) and Maturity

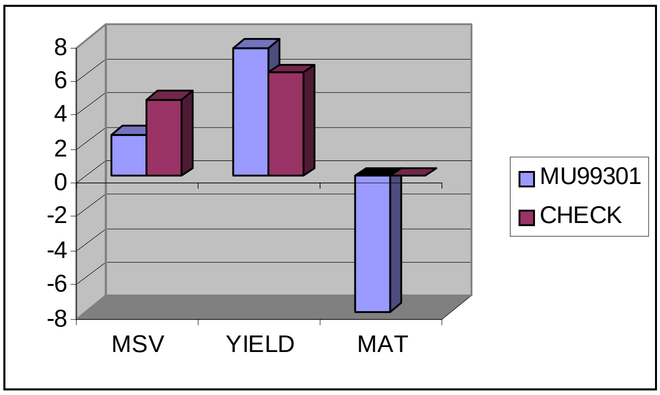
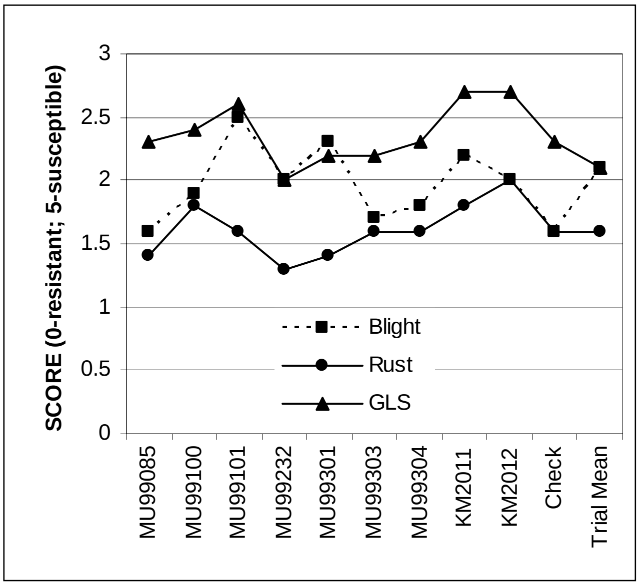


Figure 2. Susceptibility of new varieties to foliar diseases in National Performance Trials 2001.



Since 1999-2000, a rigorous strategy to improve varietal disease resistance was adopted that took into consideration the diverse maize growing ecologies in Kenya. The objectives of this paper are to highlight improvements for resistance to MSVD, turcicum or northern leaf blight (*Setosphaeria turcica*; anamorph: *Exserohilum turcicum*), GLS (Grey Leaf Spot - *Cercospora zeae-maydis*), common rust (*Puccinia sorghi*) and stem borers (*Chilo partellus*).

Figure 1 shows that a newly released hybrid MU99301 (KH521) had a lower MSVD score of 2.5 (mild reactions to streak) compared to the check or the popular variety's score of 4.5 (susceptible to MSV). In addition to resistance and tolerance to MSV, pyramiding for resistance to other foliar diseases is being achieved simultaneously in newly released hybrids. For example MU99232 has resistance to MSVD and showed lower scores (more resistance) for GLS and common rust compared to the check (Fig.2); while MU99085, MU99303, and MU99304 showed resistance to MSV and enhanced resistance to turcicum blight. These improvements in disease resistance have been achieved without compromising the yield levels. Similar improvements have been introduced for stem borers, where one single-cross hybrid was obtained that showed a mean foliar damage score of 3.5 (tolerant) compared to the most popular check, which had a mean foliar score of 9.0 for stem borers (data not shown). Generally newly released hybrids show better disease scores compared to the current popular hybrids for the farmer. This means new cultivars with an immediate potential for deployment could result in better options for the farmer in terms of disease resistant maize varieties that could be used as clean material for forage.

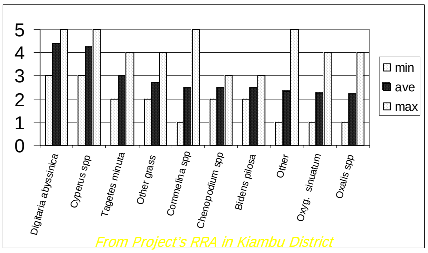
Appendix 5: Presentation by Dr Jedidah Maina – agenda item 6

CONTROLLING WEEDS TO IMPROVE FORAGE

- Impact of weeds on forage yield and quality
  - Farmers' perceptions
  - On station studies (at Muguga and FTC)
  - On farm studies
- Weeds in the maize crop contribute 5% of annual forage use in Kiambu (Project RRA)
- Integration of MSVD and weed control

