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Farmers' validation of pest control methods for the better storage of Legumes

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Abstract

Appropriate methods of pest control were tested by farmers, to prolong on farm storage and improve the quality of cowpea (*Vigna unguiculata* (L.) Walp.) in Ghana and Uganda. Three methods had been shown in previous research to be effective at controlling the main pest of stored cowpea, the bruchid beetle *Callosobruchus maculatus*.

Farmers applied the methods for the duration of the storage season in 2000-2001, following which a questionnaire was used to record their perception of the methods. Results show that farmers in Ghana validated two of the methods whilst in Uganda all three methods were perceived as being effective.

The results of the questionnaire analysis were shared with villagers, and they made additional comments. These show that, despite some reservations, farmers are ready to use the most effective method, solarisation, which uses the greenhouse effect of a simple polythene sheet to heat cowpea grains to a temperature sufficient to kill most pests. This is repeated monthly for improved effectiveness.

The benefits of this approach are discussed in terms of the validation of the methods, its impact on collaborations in the project, and on further development of promotion and extension material on the control methods.

Introduction

The work presented here was part of a Crop Post-Harvest Programme funded project seeking primarily to address technical constraints to the on-farm storage of legumes, and to identify and improve uptake pathways best fitted to the circumstances of poorer rural households in sub-Saharan Africa (Morris & Tran, 2002). Poorer people in the rural areas are currently faced with deteriorating food stocks, and are also effectively excluded from securing the premiums known to be associated with clean grain. The approach adopted seeked to mainline the role of farmers in better articulating their needs and selecting appropriate technologies, and in improving the fit and understanding of those state and civil society agencies who seek or are mandated to respond to farmers' demands.

Cowpea (*Vigna unguiculata* (L.) Walp.) plays an important role in the diet and economy of many small-scale farmers in sub-Saharan Africa, and is known to suffer substantial damage and loss of

quality as a result of infestation by a member of the Bruchidae family, *Callosopbruchus maculatus* (F.). The damage that typically occurs during on-farm and market storage, is caused by the bruchid larvae (Coleoptera: Bruchidae), which hatch from the eggs attached by the adults to the seed or to the pod before or after harvesting. Quantification of the losses due to bruchids in Africa however had not been well documented, until on-farm damage and losses were studied specifically in Northern Ghana (Tran & Golob, 1999).

This study findings endorsed the view that damage due to bruchids was an important limiting factor in both on-farm and market storage. They confirmed that prevailing control methods used by farmers were largely ineffective, identified and selected new or improved methods for on-station trials, and tested the most promising in farmers' stores. Of the nine different treatments, the most effective with under 10% of damage after 2 months was hermetic storage (using sealed plastic bucket), which unfortunately was also the most expensive. Other treatments that provided some control included thermal disinfestation - solarisation - admixtures of Shea nut butter, and an infusion of kim-kim, *Synedrella nodiflora* Gaertn. (Labiatae).

The CPHP project then seeked to actively engage farmers in validating new and improved methods for post-harvest pest control, identified in the first phase, as safe, sustainable and relevant. This validation was undertaken in Northern Ghana but also in a similar climatic zone in East Africa, namely the Eastern Province of Uganda, where cowpea is also an important crop (Goodland *et al*, 2000), to better ensure a range of robust solutions with greater potential for wider applicability.

GHANA: FARMER PARTICIPATORY TRIALS IN 2000-2001

Approach

Ninety five farmers from the villages of Kpugi and Wantugu, in the district of Gushegu/Karaga, were randomly allocated and applied three treatments and a non-treatment as a control. These treatments were based on the three most effective control methods over six months, established by researchers and extensionists on cowpea stored by farmers during the 1999 – 2000 season:

- Solarisation monthly. To improve the effectiveness of the method the treatment is repeated every month during the storage season.
- Solarisation at harvest then admixture of Shea nut butter.
- Solarisation at harvest then admixture of ash.

