Farmers' perceptions of yam pests and diseases and management practices, particularly relating to yam seed, in the Northern and Brong-Ahafo Regions of Ghana

H Kindness[1], J Peters[2], F Andan[3], OA Danquah[4], J Lamptey[4] and F Tsigbey[5]

Project No. C0948

[1]Natural Resources Institute
University of Greenwich
Chatham Maritime
Kent, UK

[2]Department of Agriculture
University of Reading
UK

[3]Ministry of Agriculture
Tamale
Ghana

[4] Crops Research Institute
Kumasi
Ghana

[5] Savanna Agricultural Research Institute
Nyankpala, near Tamale
Ghana

July 1998; revised September 2000

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1 Executive Summary

A rapid rural appraisal (RRA) was carried out during January 1998 as part of the DFID-funded 'Control of yam diseases in Ghana' Project (R6691). The main objectives of the RRA were to investigate farmers' perceptions of yam pests and diseases, particularly their impact, causality, and farmers' practices relating to seed preparation methods, selection and storage. Pests and diseases were considered by yam growers to be important constraints to yam production and marketing in the Northern, Upper West and Brong-Ahafo Regions of Ghana, which are major yam producing areas in the country. Overall, when pests and diseases were grouped together, they were ranked the second most important problem (after lack of finances) and were considered a major reason for the poor yam yields experienced by the majority of farmers in 1997. Furthermore, all but one of the farmer groups questioned, said that pests and diseases have been increasing in severity over recent years. In the Northern and Upper West Regions, termites were ranked as the most important biotic constraint affecting yam production. Mealybugs and scale insects were considered to be the second most important biotic constraint, followed by anthracnose and *Scutellonema* infestation in equal third place. Direct examination of seed tubers in the Northern Region found that termites were the major cause of macroscopic damage to seed tubers. In the Brong-Ahafo Region, scale insects and mealybugs were considered to be the major yam pest/disease problem. Termites were considered to be the second most important problem, followed by anthracnose, viruses and nematodes in third equal place. Few farmer groups mentioned seed as a source of pests and diseases. However, their seed preparation methods and seed selection criteria indicate that to a certain extent farmers do understand the benefits of using seed free from pests and disease: farmers claimed that seed tubers were selected from the healthiest plants. Farmers were also aware that tubers infested with certain pests or diseases will not germinate. The majority of farmer groups in the Northern Region said that they would not plant seed with signs of nematode damage and half of the groups said they would not plant seed with scale insect, or mealybug, infestation. However, there was some disparity between farmers 'ideal' or preferred practice, and their actual practice. Farmers in the Northern Region claimed that 82% of their white yam seed was produced by 'pricking' (i.e. purposefully double harvesting to produce, at the first harvest, ware tubers then at the second harvest, seed tubers). However, an observation of seed stores showed that only 45% of seed was collected during the second harvest. This implies that farmers are obtaining seed from non-selected plants, or at worst from plants producing small wares and, therefore, likely to be infected with pests and disease. A number of recommendations are suggested: 1) train extension staff and farmers to recognise diseased tubers which must be discarded (or eaten); 2) investigate the potential for seed traders in the Northern and Brong-Ahafo Regions; and 3) investigate control measures for pests, particularly termites and scale insects.

2 Introduction

Research carried out over the last 10 years on diseases of yams world-wide has indicated that one of the main limitations to increased productivity of yam cropping systems in West Africa is the scarcity of healthy and reliable planting material. Various methods for controlling disease (seed treatment and agronomic practices) have shown promise in improving yam health in many yam growing regions. However, there is a lack of information on the primary pathogens and pests causing poor survival and growth of yams in Ghana and the efficacy of control treatments and their acceptance to farmers in Ghana.

The DfID funded project 'Control of Yam Diseases in Forest Margin Farming Systems in

Ghana' commenced in July 1996 and aims to identify the principal diseases and pests infecting yams in Ghana and to determine their geographical distribution. Work is underway to investigate the interactions between fungal pathogens and nematodes attacking yams in the field, and to ascertain their affect on the health of tubers in storage. The economic impact of yam diseases is being verified by way of crop loss assessments. The importance of using clean or treated planting material will be determined by assessing the extent to which diseases are tuber-borne. Based on these results and on the findings of previous projects, improved and sustainable control practices will be developed and tested in close collaboration with smallholder farmers.

Survey work was carried out in 1996, using rapid rural appraisal techniques, to obtain base-line data on yam diseases (Annex, Section 9). The survey was conducted mid-season in the yam cropping calendar, which meant it was possible to assess the extent of damage caused by diseases on yam foliage (scientists on the survey teams carried out field scoring of foliar diseases). The principal areas of interest were yam varieties grown and their susceptibility to diseases, farmers knowledge of symptoms, causes and any known remedies and farmers estimation of pre- and post-harvest losses.

3 Objectives of study

This study forms part of the above-mentioned project and its purpose was to validate and/or compliment earlier survey results. The main objectives were to investigate farmers' perceptions of yam pests and diseases, particularly their causality, and farmers' practices relating to seed preparation methods, selection and storage.

Specific aims of the survey were to:

- investigate the importance of pest and disease constraints relative to other yam production and marketing problems;
- investigate which pests and diseases farmers regard as important
- investigate farmers' knowledge of pests and diseases, their causes and control methods;
- investigate seed preparation methods, seed selection criteria and seed storage methods, and
- assess the implications of farmers' perceptions and practices relating to yam pests and diseases for future research work

Some of the subject areas had been addressed in the previous RRA, but it was felt that it would be beneficial to collect some similar information (e.g. on diseases and farmers ranking of their importance) in order to compare results from different years and note any trends. It was also considered beneficial because of the timing of the survey. At the beginning of the season farmers have recently harvested and are able to recall pest and disease damage to their tubers more easily than they would be able to when asked mid-season about the previous year's crop. The timing of the survey also meant that there were diseased and damaged seed yams available to use when talking to the farmers about different pests and diseases, which are a more powerful and realistic aid than photographs or pictures of pests and diseased tubers.

4 Methods

4.1 *Survey Preparation*

This study was carried out at the beginning of the yam cropping calendar (January/February 1998) when farmers had either just planted their yam seed or were preparing to plant. Not only was it considered the best period to carry out the survey because farmers would more easily be able to recall the health of their seed from the last season's harvest (as mentioned above) but also their responses could be compared with disease scoring of seed carried out by the scientists.

Data collection was undertaken by two teams of researchers, one in the Northern Region[1] and one in the Brong Ahafo Region. Details of the team members can be found in Appendix 1.

The majority of the villages selected for the survey were those which had participated in the previous socio-economic and disease prevalence survey work out in 1996 and 1997. Three yam producing regions (Brong-Ahafo, Northern and Upper West) were selected on the basis of being major yam producing areas: Brong-Ahafo and Northern regions typically produce around 75% of yams grown in Ghana. However, some important regions (Eastern and Volta) were left out of the survey for logistical reasons. Village selection was done by the extension officers. Officers were asked to recommend villages where yam cultivation was one of the main farm activities. There is no reason to believe that selection was skewed towards either end of the production scale.

Arrangements for group interviews were made by Mr F Andan (MoFA) with the local extension officers. They were asked to assemble approximately 10 farmers, both male and female and farmers from different wealth categories. The villages visited are listed in Table 1 and their locations are shown in Figure 1. In total 224 farmers in 21 villages were interviewed. The respondents were predominantly men, particularly in the Northern region where it was said that yam is generally a man's crop. In Brong-Ahafo there is greater participation of women in yam cultivation, and 17% of respondents in this region were women. A similar picture was found during the 1996 RRA.

Group meetings were held in each village involving a number of farmers ranging from 7 to 15. In most villages the extension officers arranged the meetings with yam farmers, but in a couple of villages a group of farmers was formed on arrival in the village.

[1] Two of the fourteen surveyed villages which are referred to in this report as the Northern region villages are actually in the Upper West region. However, in order to simplify analysis the 2 Upper West villages have been grouped along with the Northern region villages.

Table 1. **Villages included in the survey**

Village number	Village Name	District	Region	Respondents	
				Female	Male
1	Sori II	Damongo (W. Gonga)	Northern	0	12
2	Larebanga	Damongo (W. Gonga)	Northern	0	12
3	Mandari	Bole	Northern	0	9
4	Mangwe	Wa	Upper West	0	8
5	Boli	Wa	Upper West	0	10
6	Dafeali	Bole/Tuna	Northern	0	10
7	Jentilpe	Bole	Northern	0	9
8	Tunayili	Tamale	Northern	0	10
9	Komoayili	Gushegu	Northern	0	9
10	Gaa	Gushegu	Northern	0	10
11	Sambu	Yendi	Northern	0	12
12	Gbungbalga	Yendi	Northern	0	9
13	Demo-naya	Nanumba (Bimbilla)	Northern	0	15
14	Massaka	Salaga	Northern	0	12
15	Berekum	Berekum	Brong-Ahafo	0	10
16	Seikwa	Berekum	Brong-Ahafo	2	10
17	Bamire	Techiman	Brong-Ahafo	3	9
18	Jema	Kintampo	Brong-Ahafo	6	9
19	Konkrompe	Atebubu	Brong-Ahafo	0	12
20	Dromankese	Nkoranza	Brong-Ahafo	2	7
21	Sunyani	Sunyani	Brong Ahafo	0	7

4.2 Survey Outline

A rapid rural appraisal (RRA) approach was taken which involved group discussions and ranking exercises. A checklist was used to guide the discussions (see Appendix 2) although this outline was modified slightly during the course of the survey.