Impact of weeds on stover yield

Farmers' perception: 0 = no effect; 5 = high impact



From Project's RRA in Kiambu District

Evidence of late first weeding (due to labour shortage)

- Time of first weeding
  - Recommended 2-3 weeks after planting (WAP)
  - Short rains 2001: mostly 3-4 WAP
  - Long rains 2002: mostly 3-4 WAP
  - No first weeding in three patches in each season
    Total 31 patches (short 2001); 47 patches (long 2002)
- Flowering weeds at first weeding
  - Short rains 2001: 7/31 patches
  - Long rains 2002: 17/47 patches
  - Main species *Commelina* and *Galinsoga*

From Project's Longitudinal Survey in Kiambu District

Evidence of late second weeding (1) (for use as forage)

- Recommended time of 2nd weeding: 6-8 weeks

Weeks after planting For second weeding	Short 2001	Long 2002
	Number of patches	
Up to 8 weeks	4	6
9-21 weeks	2	6
Handpulling for forage	9	34
Partial weeding	0	1
Not available	14	0

From Project's Longitudinal Survey in Kiambu District

Flowering weeds at second weeding

- [Data not available for all patches]
- Short rains 2001: 20/26 patches
- Long rains 2002: 18/30 patches
- Main species flowering (in more than 7 patches in both seasons)
  – *Bidens pilosa*, *Commelina* spp., *Tagetes minuta*, *Galinsoga parviflora*, *Amaranthus*

From Project's Longitudinal Survey in Kiambu District

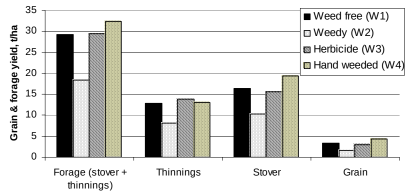
Summary of experiments carried out on weeding regimes

	Short 2001	Long 2002	Short 2002	Long 2003	Short 2003
Muguga	☑	☑	Times† & seed bank	…	
FTC Waruhiu			☑	☑	Times only ‡
Kamburu (on farm)			☑	☑	

† *Hand weeding times for both 1st & 2nd weedings*
‡ *Hand weeding times for 1st weeding only*

Effect of weeding regimes on forage and grain yields (tonnes/hectare)

Muguga short rains 2001 (Musembi's work)



sed: 3.2 1.5 0.5 0.5

Yields for other seasons generally showed no significance between weeded treatments in forage yield or grain.

(Detailed results not presented today but are available on request).

In short rains 2001, 10000 Ksh/ha reduction in weed control costs using herbicides rather than handweeding twice.

Were these cost reductions from herbicides similar in different experiments?

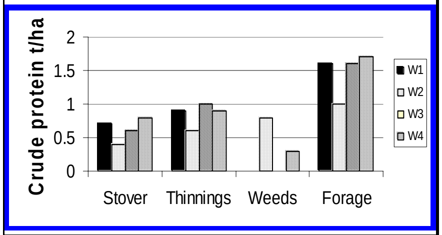
Reduction (-) or increase (+) in control costs using herbicides

{Herbicide treated – hand weeded twice} in KSh/ha

	Hand-weed	@ Ksh/d	Short 2001	Long 2002	Short 2002	Long 2003
Muguga	**2 & 8 weeks**	**180**	**-10000**	**-6620**	…	…
FTC Waruhiu	**3 & 8 weeks**	120	…	…	-2600	-900
	3 & pull	120	…	…	-1910	**+2540**
Kamburu (on farm)	**3 & 8 weeks**	100	…	…	**+420**	**+1100**
	3 & pull	100	…	…	-	**+2540**

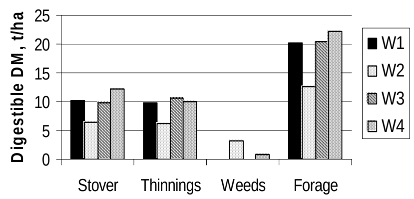
Impact of weeds on crude protein

W1: weed free W2: unweeded
W3: herbicide W4: handweeded



Impact of weeds on digestible dry matter

W1: weed free W2: unweeded
W3: herbicide W4: handweeded



Is there an interaction of weeding regimes and MSVD control using resistant cultivars?