Every month, researchers or extensionists from the Ministry of Food and Agriculture visited the two villages and sampled the cowpea from all farmers. This work was supervised by the Northern Region Post harvest Unit of the Ministry, based in Tamale. The damage caused by bruchids was assessed on the sample using a published protocol (Tran & Golob, 1999).

At the end of the storage season, participating farmers provided their views on the treatment they had applied, by answering a questionnaire designed for this purpose. The questionnaire was then analysed, and the results were shared with villagers at a subsequent meeting. Farmers and villagers added to the analysis and additional discussions built on this.

Results

i) Researchers' assessment of the effectiveness of the treatments

The average damage, as recorded by researchers and extensionists on a monthly basis, for each of the treatments over the period of the farmers' field trial is shown on the following chart (Figure 1):

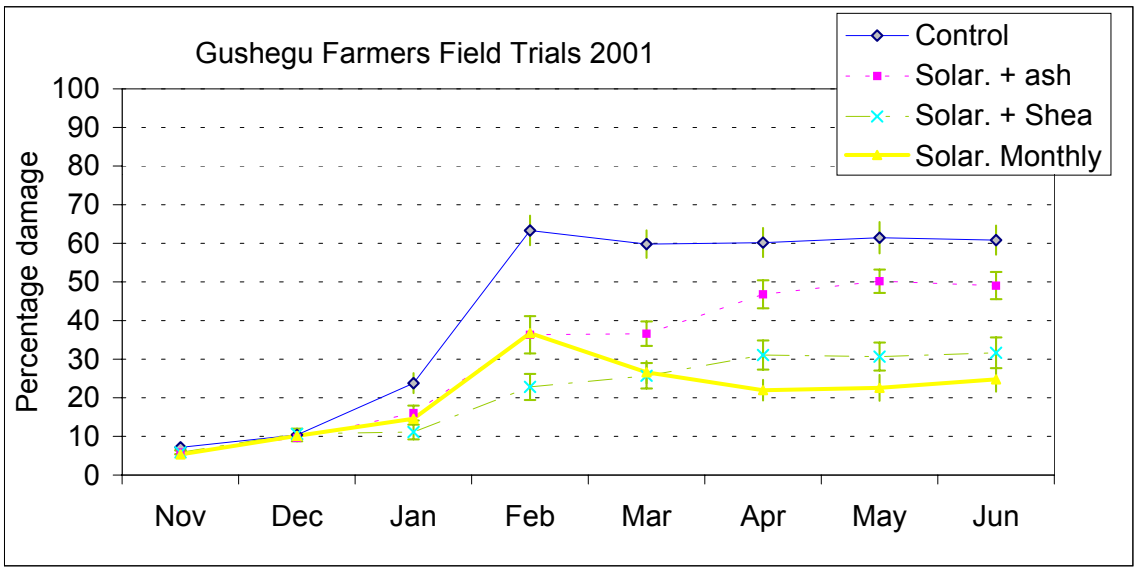

Figure 1: Average percentage damage (with SEM) over the 2000-2001 storage season

ii) Farmers' assessment of the treatments

At the end of the trial, farmers' perceptions of the treatments were recorded using an individual questionnaire. The results of the questionnaire were then shared and discussed with the two participating communities. Figures 2 and 3 below show the answers given to the questions: "What do you think of the treatment you have used?", and "Would you use the treatment again after the trial, or recommend it?". The number of positive answers are shown above the horizontal axis, the number of negative answers below.