4.2.1 General farming practices relating to yam production

Individual farmers were asked about the amount of yam they grew (last year, this year and reasons for any changes). The group was then asked to name their main yam production and marketing problems. These were written and drawn on pieces of card and the group were then asked to rank them according to importance (1. most important, 2. second most important etc.).

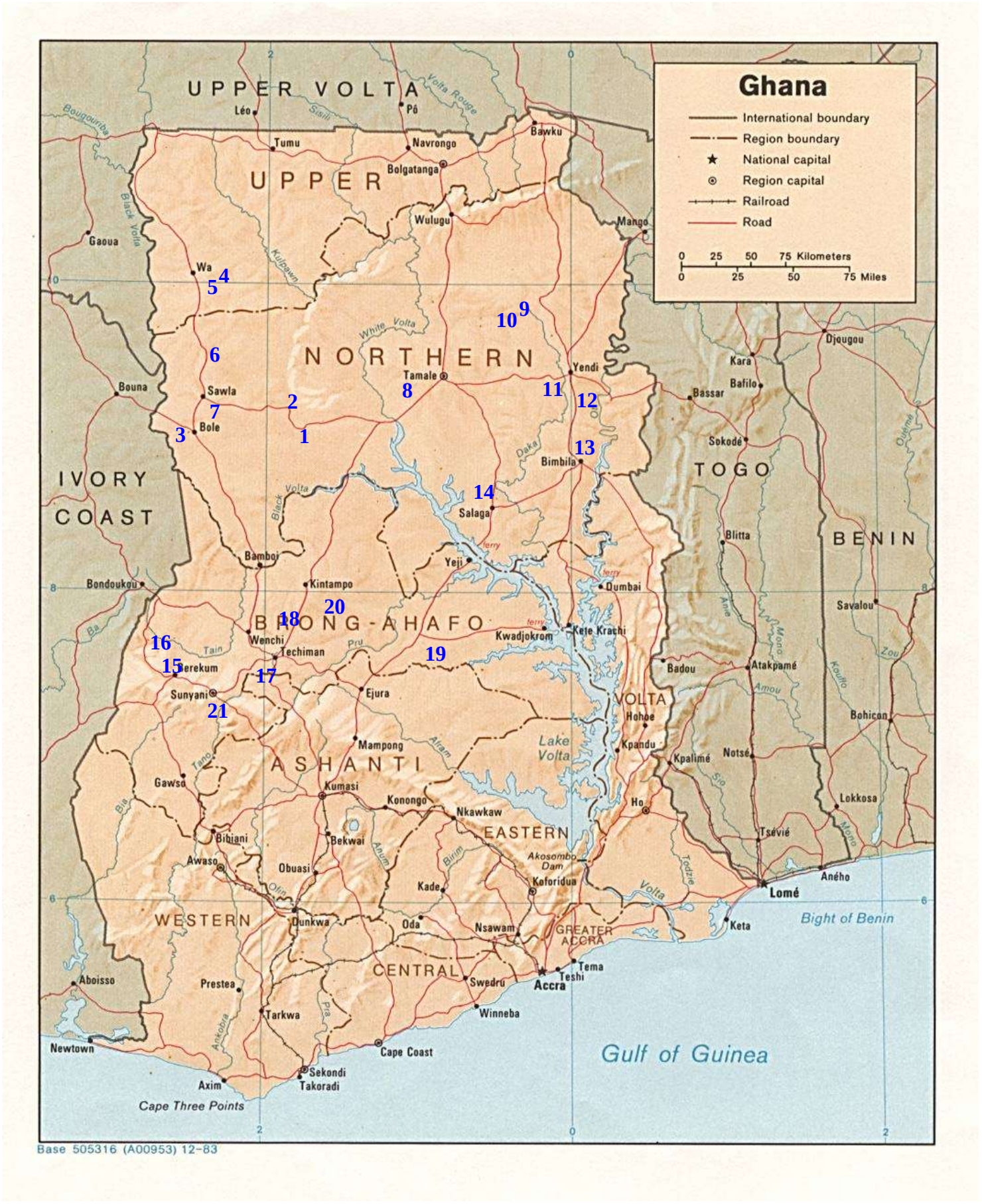

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Fig. 1. Map of Ghana showing the survey village locations in the Northern and Brong-Ahafo Regions

4.2.23 Yam Pests and diseases

4.2.23.1 Farmer knowledge

Farmers were then asked to discuss yam pests and diseases. Local names of the pests and diseases mentioned by farmers were written on cards. Farmers were then asked to describe the important pests and diseases and discuss their effects on the plants and tubers. Once the farmers had named all the pests and diseases they could think of, they were then shown diseased/damaged tubers and photographs of diseased plants/tubers and pests. The photos and tubers were used to: a) verify which pests and diseases the farmers were referring to (by matching the local names to them); and b) identify (and allow subsequent discussion on) pests and diseases that they had not already mentioned.

The use of local names meant it was possible to understand if farmers were referring to different diseases as the same thing (e.g. farmers often thought mealybugs and scale insects were the same).

Farmers were asked as a group to rank the pests and diseases in terms of importance. They were then asked about the causes of the various pests and diseases, any control methods they use or know of, which varieties are affected and any changes in disease prevalence over the last five years. Results are presented as a linear weighted percent response (i.e. 1st choice given a weighted value of 4, 2nd choice weighted value of 3, etc). The authors recognise that this approach might misrepresent the data as the categories 1st, 2nd, 3rd and 4th most important constraints will not necessarily be linearly spaced. However, given that constraints other than first choice are likely to be either under- or over- valued, the approach taken here provides a simple summary of the farmers' perceptions of biotic production constraints. Importantly, the weighted analysis did not alter the conclusions based on the original data.

4.2.23.2 Direct observation of seed health

Whilst the socio-economic interviews were being carried out, scientists from SARI, CRI and the UK examined the seed tubers that had been stored in the yam barns. Ten seeds of the most popular cultivars of *D. rotundata* and *D. alata* (Puna and Seidu bile, if possible) were chosen at random. An assessment of the severity of tuber damage was made based on a linear assessment scale (0, 1-25, 26-50, 51-75, 76-100) for each category of pest, disease and physical injury (see Table 5).

4.2.24 Yam seed: sources and selection criteria

Farmers were asked about their sources of seed and their seed selection criteria. They were also asked about the different seed preparation methods they use (i.e. 'pricked' at first harvest, buried small wares at first harvest etc.) and these different methods were drawn on cards. The group were then asked to estimate, for their most common white variety (generally Larebak/Labrako or Kpuna/Puna[2]) what proportion of seed comes from these different seed preparation methods, e.g. out of 500 mounds, how may are pricked and what is the average number of setts you get?. Out of the 500 pricked mounds, how many of the wares are small and are reburied for seed? etc.

[2] Kpuna and Larebako are the names used in the Northern region and Puna and Labrako are the names used in the Brong-Ahafo region.

4.2.25 Seed storage

Farmers were also asked about storage, focusing more on seed than on wares, and were asked to discuss where they store seed, when, for how long, what damage they suffer and were asked to rank their storage problems.

Harvesting practices and losses of wares were generally not covered during the group meetings in the Northern Region due to time constraints. However, the two contact farmers in each village whose seed was scored by the plant pathologists on the survey team were asked about losses of wares and some were also asked to draw seasonal calendars.

5 Results

5.1 *General farming practices relating to yam production*

5.1.1 *Size of yam farms*

Farmers were asked the number of yam mounds they had planted last year. Figure 2 shows the distribution of farm sizes and highlights the fact that farm sizes in the Brong-Ahafo Region are generally smaller than in the Northern Region (nb. a density of 1,600 mounds per hectare was assumed). The average yam farm size in the Northern Region was 2 hectares in 1997, compared to an average of 1.78 hectares in the Brong-Ahafo Region.