No: but impact the severe natural MSVD infection and its control by MSVD resistant cultivars was apparent

Cultivar	Grain t/ha	Thin's t/ha	Stover t/ha	Forage t/ha
H511	2.26	0.90	2.37	3.27
PAN 67	5.40	1.14	3.29	4.43
Significance	P<0.001	Trend? P=0.08	n.s.	n.s.

Some conclusions

- Weeding twice by hand is often more expensive than herbicides but difference less evident at Kamburu and in Long rains 2003
- Delaying second weeding to feed weeds to animals did not reduce forage or grain
- Quality of weeds as forage was variable: high in short rains 2001 but not in the long rains 2002.
- But caution needed to minimise weed seed influx
- Leaving patches unweeded will cause greater problems in the next crop.

Appendix 6: Presentation by Dr Francis Muyecko, ICIPE – agenda item 7.1

BENEFITS FROM PUSH-PULL TECHNOLOGY ON FORAGE AND CROP PRODUCTIVITY ON SMALLHOLDER FARMS

F. N. Muyekho[1] and Z.R. Khan[2]
[1]Kenya Agricultural Research Institute
[2]International Centre of Insect Physiology and Ecology, Kenya

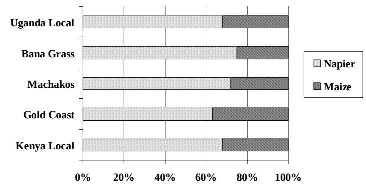
INTRODUCTION

- Inadequate quality feed a constraint to livestock productivity
- Small land size/competing enterprises limits planted forages
- Low soil fertility for forage and crop production
- Cereal stemborers (15-40% yield loss in maize)

What is 'push-pull' strategy?

The strategy involves the use of both trap (pull) and repellant (push) forage plants, so that stemborers are simultaneously repelled from the maize crop and attracted to the trap plants

Percentage of eggs laid by C. partellus on various napier grass varieties as compared to maize



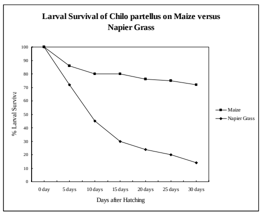


Table 1. Comparison of stem borer Infestation in Push-Pull and Control maize fields in western Kenya

District	No. farmers	SB Infest. (%) in Push-Pull	SB Infest. (%) in Control
T-Nzoia	550	17.1	32.2**
Suba	375	10.7	21.3*
Kisii	130	5.0	12.0*
Rachuonyo	120	6.3	18.4**
Bungoma	150	12.8	27.7*
Busia	130	14.0	35.7*
Vihiga	50	4.1	22.6**

Table 2. Comparison of maize yield in Push-Pull and Control maize fields in western Kenya

District	No. farmers	Maize yield (t/ha) in Push-Pull	Maize yield (t/ha) in Control
T-Nzoia	550	5.1	4.0*
Suba	373	3.4	1.4*
Kisii	130	4.1	2.8*
Rachuonyo	120	3.7	2.0*
Bungoma	150	3.8	1.6*
Busia	130	3.9	2.8*
Vihiga	50	4.9	2.9*

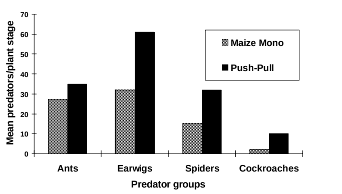
Effects of pattern of Desmodium intercropping with maize on stemborer control and yield in 1999

Inter-crop pattern	SB infest. (%)	Number of borers recorded	Maize yield (t/ha)
Maize mono	13.0	46.0	6.0
1 Des: 1 mz.	5.3	17.0	6.7
1 Des: 3 mz.	6.0	20.7	8.1
1 Des: 5 mz.	6.7	18.0	7.6
1 Des: 7 mz.	5.8	29.0	7.0
1 Des: 9 mz.	10.0	35.2	6.7
1 Des: 11 mz.	13.3	45.2	6.6

Effects of pattern of Desmodium intercropping with maize on stemborer control and yield in 2003

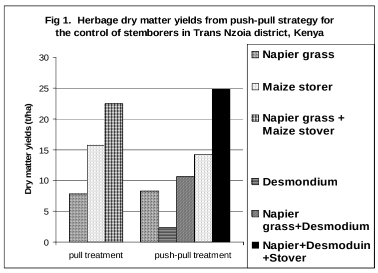
Inter-crop pattern	SB infest. (%)	No. of borers recovered	Maize yield t/ha
Maize mono	16.1	15.7	6.8
1 Des: 1 mz.	6.2	2.2	7.9
1 Des: 3 mz.	4.4	0.6	7.7
1 Des: 5 mz.	6.7	1.3	7.1
1 Des: 7 mz.	8.3	5.0	7.1
1 Des: 9 mz.	10.0	4.8	7.1
1 Des: 11 mz.	8.9	8.3	6.8