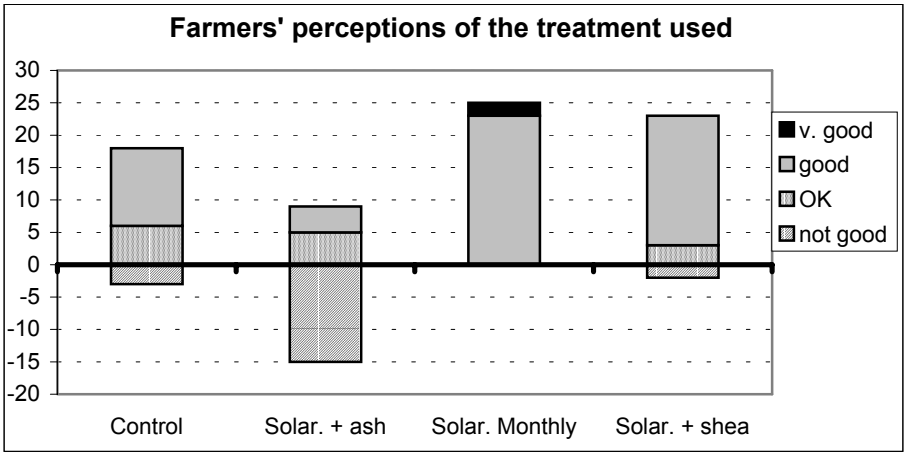

Figure 2: What the farmers thought of the treatments they had used

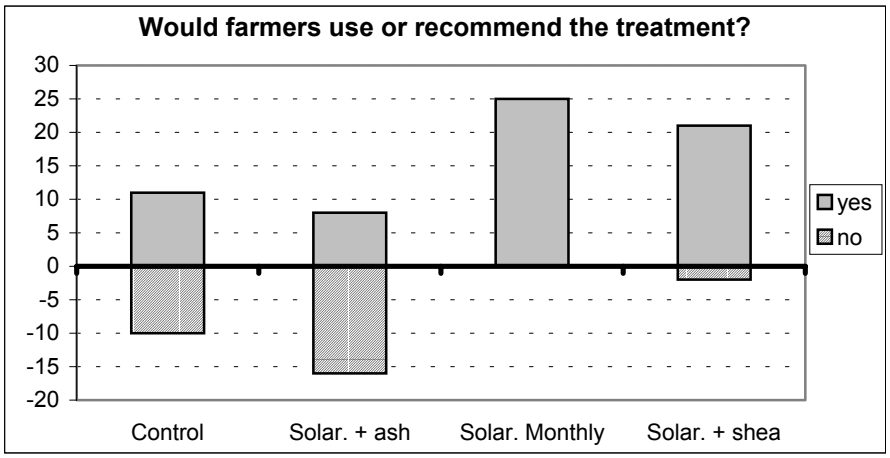

Figure 3: Would farmers use or recommend the treatment?

Farmers were invited to test their cowpea for germination, at the end of the trial. The results were positive, as shown in Chart 4 below. The histograms show the percentage germination, with the number of farmers involved superimposed on the histograms. The horizontal lines indicate the ranking assigned by farmers to germination as a criteria for assessment.

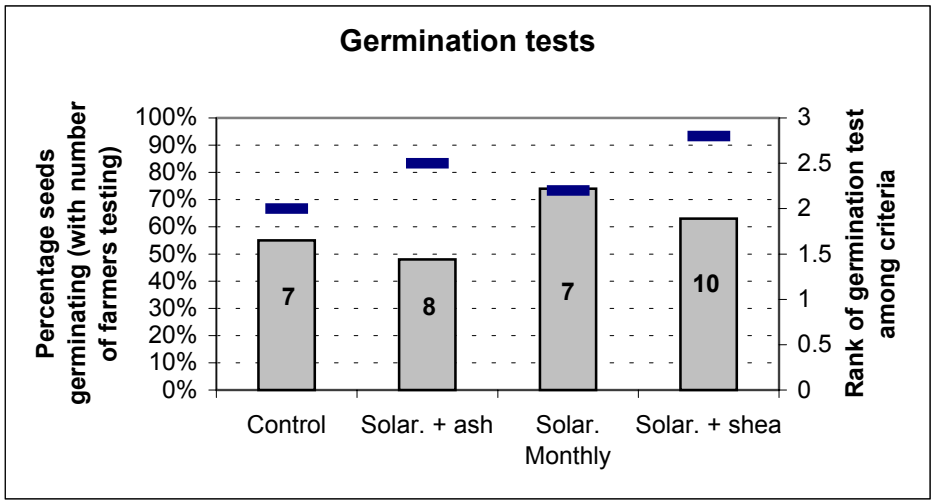

Figure 4: Percentage germination and farmers' ranking of germination as an assessment criteria