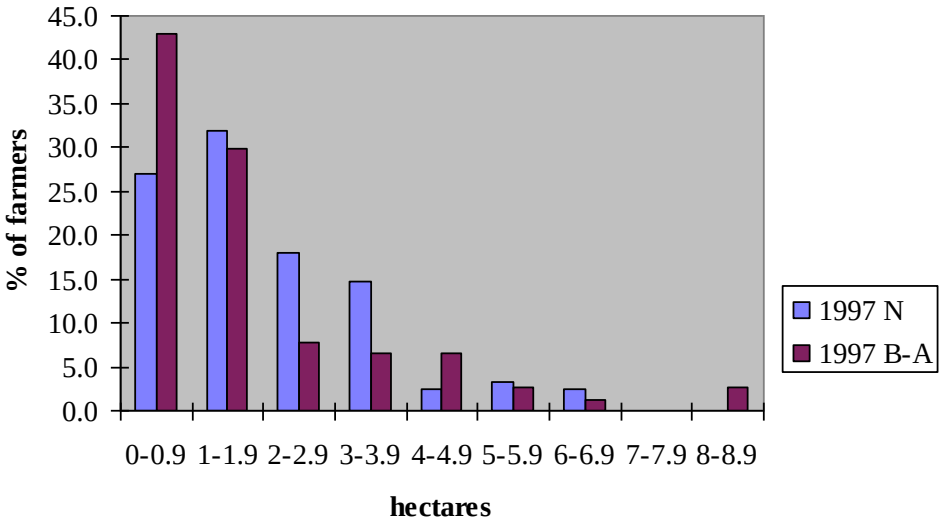


Fig. 2. Yam farm sizes in Northern and Brong-Ahafo regions, 1997
Key: N = Northern region; B-A = Brong-Ahafo region

In the Brong-Ahafo Region, the average size of yam farm owned by women was 1.29 hectares, which was smaller than the average size for men (1.89 hectares). In the Northern Region, farmers were also asked the number of yam mounds they had prepared in the current year. The distribution of yam farm sizes among respondents in 1997 and 1998 is shown in Fig 3. It shows a general increase in farm size from 1997 to 1998 (average increase of 0.47 hectares per household).

Farmers who had increased their yam farm sizes were asked their reasons for doing so. In the majority of cases, yam farm sizes had increased because of the good seed[3] harvest the previous year. However, in three villages in the Northern Region, the farmers specifically mentioned that they were rebuilding their yam farms after the conflict and some of the farmers in those villages were buying yam seed and cutting up ware tubers for seed. The reasons given for some farmers having smaller yam farms in 1998 than in 1997 were predominantly poor

[3] The seed was 'good' in terms of the quantity available, but particularly in villages where the ware harvest was poor, the health of the seed is likely to be poor. This will be examined in more detail in the section on different sources of yam seed.

seed (due to drought and diseases) but also finance, age (and therefore reduced ability to cultivate as much land as previously), sickness and limited labour capacity.

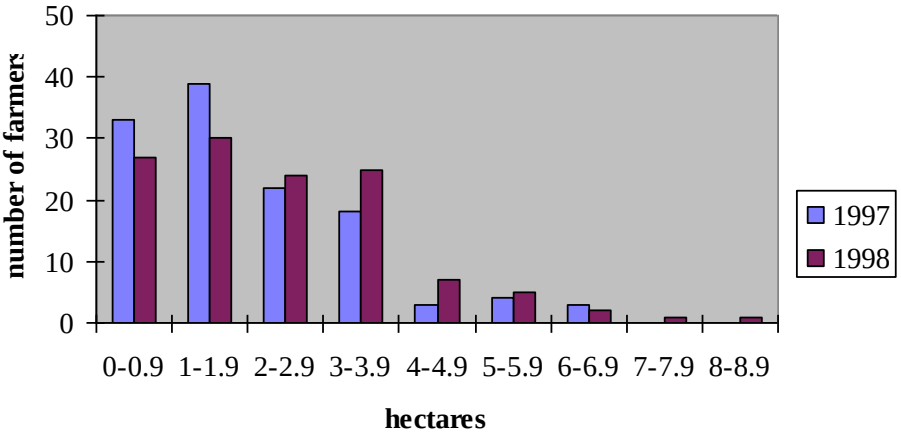


Fig. 3. Yam farm sizes in the Northern Region: a Comparison between 1997 and 1998.

5.1.2 Yam species grown

Farmers were asked to indicate the number of different species of yam they planted during the previous year. In all but one of the villages, information was only collected on the number of *D. rotundata* (white yam) and *D. alata* (water yam) mounds. Generally, farmers were not asked about other species (*D. cayenensis* (yellow yam), *D. dumetorum* (bitter yam) and *D. bulbifera* (aerial yam)). This was because the survey in 1996 had found that other species only comprised 4% of yam grown in the Northern Region and were not mentioned at all in the Brong-Ahafo region.

The relative proportion of different yam species is presented in Figs 4 and 5 for the Northern and Brong-Ahafo Regions respectively. In the Northern Region, white yam is most commonly grown species, accounting for 87% of yams grown in 1997. However, in the Brong-Ahafo Region, the amount of white and water yam grown was virtually equal (49% and 47% respectively) and a small proportion of yellow yam (4%, all in one village) was also grown.

Comparing these figures with the results from the 1996 RRA, the proportion of white yam grown in the Northern Region had increased in 1997 (from 73% in 1996 to 87% in 1997) and the proportion of white yam grown in the Brong-Ahafo region had decreased (from 56% in 1996 to 49% in 1997).

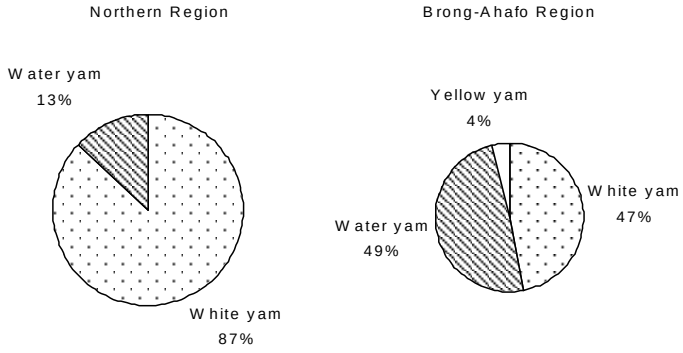


Fig. 4. Proportion of yam types grown in the two main yam growing regions in Ghana. Where 'water yam' is *Dioscorea alata;* 'white yam' is *D. rotundata* and 'yellow yam' is *D. cayenensis.* Other yam species such as *D. dumetorum* and *D. bulbifera* were grown in both regions but in volumes that were too small to register. Pie charts are drawn roughly to scale, in 1990 (the latest available statistics) the Northern Region produced 40% of yams in Ghana and Brong-Ahafo produced 23%[4].

5.1.3 Yield in 1997

In the Northern Region, the 1997 ware-tuber harvest was considered poor by the groups in 9 villages (mainly due to a lack of rain, and pests and diseases, in particular termites and nematodes) but good by four villages (Mandari, Komoayili, Gbungbalga and Demo-naya). The seed harvest was considered good by all but two village groups (Massaka and Gaa).

In the Brong-Ahafo region, the ware harvest in 1997 compared to 1996 was better for 25% of farmers, worse for 64% of farmers and the remainder were either unchanged or had not yet harvested. Of the farmers that gave reasons for these changes, the majority said that the decline was due to poor rainfall, but diseases and shortage of land were also mentioned.

Interestingly, the estimated production of yams in Ghana during 1997 was 2,407 metric tonnes[5]. This is over double the estimated production in 1994[6].

5.1.4 Importance ranking of yam as a crop

In the Northern region, groups in 8 villages were asked to rank their crops in terms of importance[7]. In general, there seemed to be a divide between the villages where sorghum is

[4] Natural Resources Institute. 1996. *Ghana renewable natural resources profile.* NRI Publication, Chatham Maritime, UK.
[5] Fowler, M. 2000. The uptake of yam research recommendations by farmers in Ghana. NRI, Chatham, UK.
[6] Food and Agricultural Organisation. 1999. *FAO production yearbook*. Rome.
[7] The farmers considered one or several of a number of factors when ranking crops in terms of importance, namely acreage, main staple food, income and prestige of the crop.

an important crop and the villages where maize is an important crop. Sorghum was ranked as the most important crop in three villages, and was 2nd in one village (and in those villages maize was ranked third or fourth or not at all) whereas in the other four villages maize was ranked either 1st or 2nd most important (and sorghum was ranked fourth or not at all). Yam was the only crop which was ranked in the top four most important crops in **all** villages. It was ranked most important in two villages, but most villages ranked it as the second most important crop.

5.2 *Yam production and marketing problems*

Table 2 shows the way in which the groups ranked different yam production and marketing problems in terms of importance. In the Northern Region, 14 villages listed and ranked their constraints and in Brong-Ahafo the results are from 7 villages. The results show that finance for labour and inputs was the most serious yam production constraint and was ranked 1st by all farmer groups in Brong-Ahafo region and 71% of farmer groups in the Northern region. Overall, pests and diseases seem to be the second most important constraint in both the Northern and Brong-Ahafo regions, although the majority of groups in the north (50%) ranked it as their third most important problem.