Comparison of stemborer predators on maize plants in Push-Pull and Control fields (Lambwe, Kenya 2001)

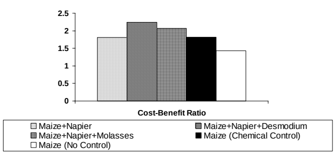


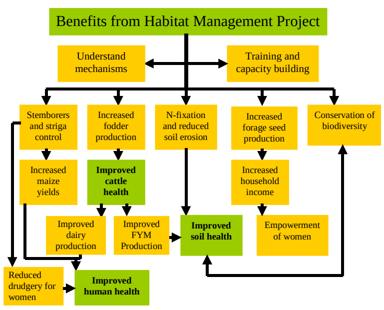
Effects of Desmodium on soil nitrogen in push-pull plots after 2 seasons

Inter-crop pattern	Nitrogen (%) in top soil	Nitrogen (%) in sub-soil
Maize mono	0.14	0.16
1 Des: 1 mz	0.19	0.16
1 Des: 3 mz	0.18	0.16
1 Des: 5 mz	0.18	0.15
1 Des: 7 mz	0.15	0.17
1 Des: 9 mz	0.17	0.14
1 Des: 11 mz	0.16	0.16



Economics of push-pull technology





Appendix 7: Presentation by Dr Sam Njihia – agenda item 7.2

PUSH-PULL SYSTEM FOR MAIZE STALKBORER CONTROL AND IMPROVING FORAGE YIELD

INTRODUCTION

- RRA results for Kiambu district 2001 ranked stem borers as 2nd in the pest & disease problem ranking
- Attacked plants are stunted or die causing yield loss of 20 – 80%
- Integrated pest management (IPM) strategies available, but efficacy of some not yet proven
- Push - pull system (see agenda item 7.1) is part of this IPM
  - **Napier grass produces smells attractive to stemborer moths (pull)**
  - **Desmodium produces repulsive smells to stemborers (push)**

Materials and Methods

- Farmer participatory studies
  - **Two farmer groups used**
  - **Kamari women's group based at Waruhiu FTC**
  - **Karweti farmers' group based at one member's land in Githunguri**
- During the short rains 2003 planting season each group planted Push-pull & control plots

Kamari

- Plot area = approx 900m²
- Two maize varieties planted
  - H511 and Pan 67 @ 450 m² each
- Perimeter = 3 rows Napier
- Intercropping – push-pull plot:
  - beans and Desmodium in alternate interrows
- Intercropping – control plot
  - beans in every interrows
- Spacing for maize = 75cm x 30cm
- Seeds per hill – 3
- Manure rates - 340 grams per hill
- Fertilizer rates - 0.40 grams per hill

Karweti

- Plot area = approx. 900m² in push-pul plot and 670 in control
- Two maize varieties planted
  - H511 and Pan 67 @ 450 m² each in push-pull
  - H511 @ 400 m² and Pan 67 @ 270 m² in control plot
- Layout similar to one described for Kamari except
- Spacing for maize = 75cm x 60cm
- Manure rates - 106 grams per hill
- Fertilizer rates -1.65 grams per hill

Results

Percentage of plants affected by stem borers in each plot of push-pull trial, short rains 2003. (Numbers and total sample in brackets).

	Kamari push/pull	Kamari control	Karweti push/pull	Karweti control
H511	0.72 (17/2352)	3.79 (91/2400)	4.71 (49/1040)	9.4 (116/1232)
PAN67	0.64 (15/2352)	3.25 (78/2400)	7.02 (73/1040)	8.4 (74/880)

- Preliminary observations tabulated above suggests that at both Kamari and Karweti the push- pull plots have less incidence of attack than the controls. Possibly attributable to push pull effect but there is need for proper validation studies since the results are based on one season's data.

Farmers’ perception of push-pull in the light of other crops in the rotation

- Rotation is a normal farming practice in Kiambu district but other crops in the system include potatoes (Irish & sweet), bananas, tomatoes
- Farmers believed that the farming practice could accommodate both these rotational crops and the spatial arrangement of the perennial Napier and Desmodium crops required for the push-pull system.
- Farmers were satisfied that the outputs from push-pull units addressed need of both human food and forage.