For each of the treatments and the control, farmers specified which criteria (in positive or negative) they used to judge the value of the treatment they had applied. The criteria used were (from left to right on the Figures 5-8): affordability of the materials, time involved, effectiveness, appearance of the cowpea, marketability, seed viability, palatability and cooking time:

The results from the questionnaires were:

- Solarisation repeated monthly is the best treatment, its only drawbacks were perceived to be its cost, and for some respondents, the time involved.
- Solarisation followed by admixture of shea nut butter is also good but not for marketing purposes; the seed viability was liked.
- Solarisation followed by admixture of ash was rejected, on almost all accounts.

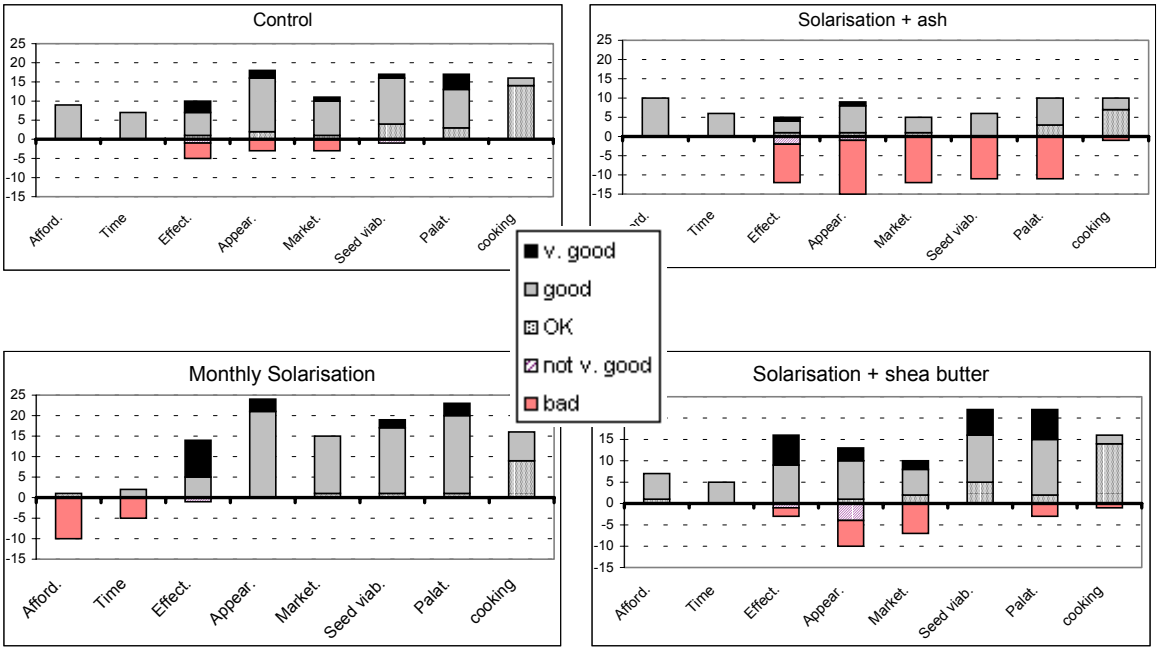

Figure 5-8: Farmers' criteria for ranking treatments

iii) Farmers overall conclusions

These results were shared and discussed with the communities, and their conclusions were:

Solarisation repeated monthly is a very good treatment. Most farmers want to use it to protect their cowpea. The two perceived drawbacks, namely cost and time, were discussed extensively.