Drought was also an important constraint in the north, whereas it was not mentioned at all in Brong-Ahafo. Marketing was the next most important constraint to pests and diseases in Brong-Ahafo, and was the fourth most important in the north. Land acquisition was a constraint in Brong-Ahafo, but not a problem in the north. Associated with the problem of land shortage and land acquisition in Brong-Ahafo region is a problem of soil fertility, but it was not ranked as a constraint in the Northern region where there is not such a problem of land availability. Poor quality and expensive tools were considered a big problem in some villages in the Northern region (in the villages where tools were mentioned they were ranked second) but in other villages they were not considered a problem at all.

Table 2. Yam production and marketing problems

	Northern region				Brong-Ahafo region			
	Rank (% of farmer groups)				Rank (% of farmer groups)			
Constraint	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 4**	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 4**
Drought	14.3	7.1	28.6	0.0	0.0	0.0	0.0	0.0
Finance (for labour and inputs)	71.4	14.3	7.1	0.0	100.0	0.0	0.0	0.0
High transport costs	0.0	7.1	0.0	14.3	0.0	0.0	0.0	0.0
Land acquisition	0.0	0.0	0.0	0.0	0.0	14.3	14.3	28.6
Low market prices	0.0	7.1	14.3	42.9	0.0	14.3	28.6	28.6
Pests & Diseases	14.3	14.3	50.0	14.3	0.0	57.1	28.6	14.3
Poor soils	0.0	0.0	0.0	0.0	0.0	14.3	0.0	28.6
Poor and expensive tools	0.0	35.7	0.0	0.0	0.0	0.0	0.0	0.0
Storage	0.0	0.0	0.0	21.4	0.0	14.3	14.3	14.3
Theft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Key : Rank 1 is most serious, rank 2 is next most serious etc.
14.3% in the Northern Region is equivalent to 2 out of 14 groups
14.3% in the Brong-Ahafo region is equivalent to 1 out of 7 groups

Table 3. Common, scientific and local names of yam pests and diseases

English common name	Scientific name	Local names Northern region	Local names Brong-Ahafo region
Anthracnose	*Colletotrichum gloeosporioides*	Baloo, Kyeh, Wakon, Geylaa, Soraa, Bochai Bochaa, Nyu wang	
Die-back	Unknown possibly *Rhizoctonia solani*	Yaba, Bochaa, Gbgani, Nyu kuum	
Dry rot	Numerous fungi including: *Fusarium* spp *Aspergillus* spp	Nyokugu, Kpiri kuuni, Kpiri ziegu	
Foliage Beetles	*Crioceris livida*	Nyebarimi, Nyikpera	
Mealybugs	Many including: *Phenacoccus gossypii*	Ninsaahi, Mamaree, Nyinsa kpala, Gbanpiela, Dayu puri	Fuo, Mfunemfu, Mfu
Yam nematode (tuber cracks)	*Scutellonema bradys*	Nyugbana, Nyofieni, Fanni, Fanibu, Sanaa, Wa fama, Wafanni, Fariga, Gbani, Gbgani, Bochaa	Awurukuo, Kaba, Honoawu
Root knot nematode (knobbly tubers)	*Meloidogyne* spp	Nyofieni, Toggi, Fanibu, Wa fama, Jamkpana, Samgbana, Jagaa, Bochaa	
Scale Insects	Aspidiella hartii	Furim, Nyinsa Kpala, Dunkasagabinnu, Nyirisi, Minaa, Poora Gbanpiela, Dayu puri	Fuo, Mfu, Mmoafufuo
Termites	*Amitermes evuncifer*	Tambiogu, Tambiegu, Digri, Yaba, Kpolow, Gumo, Chau, Tambe gunn, Tambe gunga	Mfotee, Nkanka, Nekye, Mmontro, Mmoanturo
Tuber Beetles	*Heteroligus* spp.	Wolingo, Bulinbugiri, Kpalinpor, Jalanboti	
Virus	Numerous including: yam potyvirus and badnavirus	Koga, Konkonga, Danduli, Lenlen, Nyukuong, Buguliheu, Nyu kooga, Nyukoga	Jabrija, Babaha, Nkufru, Asense
Wet rot	*Erwinia carotovora* and other bacteria	Nyoponu, Puonpielaa, Nyupuom, Hiipuo, Kpiri pieli, Kpiri mahili	

5.2.1 Pests and diseases

Farmers were asked to discuss their yam pests and diseases, their effects on the plants and tubers and were asked to rank them in terms of importance[8]. Table 3 summarises the scientific, common English and local names of the various yam pests and diseases. Further detail on the farmers descriptions of the pests and diseases and their effects, any control measures used and ranks given by each village group are in the village interview summaries in Appendix 4. Farmers in all but one village did not distinguish between mealybugs and scale insects, and so they have been treated as a single problem in the table and analysis. Also, 9 out of the 14 villages in the Northern Region distinguished between tuber cracks (caused by the yam nematode, *Scutellonema bradys*) and knobbly tubers (caused by the root knot nematode, *Meloidogyne* spp.) and so they have been treated separately.

5.2.1.1 Importance ranking – Northern Region

Table 4 summarises the relative importance rankings by the farmers groups for each of the pests and diseases mentioned. In the Northern Region, termites were ranked as the most important biotic constraint by 9 out of 14 groups, and second most important by four groups (Appendix 3). It was the most important pest in 1997, as it was in the 1996 season (Peters *et al*., 1997). Mealybugs/scale insects were the second most important biotic constraint (ranked 1st, 2nd or 3rd most important problem by 9 groups in the Northern Region) followed by anthracnose and *Scutellonema* infestation in equal third place. Root knot nematodes, anthracnose and die-back, although ranked in the top three biotic constraints by fewer farmer groups than termites and mealybugs, were considered to be the number one problem in villages where these were a problem. Root knot nematodes were considered the main yam pest/disease constraint in three villages (Tunayili, Massaka and Gbungbalga). Two farmer groups (in Mandari and Gbungbalga) thought that the yam nematode lesions and anthracnose were different stages of the same disease and two other groups (in Boli and Gaa) thought severe termite damage causes die-back.

5.2.1.2 Importance ranking – Brong-Ahafo Region

In the Brong-Ahafo Region, scale insects and mealybugs were considered to be the major yam pest/disease problem (Table 4). They were ranked either 1st or 2nd in all the villages. Termites were the second most important problem overall (four groups ranked them either 1st or 2nd), followed by anthracnose, viruses and nematodes in third equal place.

5.2.1.3 Comparisons between the Northern and Brong-Ahafo Regions

Comparing the rankings in the Northern and Brong-Ahafo Regions, in the former termites are considered to be a more serious problem than scale insects/mealybug, whereas the reverse is true in Brong-Ahafo. Nematodes and anthracnose are given equal weighting in both regions. However, anthracnose (and dieback) and nematodes were only considered to be the most important biotic constraint in villages in the Northern Region. Viruses were not considered to be a problem of primary importance in either Brong-Ahafo or the Northern Region.

[8] The criteria used by farmers to rank pests and diseases were frequency and severity.

5.2.1.4 Comparisons between 1996 and 1997 growing seasons

If we compare the ranks given by farmers in 1996 and 1997, in the Northern Region, root knot nematodes and dieback increased in importance, whereas tuber beetle and wet rot decreased in importance. In 1997 in the Brong-Ahafo Region, the two most important pests (mealybug/scale insects and termites) remained the same, viruses, anthracnose and nematodes increased in importance and tuber beetle and foliage beetles decreased in importance. Farmer groups in both regions were also asked about any changes they had seen in pest and disease prevalence in recent years. All but one of the groups which were asked this question said that pests and diseases have been getting worse. Most groups did not know the reasons for this, although one mentioned that there are no longer chemicals available to treat diseased plants and tubers and another group mentioned that land used for cultivation is no longer virgin and that fallow periods have reduced, which has had an adverse effect on the diseases they consider to be soil-borne.

Certain groups indicated which pests and diseases in particular have been getting worse. Termites and anthracnose were each mentioned by three groups and two groups mentioned nematodes.

Table 4. Importance ranking of yam pests and diseases in the Northern and Brong-Ahafo Regions, Ghana

Pest/disease	Relative importance (%)[1]	
	Northern	**Brong-Ahafo**
Termites	30	17
Mealybugs / scale insects	17	31
Anthracnose	11	10
Nematodes (*Scutellonema bradys*)	11	10
Die-back	9	0
Nematodes (Root knot)	6	10
Virus	6	10
Wet rot	3	0
Foliage beetles	2	0
Dry rot	2	0
Tuber beetle	2	6
Millipede	1	7
Rodents	1	0
Centipede	0	0

[1] Based on totals perceptions of pest/disease being 1st, 2nd, 3rd and 4th most important constraint (totals were weighted 4, 3, 2 and 1 respectively).