Unresolved questions about the push pull systems

- The maximum size of the push-pull unit to ensure that semiochemicals involved are effective?
- Napier variety: the variety Kakamega 1, which is resistant to Napier head smut, has not been evaluated for attractiveness to stemborer moths.
- The recommended management (harvesting and cutting back) practices for Napier and Desmodium for optimal results.

Work still needed

- As expected results in the participatory budgets show negative gross margins in the first season of the technology due to setup costs and so longer-term evaluation of costs and benefits is needed. Validation studies should determine how long it will take for gross margins in the push pull systems to turn positive.
- The technology needs adaptation to the crop rotations practiced in central Kenya.
- Technology promoters need to be trained in all of push pull technology including
  - Bulking of desmodium plants using either seeds or vines
  - Economically viable push-pull lay-outs
  - How to introduce farmers to the technology.

MESSAGE

- Push- pull technology offers a useful contribution to control of stem borers (and weed suppression by the Desmodium) while crops produced address food and forage needs.

Appendix 8: Presentation by Dr Jackson Njuguna – agenda item 8

Cattle manure as a means of dispersal for weeds and head smut of maize

J. M. Maina and J.G.M. Njuguna

Introduction

- RRA and longitudinal studies indicated that some farmers fed flowering weeds to dairy animals
- Other farmers fed smutted maize forage to their dairy animals
- Some farmers were afraid that smutted maize forage was harmful to dairy animals
- Faced with the forage shortage problem, some farmers opted to remove only the smutted parts of the maize plants and to feed the animals with the rest.
- Smutted parts (usually tassel and cob) are removed but left on the ground, contaminating the field even more.
- Two types of smut occurs often in maize namely common smut (caused by *Ustilago maydis*) and head smut (caused by *Sporisorium reilianum*), the latter being more destructive than the former.

Materials and methods

- Experiments conducted in 2002 and 2003 to investigate the passage of weed seed and smut spores through the animal gut and the effect of composting the dung
- Three Holstein steers weighing about 700 kg were used.
- Animals were fed on Napier grass for one week before the treatment
- Treatment consisted of 400g mixture of maize germ and bran on to which 250g of smut spores and 250g of weed seed of each of five weed species: Amaranthus spp., Bidens pilosa, Erucastrum arabicum, Galinsoga parviflora and annual grasses
- The treatment ration was given to the animals daily for 3 weeks.
- The dung from the three steers was collected daily and pooled together and then split into two
- One heap was composted for three months and the other heap spread on the floor to dry

Results

- Both the weed seed of Amaranthus and the smut spores passed through the gut unharmed. The other weed seed appear to have been destroyed during passage.
- Composting appear to kill all smut spores and most seeds of Amaranthus.

Transmission of *S. reilianum* spores and *Amaranthus* seed through manure. Spores survival was detected by development of head smut on plants of a susceptible maize genotype . Seed survival was evidenced by emergence of seedlings over at least six months.

Treatment	% maize plants smutted	Number of germinated
Fresh cow dung (T1)	43	3.75
Dried cow dung(T2)	14	37.25
Composted cow dung(T3)	0	9.75
Positive control (T4)	53	438
Negative control (T5)	0	1.5

Take- home message

- Although some weeds are good forage for dairy animals, do not feed seeding weeds to livestock.
- Plant maize cultivars that are resistant to head smut if the disease occurs frequently.
- Do not feed smutted maize forage to cattle, but if you do, then compost cow dung for at least three months before use.
- If you buy manure from afar look out for new weeds.

Appendix 9: Presentation by Dr David Miano Mwangi – agenda item 9

Participatory Budgets in Forage Technologies

Mwangi D. M., Methu J. N., Maina J. W, Nyanyu G. Kirui, J. and Njuguna J.

Introduction

i. What are participatory budgets?
ii. Why we think they are important?
iii. Examples of how they were used in:
    1. Push and pull technology (Karweti and Kamari)
    2. Fodder conservation (partial budget)
iv. Conclusions

What are participatory budgets (PB)?