Women said that the time involved would not be a hindrance, as they can keep an eye on the cowpea during solarisation whilst doing other household duties like cooking, washing etc.

The cost was discussed in terms of a cost-benefit analysis: the profit to be made by selling cowpea in June or July, when it is scarce and therefore expensive is at least 100% of the lowest price at harvest. It was found that an investment of 15% of the expected profit would secure the material necessary for solarisation, and all farmers agreed that this was a very worthwhile investment.

In both villages, farmers decided to purchase the materials themselves to treat their cowpea for the next storage season, and requested that project staff would come back to the villages to provide advice if necessary.

Solarisation at harvest followed by admixture of shea nut butter is a good treatment, but because of the appearance of the cowpea, it cannot be used for marketing. Farmers said that the treatment was however very good for seeds, as the germination was high in their tests, and some even liked the taste of the cowpea (shea nut butter is also traditionally used for cooking). The conclusion was that for treating small quantities of cowpea that will not be sold, this treatment is good.

Solarisation at harvest followed by admixture of ash was rejected as it did not protect the cowpea.

UGANDA: FARMER PARTICIPATORY TRIALS IN 2000-2001

Approach

One hundred and fifty farmers from 6 sub-counties in the districts of Kumi and Katakwi took part in on-farm trials in the season 2000-2001. In these districts of eastern Uganda (the second) harvest commences in October-November. As in Ghana the same three treatments, with a non-treatment as a control, were allocated to and applied by farmers. Unlike in Ghana however, their training was undertaken by the staff from the coordinating NGO, Matilong, with previously trained Fields Extension Workers (FEWs, from the Ministry of Agriculture) and/or link extension farmers (working with the NGO).

Some further departures from the Ghanaian protocol must be noted:

- Farmers undertook the assessment of the damage themselves, under the supervision of the FEWs and/or link farmers, selected by the district farmers' association, agricultural office or local NGO.
- Treatments did not commence directly after harvesting but were applied between January and February, depending on the locations. This followed delays in the organisation of the training and the securing of plastic sheeting.
- The exact treatments protocol was not followed as closely as in Ghana. A few farmers did not follow the recording procedures, but more interestingly a number of farmers took to cleaning or winnowing the cowpea after each monthly assessment of the damage.

At the end of the trial, farmers' perceptions of the treatments were recorded using a questionnaire similar to the one used in Ghana. Additional discussions took place between NGO staff and farmers, during and after the trial.

Results

i) Researchers' assessment of the effectiveness of the treatments

Despite the departure in the protocol, the overall results (Figure 9) nevertheless clearly show the impact of the treatments:

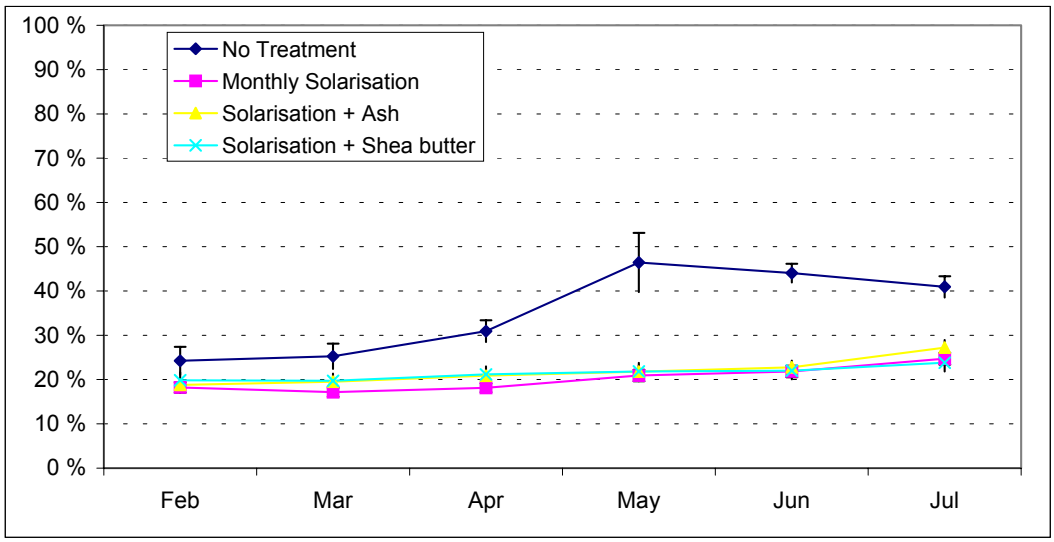

Figure 9: Average percentage damage (with SEM) over the 2000-2001 storage season

ii) Farmers' assessment of the treatments

The main results from the questionnaire assessment are presented below.

Most of the farmers who took part in the trials responded to the questionnaire (124/150). When they were asked to rank the treatment they had been allocated as 'not good', 'OK', 'good' or 'very good', the results were broadly similar to those obtained in northern Ghana, with two main differences:

- The non-treatment used as a control was perceived to be overwhelmingly 'not good' (in Ghana, it was perceived as acceptable)
- Solarisation then admixture of ash was perceived as being good (in Ghana it was perceived as unsatisfactory. In both cases, farmers perceptions were in accord with the damage recorded)

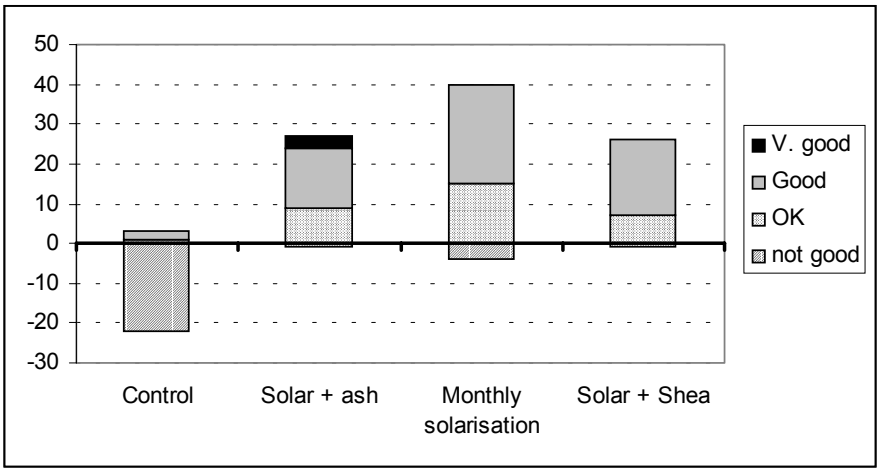

Figure 10: What the farmers thought of the treatments they had used

When asked wether they would use themselves or recommend the treatments to other farmers, the answers were similar to those obtained in Ghana, with the notable exception that farmers who had tested solarisation followed by admixture with ash said that they would use or recommend this treatment (Figure 11).