5.2.1.5 Seed health in the Northern Region: assessments by pathologists

Assessments of seed tuber health in the Northern Region by UK and CSIR scientists largely backed the farmers perceptions of yam pests and diseases. For example, termites were the main cause of seed tuber damage in the cultivar 'Puna': almost 18% of tubers showed signs of infestation (Table 5). Termites were considered to be the most important biotic constraint by farmers in the Northern Region. However, cutlass damage during harvesting caused losses equivalent to that of termites. Surprisingly, millipede damage, although nearly as high as termite damage, was not considered to be a major problem by farmers. Perhaps because it is difficult to differentiate between

termite and millipede damage, farmers tended to group any kind of insect burrows as being caused by termites. Interestingly, only around 36% of 'Puna' and 25% of 'Seidu bile' seeds were free from any obvious signs of damage.

Table 5. Assessment of Seed Tuber Health in the Northern Region, Ghana

	Incidence of tuber damage (%)[3]			
Mean (%)	*D. alata* 'Seidu bile' (SE)[4]		*D. rotundata* 'Puna' (SE)[4]	
('Seed')[1]	-		(45.2)	
Healthy	25.4	(6.3)	36.1	(3.5)
Termite/ant damage	6.4	(1.8)	17.9	(3.4)
Cutlass damage	19.9	(5.6)	15.4	(2.4)
Millipede damage	17.6	(7.2)	12.2	(2.9)
Surface fungal mycelium[2]	11.0	(3.7)	10.2	(2.5)
Internal rots	2.3	(1.2)	6.7	(2.0)
Rodent damage	0.4	(0.4)	6.2	(1.8)
Mealybug	0.0	(0.0)	5.7	(2.1)
Meloidogyne sp.	7.2	(4.7)	5.7	(3.5)
Scutellonema bradys	11.3	(7.6)	2.0	(0.9)
Scale insect	15.6	(9.7)	0.5	(0.4)
Sun/heat damage	0.4	(0.4)	0.3	(0.2)

[1] Proportion of tubers in storage grown for propagation purposes through double harvesting.
[2] Mainly *Sclerotinia/Rhizictonia* spp.
[3] Mean incidence in 10 tubers averaged over 21 & 11 farms for 'Puna' and 'Seidu bile' respectively.
[4] Standard errors of means ($p<0.05$) are given in brackets.

5.2.2 Farmers' perceptions of the effects of pests and diseases on yams

Farmers were asked the effects of the different pests and diseases on yam foliage and tubers. Termites were said to damage tubers by eating the flesh, and several groups in both regions indicated that the damage is worse on white yams. The results of the observations on seed tuber damage in the Northern Region support this: 17.9% of white yam tubers had termite damage compared to 6.4% of water yam tubers (Table 5). Six groups felt that termites adversely affect germination, whereas another three felt that termite damage affects the market value of the yams.

All the Brong-Ahafo groups and nearly all of the Northern groups indicated that scale insects/mealybugs affect germination of seed. A few of the groups in the north mentioned that the tubers are dry and light and that they can be consumed but have a bad taste. Two of the Brong-Ahafo groups felt that scale insects and mealybugs adversely affect the market value of yam tubers. There was no general consensus on the type of yam affected by scale insects and mealybugs in either region, although three farmer groups mentioned that mealybugs are worse on white yams and two mentioned that scale insects are worse on water yams. Again, farmers' perceptions are borne out by the data: in the Northern Region, the incidence of mealybug was 5.7% and scale insects was 0.5% on white yam compared to 0% for mealybug and 15.6% for scale insects on water yam (Table 5).

In Brong-Ahafo, nearly all the groups interviewed emphasised the fact that nematodes adversely affect the market value of the crop, but this was only mentioned by 2 out of 14 groups in the Northern Region. In the latter, more emphasis was put on the fact that nematodes reduce the amount that can be consumed and cause a bad taste, and a

few said that they prevent seed from germinating. Nine groups in the Northern Region and one in Brong-Ahafo said that nematode infestation is worse on white yams. Examination of seed tuber damage showed that nematode damage was more prevalent on water yam than on white yam (11.3% *Scutellonema bradys* and 7.2% root knot on water yam compared to 2.0% and 5.7% on white yam). However, there is no contradiction between farmers' perceptions and scientists' observations as standard errors are high and the differences between nematode incidence on white and water yam are not significantly different.

Farmers in the Northern Region described anthracnose damage as yellowing and early wilting of the leaves, which eventually fall off. In both regions nearly all groups said that anthracnose infested plants produce small tubers. There was some divergence of opinion on the varieties of yam affected by the disease. Most groups in the north said that it affects all yam types, although two groups said it affects white yam more, whereas in the Brong-Ahafo Region, only two groups mentioned which varieties were affected by the disease and both of them said that water yam are more affected. Results from field trials carried out by the project suggest that water yams from the Brong-Ahafo Region ('Matches') are more sensitive to anthracnose than white yam and more sensitive than water yam from the north ('Seidu bile') (Peters, unpublished). This suggests that the varieties of water yam grown in the two regions are different.

The effects of die-back were not mentioned in Brong-Ahafo because it is not considered a very important problem there. In the Northern Region, the groups that ranked the disease described it as being very similar to anthracnose; it causes the leaves to turn yellow, wilt and fall off and infected plants either produce small tubers or no tubers at all. Three groups said that it affects all varieties of yam, but two groups said it is worse on white yam.

Viruses were considered a more important problem in Brong-Ahafo than in the Northern Region. However, in both regions most of the groups commented that virus infested plants produce small tubers. There was no mention in Brong-Ahafo as to whether white or water yams were more susceptible to viruses, but in the Northern Region, the groups were divided on whether viruses were worse on white yams or whether both white and water yam were equally affected.

5.2.3 Farmers' perception of causes[9] of pests and diseases affecting yam

Farmers in the Northern Region were asked what they thought the causes of the various pests and diseases are. Twelve of the groups said that termites are exacerbated by debris (dry grass etc.) being left in yam mounds. Other causes mentioned were drought and damp soil.

Scale insects/mealybugs were attributed to a variety of causes. Seven groups said that they are soil borne, three groups said they did not know and three thought they were due to ants (several farmer groups described scale insects/mealybugs as insect/ant faeces or eggs, and did not recognise that they are in fact insects). Two groups

[9] The definition of 'cause' being used here is 'what produces or brings about the pest or disease' which is how the question was phrased for the farmers. In most cases the farmers answered this question in terms of how the pests and diseases are transmitted and/or aggravated.

thought that they may be seed borne and four groups mentioned that they are worse if the second harvest is delayed.

All but one of the groups in the Northern Region said that nematodes are soil borne and/or caused by wet or waterlogged soils. However, one group that they are seed borne and one said that they are worse if harvested late due to the heat of the soil. Anthracnose, die-back and viruses were mainly said to be soil-borne diseases.

5.2.4 Control measures

Attempts to control termites are not done to the same extent as that for scale insects/mealybugs in the Brong-Ahafo Region (see below). One farmer said he controls termites by putting vines in mounds after milking and covering them with soil, and 50% of farmers in one village use the chemical Dursban (active ingredient, Chloropyrifos, Dow Chemical Company) to control them. In the Northern Region, the majority of farmers said that they do not know of any control measures for termites. Four groups did mention good land preparation and clearing debris from mounds and another four mentioned chemicals as a control measure, but of these one group said that they had never used chemicals and another said they are no longer available.

In Brong-Ahafo, 40% of farmers treat scale insect/mealybug infected yam seed with chemicals (those mentioned include Actellic, Karate, Dursban, DDT, Phostoxin and Gammalin 20). One farmer also mentioned leaving infected tubers in the sun to kill the insects and three farmers, from different villages, mentioned placing infested tubers under trees[10] where black ants can feed on the scale insects/mealybugs. In the Northern Region, farmers in two villages knew about chemicals as a control measure for scale insect/mealybug, but they were only used by one farmer. Five groups said that they did not know of any treatments and five said that infested tubers should be separated from other tubers to stop the insects spreading. In one group, a farmer mentioned that wood ash can be used to control scale insects/mealybugs, another said that dipping yam seed in diluted ground pepper before planting is a control method and another said that shifting cultivation of yam to new land controls the problem.

Most of the groups in both the Northern and Brong-Ahafo Regions did not know of any control measures for nematodes. In Brong-Ahafo, one group mentioned proper bush burning in order to avoid nematode infestation and a farmer said he controls nematodes by removing seed yams as soon as tuberisation commences. In the northern region, one group suggested abandoning fields where nematode infected yams were grown and another suggested moving to drier soil.