A tool which examines a farmer's use and production of resources over time for a specific enterprise – i.e. control of stem borer in maize or forage conservation in dairy.

i. Analyse farmers existing activities, resource use and production
ii. Explorer implication of changes in resource use
iii. Compare different enterprises
iv. Plan new enterprise

Format for PB

Example: Push-pull in Karweti

i. Used to compare a change in the use of resources – push-pull to control stem borer
ii. Current practices (Gichichio)
iii. Push pull (New technology)
iv. Two seasons – Long rains 2003 (kimera kia njahi) and short rains 2003 (Kimera kia mwere)

Activities and inputs for control (current practice) by month (long rains)

ACTIVITIES

March 2003
Land preparation

April
Planting maize
Planting beans

May
1st Weeding

June
2nd Weeding

August
Maize thining

October
Harvesting

INPUTS

March

Labour 44.4 mandays @100 KSh/day	= 4440

April

Labour 66.7 mandays @100 KSh/day	= 6670
Pan67- 25kg seed@150 KSh/kg	= 3750
H511 – 33.3kg@ 135 KSh/kg	= 4500
Bean seed 22.2 kg@ 40 KSh/kg	= 889
Fertilizer – DAP 88.9 kg @ 25 KSh/kg	= 2222

May

Labour 22.2 mandays @100 KSh/day	= 2220

June

Labour 11.1 mandays @100 KSh/day	= 1100

August

Labour – 22. mandays @100 KSh/day	= 2220

October

Labour 33. mandays @100 KSh/day	= 3330

SUMMARY OF INPUTS

Labour: 199.9 mandays @100 KSh/day	= 19990
Maize Seeds	
Pan67 - 25 Kg @ 150 KSh/kg	= 3750
H511 – 33.3 kg @ 135 KSh/kg	= 4500
Bean seeds	
22.2 kg @ 40 KSh/kg	= 889
Fertilizer – 88.9 Kg @ 25 KSh/kg	= 2222

Total cost (Pan67) = KSh. 26,851.50
(H511) = KSh. 27601.5

OUTPUTS

August
Maize thinnings – 66.6 loads @. 50 Ksh /load = 3,330
assume 50% for each cv.

October
Maize grain
H511 – 266.7 "tins" @ 40 KSh/tin = KSh 10668
Pan67 – 399.4 "tins" @ 40 KSh/tin = KSh 15974.40
Stover
Pan67 – KSh. 6666.70
H511 – KSh. 10000

SUMMARY OF OUTPUTS

H511

Grain	Ksh. 10,668
Thinnings	KSh 1665
Stover	KSh 10000
TOTAL	**KSh 22333**

Pan67

Grain	Ksh. 15,974.40
Thinnings	KSh 1665
Stover	KSh . 6,666.70
TOTAL	**KSh 24,306.10**

Gross Margin

Pan67	**KSh - (3295.50)**
H511	**KSh - (5268.50)**

Activities and inputs for push-pull by month (long rains)

ACTIVITIES

March 2003
Land preparation

April
Planting maize
Planting beans

May
1st weeding

June
2nd Weeding
Watering
Desmodium

September
Harvesting Napier 1 row

October
Harvesting maize

[No thinning as only one seed planted per hill]

INPUTS

March
Labour 44.4 mandays @100 KSh/day = 4440

April
Labour 66.7 mandays @100 KSh/day = 6670
Pan67- 22.2kg seed@150 KSh/kg = 3333.30
H511 – 22.2kg@ 135 KSh/kg = 2997
Bean seed 22.2 kg@ 40 KSh/kg = 888
Fertilizer – DAP 88.9 kg @ 25 KSh/kg = 2222

May
Labour weeding 44.4 mandays@100 KSh/d 4440

June
Weeding 44.4 mandays @100 KSh/day = 4440
Watering 66.7 mandays @100 KSh/day = 6670

September
Labour – 22. mandays @100 KSh/day = 2220

October
Labour 44.4 mandays @100 KSh/day = 4440

SUMMARY OF INPUTS
Labour: 588.7 mandays @100 KSh/day = 58870
Pan67 seed - 22.2kg @150 KSh/kg = 3333.30
H511 seed – 22.2kg@ 135 KSh/kg = 2997
Bean seed 22.2 kg@ 40 KSh/kg = 888
Fertilizer – DAP 88.9 kg @ 25 KSh/kg = 2222
Manure for Napier– = 6670

Total cost (Pan67) = KSh. 71983.80
(H511) = KSh. 71647.50

OUTPUTS

September
Napier grass – 55.6 loads @. 50 Ksh /load = 2780

October
Maize grain
H511 – 1000 “tins” @ 40 KSh/tin = KSh 40000
Pan67 – 1000 “tins” @ 40 KSh/tin = KSh 40000
Stover
Pan67 = KSh. 11111
H511 = KSh. 8888.80

OUTPUT SUMMARY

H511

Grain	Ksh. 40000
Stover	KSh 8888.8
Napier	KSh 2780
TOTAL	**KSh 51668.8**

Pan67

Grain	Ksh. 40000
Stover	KSh 11111
Napier	KSh 2780
TOTAL	**KSh 53891**

Gross Margin
Pan67 KSh - (18092)
H511 KSh - (19978.7)