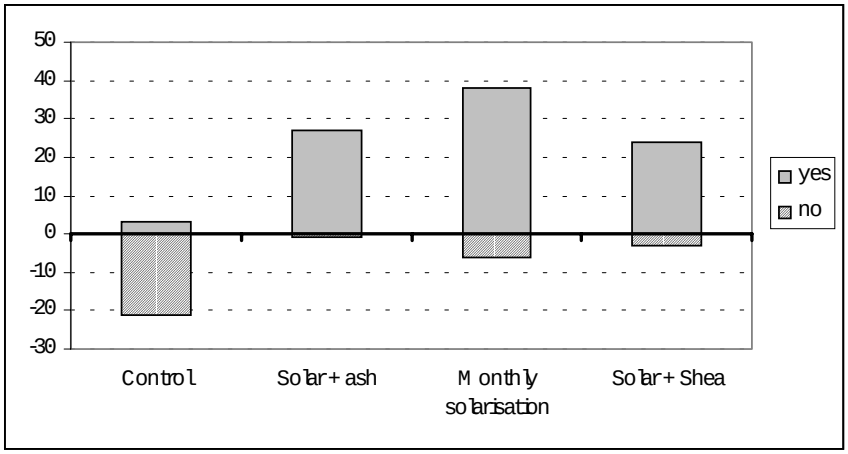

Figure 11: Would farmers use or recommend the treatment?

Farmers' feedback through discussions during and after the trial indicate that they recognise the effects of the three treatments. Solarisation was generally held to be good with respect to germination, marketability, and cooking times (normal), with positive remarks made by some for

time and affordability. Some concern was however expressed about effecting solarisation during the rainy season, and about its suitability for treating larger quantities. The sourcing of plastic sheets was noted as a problem.

Solarisation followed by an admixture of ash was held to be good against most criteria - affordability, time, effectiveness, appearance, marketability, viability, palatability and cooking times - but not recommended for larger quantities.

Solarisation followed by an admixture of Shea nut butter was deemed favourable with respect to time taken, effectiveness and viability. The change of appearance it affected ('brown and oily') was deemed to reduce marketability however, and many claimed it prolonged cooking times (from 45 to 60 minutes). Its palatability was contested by some while others suggested that sand particles adhered to it giving it a gritty texture. The 'oiliness' was deemed to impede grinding, drying and transportation. Moreover Shea nuts were not readily available in Kumi district.

Discussion

In the main farmer validation was effected for two and three treatments respectively in Ghana and Uganda. In Ghana there was greater rigour and investment in the science resulting in higher quality data outcomes, and a knock-on effect for Uganda. Following the success of the work in Ghana, the quest for scientific rigour in Uganda was subsumed by a greater focus on the participatory process. This in turn may have led to farmers (and organisers) there having a greater hand in the experimentation process and feeling free to improvise around the treatment protocol.
Uptake will need to be monitored, as too will the price and availability of the polythene sheeting used for solarisation. MoFA and Matilong for Ghana and Uganda respectively will undertake this task. For those living in more remote locations the issue of accessibility, both to information and to materials, may need a specific follow-up study.
The CPHP funded project (Morris & Tran, 2002; Tran, 2001) had amongst its objectives, the promotion of more cooperative ways of working amongst collaborators and target organisations, and the mainlining of a more central role for farmers. This resulted in three beneficial outcomes:

- The control methods were both assessed for their effectiveness and their acceptability by farmers.
- The collaborators, having achieved a more real ownership of the research, are more likely to continue the work, after the completion of the project. In Ghana the PHU officer is playing a central role, with other collaborators, in the new in-country coalition seeking to promote new knowledge and technologies generated by CPHP projects, and hence optimise earlier investments. Similarly in Uganda the broader project coalition team, having successfully secured funding locally to engage in the participatory development of extension material, is now engaged in identifying methodologies to facilitate farmer participatory monitoring and evaluation.
- Promotion of the results continued in a similarly collaborative manner, including farmers. In Ghana, together with running training courses for in-house (and some NGO) extension staff and promoting the methods and treatment at professional events, the Post Harvest Unit has worked with a couple of agencies in the production of funding proposals to promote the findings with specific constituencies. In Uganda where the process has been coordinated by an NGO but has involved a larger coalition of interest groups, dissemination and promotion have been more diffused. Momentum has none the less been maintained by the involvement of the Development Network of Indigenous Voluntary Agencies (DENIVER) at one end of the scale, and by the enthusiasm of individual farmers' groups at the other (e.g. MACOPECA), and is underpinned by the on-going investment and interest of local DfID funded project (COARD).

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