No control measures for anthracnose, viruses and dieback were mentioned in Brong-Ahafo, and in the Northern Region the majority of the farmer groups did not know of any control measures for these diseases. Changing the land on which yams are cultivated was mentioned once for both anthracnose and viruses, and harvesting early was also mentioned for anthracnose.

[10] One farmer said that it should be a particular tree, called the 'Senya' tree

5.3 Yam seed

5.3.1 Sources of seed

In the Northern Region, most yam seed comes from the previous year's harvest. 77% of farmers said that they were increasing their farm sizes this year, and virtually all of them said that the additional seed was from their previous harvest. Farmers said that they buy seed either because they want to expand their farm, because they want new varieties or because they have insufficient seed from their previous harvest.

In some villages, the survey team questioned the groups further about the number of farmers who had bought seed. The response was that 18% of farmers in six of the survey villages had bought some seed in the last five years. In two of these villages, Sambu and Demo-naya, a larger proportion of farmers (25% and 33% respectively) had bought seed this year because they are building-up their yam farms after a period of conflict, and said that prior to the conflict it was not common practice to buy seed. Of those that did buy seed, it is not known what quantity of seed was purchased. The farmers who had bought seed did so from other farmers in neighbouring villages, so the 'cleanliness' of the seed is unlikely to have been any better than seed from their own farms. Only four of the survey groups in the Northern region were asked if they sell seed and of these only one farmer sold any seed last year.

In the Brong-Ahafo Region, again most seed comes from the previous year's harvest, but a higher proportion of farmers buy seed compared with the northern farmers. The proportion of those interviewed who bought yam seed in 1997 ranged from 14% to 50% in different villages, averaging 30% of the farmers. As in the north, most farmers did not indicate how much seed was purchased but two farmers said that they bought about 15% of their total yam seed. The reasons given for purchasing additional seed were shortage of seed, wanting to expand yam farms and an insufficient quantity of particular varieties. Farmers in six of the seven survey villages in Brong-Ahafo also sold seed. On average 16% of the farmers interviewed sold seed in 1997.

5.3.2 Seed preparation methods

The following table shows the various seed preparation methods used by farmers for white yam varieties. It also shows the percentage of seed which farmers in the NorthernRegion said they get from each method for Larebako/Kpuna, which are their most common white varieties (averaged over 12 villages).

Table 6. White yam seed preparation methods

Seed preparation methods	Northern region % of seed
Pricked (1st harvest)[11]	82
Cut wares (1st harvest)	7
Buried small wares (1st harvest)	5
Multiple/parasite tubers (2nd harvest)	6
Small wares (2nd harvest)	1

Table 6 shows that most seed comes from pricking at 1st harvest, and that the methods which are likely to produce less clean seed (buried small wares at 1st harvest and small wares from 2nd harvest) only account for 6% of seed.

The affect on health of cutting wares at 1st harvest is ambiguous because provided the tuber is healthy and properly cured before storage then it is no worse that the normal pricked seed. However, the problem is in storing the cut wares over the wet season. Burying, which is the common practice, leaves the seed susceptible to fungal and bacterial rots as well as attack by termites and other pests. A better practice would be to store whole ware tubers over the wet season.
These figures would tend to indicate that farmers' seed preparation methods are generally good in terms of selecting cleaner seed. However, several factors need to be borne in mind when considering these figures :

- When discussing the issue of seed preparation methods with farmers, it did not become clear until near the end of the survey that the farmers were largely talking about **deliberate** seed preparation methods. They had difficulty estimating the amount of seed from buried small ware tubers at 1st harvest, and it was only in the last village surveyed that the amount of seed from small ware tubers at 2nd harvest was mentioned and estimated. In that village, 12% of seed was said to come from small wares at 2nd harvest.
- Most farmers said that 1997 was a bad year in terms of ware harvest but that it was a good year for seed. This implies that there was more seed from small wares than normal.
- The plant pathologists carrying out the pest and disease scoring in farmers fields indicated that a much higher proportion of the seed they saw was small wares from the first and second harvests than that indicated by the farmers.

It seems therefore that the farmers responses to the question about seed preparation methods and the proportion of seed they get from different methods indicated their 'ideal' or preferred practice, and that their actual practice (particularly in a bad year) is likely to include more seed from less clean (non-deliberate) seed preparation methods.

In the Brong-Ahafo Region, all the village groups interviewed said that their main source of white yam seed is from pricked tubers. However, various other seed preparation methods are used when the pricked seed is insufficient. Several farmers in five of the villages said that they use small ware tubers harvested at pricking time

[11] Pricked seed is harvested at second harvest (around November/December) follwoing careful removal of the primary tuber mid-season.

and one village even had a particular name for this type of seed (*mmrahyema*). Three of the groups mentioned using the heads of ware tubers, two groups mentioned bought seed, one group said that some tubers are left after harvesting and can be used for seed and another group said that many of them cut up wares at first harvest and store them in the yam mounds.

The proportion of seed from each source is not known, so it is difficult to draw any conclusions on the health of white yam seed being used by farmers in Brong-Ahafo. However, a significant number of farmers said they use small ware tubers from the first harvest, and it is likely that these are a source of unhealthy seed. It is also possible that heads of ware tubers are a source of unhealthy seed if they are not cured and stored properly.

For water yam, most of the farmers said that they use small ware tubers for seed (although some are aware that bigger tubers result in better yields). Two of the groups mentioned that when there are insufficient small wares they use pieces from larger ware tubers. There was little knowledge about the minisett technique; only 3 farmers in 1 village in Brong-Ahafo had tried the technique but they found it to be good.

There is some evidence from Nigeria that the minisett technique[12] results in better germination and yields (Kalu, 1989)[13]. However, when faced with problems of availability and/or cost of inputs, there is little that can be done to improve farmers' current water yam seed preparation methods.

5.3.3 Seed selection criteria

All the groups surveyed in both the northern and Brong-Ahafo regions said that seed should be a good size (bigger seeds germinate and yield better) and that it should be healthy. Opinions of what a good size of seed is ranged from 100g - 150g in one village to 600g in Demo-naya and Gbungbalga. In Sambu village, the group said that the weight of tubers is also important. If they are too heavy (i.e. if they have too much water) they are either pricked with a knife or the end is cut off before they are planted. This allows them to rot and then germinate quickly, and the rotting also fertilises the soil.

Farmers did not recognise all diseased tubers. Some farmers in the Northern region did not recognise tubers which were not very badly affected by nematodes (both cracked and knobbly) and some farmer groups felt that knobbly nematodes were a characteristic of the variety.

Farmers in the majority of villages in Brong-Ahafo and northern regions said that they would not plant nematode infested tubers. However, a minority of farmers said that they would plant tubers with cracks (some would only plant the undamaged parts) and others would plant tubers with small knobbly nematodes.

[12] Tubers are collected from healthy plants, cut into small (50g to 100g) pieces and then air-dried for 24 hours. After this curing process the 'minisetts' are dipped in fungicide and/or insecticide then planted before/during the rainy season.

[13] Kalu, BA (1989) 'Seed preparation by minisett technique: evaluation of three Dioscorea species in the Guinea and derived Savanna zone of Nigeria' Tropical Agriculture 66: 83 - 87

Half of the groups in the Northern Region indicated that they would not plant tubers infested with scale insects/mealybugs. Others, particularly those in Brong-Ahafo region, said they would plant them if they were chemically treated. A couple of groups in the north said that they could be used for planting after the scale insects /mealybugs had been scraped off.

Eight groups in the Northern region said that they would plant yam seed which had come from plants with anthracnose, provided the seed was large enough. One group mentioned that it could be planted as long as it was on different land (as mentioned above, the majority of groups think it is a soil borne disease). However, the main reason why farmers are willing to plant the seed is because there is a lack of awareness that the disease is seed borne. A number of groups also said they would plant yam seed from plants with viruses if the seed was large enough and looked healthy, whereas one group said they would only use it if there was nothing else available and another said that the seed from virus infected plants is so small that there is nothing to plant.

Three groups in the north and two in Brong-Ahafo said that they would not use bruised or damaged tubers (e.g. cutlass damage during harvesting) for seed because they would rot. They would only be planted if they had a bruise which had healed.

5.4 Storage

Various storage structures for both yam ware tubers and seed are used by farmers. The different types used for seed in the Northern region are as follows:

1. Heaped under trees and covered with dead yam vines and millet and sorghum stalks (*Nyu Kogu*)
2. Structures made of millet stalks with an up-right pole for reinforcement, most often conical shaped (farmers in different villages spoke different dialects and therefore had different names for this type of storage structure, namely *Sigu, Wasigu, Hilluo* and *Wa-sie)*
3. Rectangular woven straw mat structure, roofed with the same material *(Dede)*
4. Round huts with woven straw walls (zana mats) and a thatched straw roof (*Suguli/ Sugli Dagbani)*
5. Buried seed where the tubers are put in a pit and covered under shady trees (also called *Nyu Kogu)*
6. Raised hut introduced by the GTZ Post harvest project, but is not common in the Northern region

The first and second of these are the most commonly used storage structures (farmers in 9 of the 14 survey villages mentioned them). The other storage structures were only mentioned by farmers in one or two villages.