Activities and inputs for push-pull – summary only (short rains)

ACTIVITIES

SUMMARY OF INPUTS
Labour: 338.6 mandays @100 KSh/day = 33860
Pan67 seed -16.7kg @150 KSh/kg = 2505
H511 seed – 16.7kg@ 137.50 KSh/kg = 2296.25
Bean seed 5.6 kg@ 40 KSh/kg = 224
Fertilizer – DAP 91.6 kg @ 25 KSh/kg = 2290
Manure– = 32222

Total cost (Pan67) = KSh. 71101
(H511) = KSh. 70892.25

OUTPUT SUMMARY

Napier	**29445.4**
Desmodium	**1600**
Beans	**5777.80**
H511 Grain	Ksh. 7112
Thin+Stover	KSh 19435.50
Pan67 Grain	Ksh. 10666.70
Thin+Stover	KSh 20546.60

Gross Margin
Pan67 KSh – (3064.50)
H511 KSh - (7521.55)

Activities and inputs for control (short rains)

ACTIVITIES

SUMMARY OF INPUTS
Labour: 193.9 mandays @100 KSh/day = 19390
Pan67 seed – 33.3kg @150 KSh/kg = 5000
H511 seed – 12.5kg@ 137.50 KSh/kg = 1718.75
Bean seed 22.2 kg@ 40 KSh/kg = 888
Fertilizer – DAP 116.7 kg @ 25 KSh/kg = 2917
Manure – = 25000
Total cost (Pan67) = KSh. 53195.50
(H511) = KSh. 49914.25

OUTPUT SUMMARY

Beans	**10224**
H511 Grain	Ksh. 6666.7
Thin+Stover	KSh 8057.2
TOTAL	**24947.90**
Pan67 Grain	Ksh. 10557.2
Thin+Stover	KSh 21333.3
TOTAL	**42115.50**

Gross Margin
Pan67 KSh – (11081)
H511 KSh - (24966.35)

Gross margins over 2 seasons

Treatment	Cultivar	Long rains	Short rains	TOTAL
Push-pull	**H511**	**-(19978.7)**	**-(7221.55)**	**-(27200.25)**
	PAN 67	**-(18092)**	**-(3064.50)**	**-(21156.5)**
Control	**H511**	**-(5268.5)**	**-(24966.35)**	**-(30234.85)**
	PAN 67	**-(3295.5)**	**-(11081)**	**-(14376.5)**

Participatory partial budget in feed conservation

Methodology

Determine dry period (Months)
Current dry season strategy vs silage making
Determine inputs and cost of current strategy
Buy in grass from coffee estates
Cost per load in dry season = KSh. 250
Requirement: 78 loads in 5 months plus an extra bag of bran per month

Inputs and output

INPUTS for current strategy

January
Grass 16 loads @ 250 = KSh. 4000
1 bag of bran = KSh. 260

February
14 loads @ 250 = KSh. 3500
1 bag of bran = KSh. 260

March
14 loads @ 250 = KSh. 3500
1 bag of bran =KSh. 260

August
Grass 16 loads @ 250 = KSh. 4000
1 bag of bran @ 260 = KSh. 260

September
16 loads @ 250 = KSh. 4000
1 bag of bran @ 260 = KSh. 260

Total – KSh. 20800

INPUTS for making silage

Need 9 tubes of approx 400 kg in May or Nov

3 t of forage from push-pull
22.5 m polythene tube @ 110 = KSh. 2475
Molasses 2.5 Jeri cans @ 300 = KSh. 750
5 mandays @100 = KSh. 500

Total – KSh. 3725

OUTPUTS SCENARIO 1 as current strategy

January (milk @16 KSh/litre)
8 litres/day =3968

February
8 litres/day =3584

March
8 litres/day =3968

August
8 litres/day =3968

September
8 litres/day =3840

Total – KSh. 19328

Scenario 1 – Milk yield remains 8 litres/day with or without forage conservation

Output – KSh 19328

Gross margin without conservation - 19328-20300 = KSh. (972)
Gross margin with conservation – 19328 – 3725 = KSh. 15,603

Scenario 2 – With conservation milk yield increase to 18 litres /day due to more and better quality feed

Output – KSh 38656

Gross Margin: 38656 – 3725 = KSh 34931

Conclusions

Making a loss in push-pull and control
Reduced losses during the second season – reduced labour costs in push-pull
Concerns
Extra costs – watering *Desmodium*
Extra inputs –
Conservation positive even when output remains the same.