In the Brong-Ahafo region the following storage structures were mentioned:

1. Seed placed on clean clear ground under shady trees and covered
2. Under shady trees, on the ground - with a fence made from palm fronds
3. Barns with tubers tied to poles (*aputuo)*
4. Tubers placed on boards or sacks on the floor inside the house

5. Sheds with slightly raised wooden platforms - tubers arranged on platforms and covered with vines or palm fronds. Structures erected under shade (tree) or in the farm (*putuo*)
6. Raised platforms in the compound: simple barn or structure with legs about one metre from the ground, situated in the house compound (modified GTZ structure)
7. Wooden platforms in rooms: wooden planks or boards in a room, slightly raised, on which the tubers are arranged

The groups were asked the proportion of tubers which they store in each of the different structures. Some groups gave a combined figure for ware tubers and seed (column 1 in Table 6) whereas other groups distinguished between storage methods used for ware tubers and seed (columns 2 and 3 in Table 6).

Table 7 shows that for wares and seed combined, 35% of tubers were stored in sheds with wooden platforms and 32% of tubers were stored on the ground under shady trees. These methods were mentioned by 4 and 3 groups respectively. For seed on its own, a higher proportion of tubers were stored on the ground under trees (52%) whereas for ware tubers on their own, a higher proportion of tubers were stored in sheds with wooden platforms (90%). This would seem to imply that a greater proportion of seed is stored on the ground and that a greater proportion of ware tubers are stored in sheds (although the small sample size should be borne in mind when drawing conclusions from these figures).

Table 7. Proportion of yam tubers stored using different storage methods

	Seed and Ware	**Seed**	**Ware**
Ground under trees	32% (3) *	52% (1)	
Ground under trees with a fence		22% (1)	
Barns with tubers tied to poles	26% (3)		
Tubers in room	6% (1)		
Sheds with wooden platforms	35% (4)	26% (1)	90% (2)
Raised platforms in compound			7% (1)
Wooden platforms in rooms			3% (1)

Key: * The numbers in brackets refer to the number of farmer groups who use this type of storage method or structure. E.g. 3 farmer groups store their yam tubers (seed and ware) on the ground under trees and 32% of tubers are stored in this way.

Farmers in both the Northern and Brong-Ahafo Regions were asked about storage problems. Farmers in the Northern region were asked to list and rank their storage problems (irrespective of storage method) whereas in the Brong-Ahafo region farmers were asked to list which problems they suffered with each storage method or structure.

Table 8. **Importance rank of storage problems in Northern Region**

	Rank (number of groups)

	Rank 1	Rank 2	Rank 3	Rank 4
Theft	4			
Heat & rotting	3	2	3	
Rodents	1	4	1	1
Fire		1		
Termites		1		

Table 8 shows that theft was ranked as the number 1 storage problem by most farmer groups (4) in the Northern region although in villages where it was not the main storage problem it was not considered a problem at all. Heat and rotting were ranked in the top three by most groups and appears to be a more widespread problem, followed by rodents.

Table 9 highlights the number of times each storage problem was mentioned for each storage structure in the Brong-Ahafo Region. For the three most commonly used structures (ground under trees, barns with tubers tied to poles and sheds with wooden platforms) theft and rodents were mentioned most frequently. However it is not possible to tell from the data which of the storage problems caused most damage to tubers.

Table 9. Storage problems in the Brong-Ahafo region

	Ground under trees	Ground with fence	Barns with tubers tied to poles	Tubers in room	Sheds with wooden platforms	Raised platforms in compound	Wooden platforms in rooms
Theft	2		3		4		
Heat & rotting	1	2	2	1	2		1
Rodents	2	1	3		5	1	1
Fire	2		2		3		
SIs/MBs					1		
Snakes	2				1		
Bats					1		
None	2	1					

In both the Northern and Brong-Ahafo Regions farmers said that they store seed from between 1 to 4 months. Farmers were also asked about the level of damage which tubers suffer whilst in storage, and although this data was generally not collected according to storage structure and storage length, the aggregate figures are interesting. Farmers in the Brong-Ahafo Region said that they suffer damage of between 0% and 10%, whereas farmers in the Northern Region said that they suffer damage of between 0% and 60%.

6 Discussion and Conclusions

The results clearly show that pests and diseases are important constraints to yam production and marketing in the Northern, Upper West and Brong-Ahafo Regions of Ghana, which are major yam producing areas in the country. Overall, when pests and diseases were grouped together, they were ranked the second most important problem and were considered a major reason for the poor yam yields experienced by the majority of farmers in 1997. Furthermore, all but one of the farmer groups which discussed changes in pests and diseases in recent years said that they have been increasing in severity.

Various farmer groups mentioned the adverse effects that pests and diseases have on the quantity and quality of yam tubers for both consumption and sale, and on the availability and quality of seed. Nearly all of the farmer groups in the Brong-Ahafo Region singled out nematodes as having an adverse effect on the market value of tubers. Somewhat surprisingly, in the Northern Region where nematodes were considered a greater problem than in Brong-Ahafo, this affect of nematodes on market value was mentioned by very few farmer groups. No attempt was made during this survey to estimate the economic losses associated with pests and diseases, but other studies have shown that the loss of revenue can be considerable, e.g. see Bancroft *et al* (1998)[14] which found that termite, rot and nematode infestation reduced the market value of yam tubers by 25% to 63%.

Farmer knowledge of pests and diseases was generally good in terms of describing and recognising different pests and diseases. Some farmer groups were also very perceptive about the varieties which are susceptible to different pests and diseases (particularly termites, scale insects and mealybugs). Some farmers did not recognise certain diseases. Low levels of nematode damage were not recognised by a number of farmer groups and high levels of root knot nematode damage were considered by some to be characteristic of the variety.

Farmers were less aware of the causes of different pests and diseases. They stated that most pests and diseases are soil borne. However, viruses, die-back, anthracnose, nematodes, mealybugs and scale insect are all seed-borne, and although soil and alternative hosts play a part[15], the single most important thing that farmers can do to prevent epidemics of these diseases is to ensure that seed is clean. Only one group mentioned seed as a transmission mechanism for nematodes and two groups mentioned seed in connection with scale insects or mealybugs. A disregard for the seed-borne nature of pests and diseases leads to reductions in yield and tuber quality,

[14] Bancroft, R., Crentsil, D., Gray, A. and Gogoe, S. (1998). The marketing system for fresh yams in Techiman, Ghana and associated post-harvest losses. *The proceeding of the 11th Symposium for the International Society for Tropical Root and Tuber Crops*, Trinidad and Tobago, 1998.

[15] For example, farmers are right to state that nematodes are soil and seed-borne; wet soils will aggravate nematode infestation because they are able to migrate from alternative hosts to yam much easier and will multiply faster. By harvesting late, the nematodes have longer to build up larger populations in the tuber. Also, farmers tend to plant yams on land which has been left fallow for many years. This is the ideal practice for reducing pest and disease populations in the soil. However, as human population densities rise so will the pressure to plant on land with shorter crop rotations. So soil-borne diseases will rise.

as was experienced by the survey farmers in 1997.

However, despite the fact that few farmer groups mentioned seed as a cause of pests and diseases, their seed preparation methods and seed selection criteria indicate that to a certain extent farmers do understand the benefits of using clean(er) seed. Much of their white yam seed comes from pricked plants, and they said that they prick the healthiest plants. They also know that tubers with certain pests or diseases will not germinate. The majority of farmer groups in the Northern Region said that they would not plant seed with signs of nematode damage and half of the groups said they would not plant seed with scale insect, or mealybug, infestation.

As indicated earlier in the report however, there was some divergence between farmers 'ideal' or preferred practice, and their actual practice. Farmers in the Northern Region said that 82% of their white yam seed was pricked, whereas the seed observation results found that 45% of seed was pricked (Table 5). The likely reasons for this divergence are that farmers found it difficult to estimate the quantity of seed from non-deliberate methods and that 1997 was a bad year for the ware harvest but was a good year for seed. This latter factor is particularly important because it implies that farmers were getting more seed from small wares that normal.

Without examining the small ware tubers it is not possible to comment conclusively on their health but since farmers mentioned pests and diseases as a major reason for the poor harvest in 1997, it is probable that a large number of the small ware tubers used for seed were diseased. Also, even if in theory farmers know that seed from diseased plants will not germinate, in practice they generally do not keep track of the plants which have suffered from foliar diseases and therefore do not know at seed selection times which are the tubers from those plants. Farmers say that they plant tubers if they are a reasonable size (nearly all farmer groups said that they would plant seed from plants with anthracnose or viruses so long as the seed is big enough, which depending on the village ranged from 100g to 600g) and so only if the foliar diseases result in very small tubers would they not be planted. In contrast farmers are less likely to plant seed with visible pest and disease damage, such as scale insects and nematodes.