Appendix 10: Agenda for Stakeholder Meeting 2 April 2004

Session A. Introduction and welcome 0830-1000

1. Welcome
2. Introduction to participants
   2.1. Opportunity for all to say who they are and their affiliation and interest in project
3. Objectives of project and meeting (AJM)
   3.1. Agenda note: This final stakeholder meeting of R7955 has the primary purpose of reporting to stakeholders on the overall project and extent to which its outputs have been completed. It follows on from Stakeholder meetings on 11 July 2001 and 30 September 2002. Copies of the minutes of both meetings were circulated, but are also available on the project website. Results and extension messages and implications of all activities will be presented and open for discussion. Opportunities for ongoing dissemination and impact will also be explored.
4. Description of methods. RRA, Longitudinal Study, On-station research, Participatory on-farm research, Training and Dissemination (Jackson Njuguna)

Refreshments break and group photograph *1000-1030*

Session B. Scope for alleviating seasonal forage shortages using Crop Protection Technologies

5. **Controlling maize streak virus disease to improve forage yield**
   5.1. (Ben Lukuyu) 1030-1100
   - The importance of MSVD in Kiambu (RRA/longitudinal results)
   - Impact and economic consequences of MSVD on forage from maize
   - Why date of infection gives different results on-station and on-farm
   - Impact of agronomy (fertiliser, planting density, planting date)
   - Acceptability trials for PAN 67 and KH521
   - Recommendation: use of resistant varieties (BL)

   5.2. Promotion and uptake of MSVD resistant cultivars in Kiambu
   5.2.1. KH521 (Muguga 1) (Freshco Seeds) 1100-1105
   5.2.2. PAN67 (Pannar Seed Company) 1105-1110

   5.3. Development of MSVD resistant cultivars at KARI Muguga (Dr Jane Ininda) 1110-1120
6. **Controlling weeds to improve forage yield** (Jedidah Maina) 1120-1150
   - Controlling weeds to improve forage
   - The context (RRA/longitudinal) impact of weeds
   - Impact and economic consequences of weeds on forage from maize
   - Interaction of weeding and MSVD
   - Recommendations: regimes, late weeding
   - Promotion and uptake of herbicides using small packs
7. **Push-pull system for maize stem borer control and improving forage yield**
   7.1. The push-pull system (Dr Francis Muyecko, ICIPE) 1150-1205
   7.2. On-farm studies in Kiambu (Sam Njihia and David Miano) 1205-1230
   - The context (RRA/longitudinal) impact of maize stem borer (SN)
   - Farmer participatory studies
   - Results to date
   - Work still needed

8. **The impact of livestock** on maize head smut disease and weed seed transmission - Spore and seed transmission to subsequent crops after feeding & composting.(Jackson Njuguna and Jedidah Maina) 1230-1245

9. **Forage conservation**.(David Miano & Joseph Methu/Land o'Lakes) 1245-1300

Lunch break *1300-1400*

10. **Summary**
    The main messages of technologies (Alistair Murdoch) 1400-1410
    Economic implications for farmers (Peter Dorward) 1410-1415

Session C. Dissemination and training

11. **Dissemination and training activities** (Francis Musembi/Grace Mbure) 1415-1430
    - Farmer field days
    - Farmer exchange visits
    - Participatory on-farm research
    - Training of extension workers
    - Publications/project website/project leaflets

12. **Encouraging wider dissemination**

    12.1. Group discussion led by David Maino 1430-1500
    - What are the key activities and issues for encouraging uptake?
    - What could you or your organisation do to encourage uptake? (Note you may wish to concentrate on one technology)
    - Are there any other issues that need to be taken into account?

Refreshment break *1500-1530*

    12.2. Feedback from discussion groups representing, for example, 1530-1615
    - Extension
    - NGOs
    - Companies
    - Research organisations

13. **Proposed ongoing dissemination in 2004 by R7955 team** (Peter Dorward) 1615-1625

14. **Concluding remarks** **1625-1630**

Disclaimer: This meeting is organised by research project R7955, *IPM of maize forage dairying*, funded by DFID Renewable Natural Resources Knowledge Strategy Livestock Production (LPP) and Crop Protection (CPP) programmes for the benefit of developing countries. The views expressed are not necessarily those of DFID.

Website:
http://www.apd.rdg.ac.uk/Agriculture/Research/CropScience/Projects/IntegratedWeed/index.htm