This issue of keeping track of diseased plants and not selecting seed from them is also important for water yam. Although farmers seed preparation and selection methods were felt to be generally good, keeping track of diseased plants and selecting seed from healthy plants would help ensure that pests and diseases are not recycled from one year to the next (particularly for farmers who cannot afford or do not have access to insecticides and/or fungicides).

Based on these survey findings, a number of recommendations can be made (although not all are within the scope of this project):

- Conduct further survey work and/or carry out on-farm monitoring of farmers' seed preparation methods and selection practices. This survey found that farmers' actual practices differed from what they said they did, and although various reasons for the differences were discussed, it would be beneficial to investigate this issue further, particularly in the Brong-Ahafo Region. For example, it is not known if

farmers are aware that seed from certain non-deliberate preparation methods (i.e. small wares from the first or second harvests) is likely to be diseased, or if they know it is likely to be unclean seed but have no option but to use the seed. It may be necessary to investigate further the options open to farmers when their seed from pricked plants is insufficient, particularly in years like 1997 when there is a poor harvest. It would also be useful to examine why so few farmers in the Brong-Ahafo Region use the minisett technique;

- Based on the results from the survey/monitoring work above, train extension staff and farmers about transmission mechanisms for yam pests and diseases and how to recognise diseased tubers which must be discarded (or eaten);

- Investigate the potential for seed traders in the Brong-Ahafo Region. The survey results showed that a larger proportion of farmers in the Brong-Ahafo Region bought and sold seed and use chemicals as a control measure for pests and diseases than in the Northern Region. It would be worth looking at whether or not there would be a market for clean yam seed in the region;

- Investigate control measures for pests, particularly termites and scale insects, which were considered the worst pest/disease problems by farmers. Scale insects/mealybugs can be controlled by planting clean seed, but termites are a more complicated problem (although burying seed is definitely not a good idea);

- Examine alternatives to using chemicals to clean seed, such as botanical products;

and

- Train extension staff and/or farmers about storage. Structures which incorporate yam vines and stalks can contribute to the transmission of diseases like anthracnose. Farmers should be encouraged to use storage structures which are well ventilated, which offer protection from the heat and rain and discourage theft, but which do not incorporate crop debris from the previous years' yam crop.

Appendix 1: Field Team members

Northern zone team

F Andan, Post-harvest Technologist, Ministry of Food and Agriculture/NRI
H Kindness, Socio-economist, Natural Resources Institute
Dr J Peters, Plant Pathologist, University of Reading
F Tsigbey, Plant Pathologist, Savannah Agricultural Research Institute

Brong-Ahafo zone team

Dr O A Danquah, Mycologist, Crops Research Institute
L Kenyon, Plant Virologist, Natural Resources Institute
Dr J Lamptey, Plant Virologist, Crops Research Institute
K Marfo, Socio-economist, Crops Research Institute
A Missah, Nematologist, Crops Research Institute

Appendix 2 : RRA Survey outline - Incidence and importance of diseases on post-harvest yams

Group interviews

- Decide on roles of survey team prior to group meetings
- Explain the purpose of the survey to the farmers
- Introductions of team members and farmers

Checklist

1. Farmers names and numbers of mounds grown last season (divide into white yam and water yam) and number of mounds prepared this season *(write on pieces of card)*

2. Was last year a good or bad in terms of yam yield? *(group discussion)*

3. Yam production problems *(ask farmers to list production problems and write them on pieces of card; then ask the group to rank them in terms of importance)*

4. Pests and diseases

    a) List pests and diseases *(write local names on pieces of card)*

    b) What do pests/diseases look like? *(group discussion)*

    c) Compare local names with scientific names *(show farmers damaged tubers and/or pictures and ask which of the local names they've given each one is)*

    d) Effects of pests/disease *(group discussion) :*

        - on plant/on tuber?
        - at what crop stage?
        - which seasons?
        - on which varieties?

    e) What are the causes of the pests and diseases *(general group discussion for causes of each of the pests and diseases mentioned)*

    d) How do farmers treat the different pests and diseases? *(group discussion)*

5. Ranking of pests and diseases

    a) Rank pests & diseases for last season *(most serious=1, next serious = 2)*

    b) Are pests and diseases increasing or decreasing *(ask for each of the pests and diseases, generally, say over the last 5 years)*

6. Seed tubers

    a) Sources or seed

        - Where do farmers get seed *(bought, own farm, other - count)*
        - If bought, what proportion, from where, reasons for buying
        - If not bought, reasons for not buying? *(group discussion)*

    b) Seed preparation methods *(ask farmers to list them and write them on*

cards; prompt them about other methods if they don't mention them; ask each farmer to say which proportion of his/her seed is from which method)
c) Seed selection criteria, reasons for selection and size of seed *(general group discussion and use different size tubers/stones to discuss size)*

d) Do farmers treat seed, and if so how? *(general group discussion)*

e) Storage

- Methods *(group discussion and write methods on pieces of card - include a card for 'not stored' if applicable)*
- Length of time stored? *(group discussion)*
- Proportion of seed tubers stored using different methods? *(using the storage method cards, ask each farmer to say what proportion of his/her seed is stored using each storage method - also indicate what proportion of seed is not stored)*
- Proportion of seed damaged during storage *(ask each individual farmer for an overall figure (for all methods combined) of seed lost during storage but also ask farmers to indicate which method produces most loss ands which produces least loss)*
- Storage problems *(group discussion and rank)*

f) Do farmers ever plant damaged tubers? *(group question - show examples of damaged tubers and ask farmers if they would plant them)*

g) What are the effects of planting small tubers and damaged tubers? *(group discussion)* ; If farmers say that planting small and/or damaged tubers affects the yield, ask why they do it? *(group discussion)*

h) Do any of the farmers sell seed?

7. Harvesting practices and losses
a) When are yams harvested and how many at one time? *(group discussion)*
b) Are wares stored? If so, what storage methods are used? What proportion of wares are stored? How long are they stored for? *(group discussion)*
c) How are yams sold? *(group discussion)*
d) For the last load of yams sold *(select 2 farmers - small & large producers)*

- what was the size of the load?
- when were they sold?
- were they stored before sale or harvested on demand?
- were they sorted by the farmer prior to sale?
- if so, how many were damaged (before storage and after storage) ?
- was there any additional sorting by traders?
- if so, how many were damaged?
- what were the main causes of damage *(list and rank)*

Observe/record gender differences in responses

Appendix 3: Original Rankings of pests and diseases.

	Northern region Rank (number of groups)				Brong-Ahafo region Rank (number of groups)			
Pest/disease	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 4**	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 4**
Anthracnose	2	3	0	1	0	1	2	1
Centipede	0	0	0	0	0	0	0	0
Die-back	3	0	1	0	0	0	0	0
Dry rot	0	0	0	3	0	0	0	0
Foliage beetles	0	0	2	0	0	0	0	0
Mealybug/Scale insect	1	5	3	2	5	2	0	0
Millipede	0	0	0	1	0	1	1	1
Nematodes (C)	3	1	1	1	0	0	3	2
Nematodes (K)	1	0	2	1	0	0	3	2
Rodents	0	0	0	1	0	0	0	0
Termites	9	4	0	1	2	2	0	0
Tuber beetle	0	0	1	1	0	1	1	0
Virus	0	1	2	2	0	1	1	3
Wet rot	0	0	2	1	0	0	0	0
Total	**19**	**14**	**14**	**15**	**7**	**8**	**11**	**9**

Key: Some farmer groups had time or were able to rank all the pests and diseases they mentioned whereas others stopped at 6. For simplicity in analysis, only the top 4 ranked pests and diseases for each village have been included.
The **total** row for different ranks is not always equal to 14 or 7 (the number of villages in the Northern and Brong-Ahafo regions respectively) because sometimes farmers gave more than one pest/disease the same rank because they were considered to be the same pest/disease).

REPORT ON YAM FIELD DISEASES IN GHANA.

J. Peters, W. Ellenbroek, O. A. Danquah, J. Lamptey, F. Andan, F. Tsigbey.

University of Reading/NRI, January 1997

PREFACE

Project Control of Yam Diseases in Forest Margin Farming Systems in Ghana commenced in July 1996 to investigate yam diseases in Ghana. The project is financed for 3 years by the British Overseas Development Administration (ODA), under the Forest-Agriculture Interface of the RNRRS Crop Protection Programme.
The aim of this project is to develop improved methods for the control of the principal plant pathogens of yams in Ghana. In the last ten years or so, there has been a great deal of work focused on diseases of yams world wide, indicating that one of the main limitations to increased productivity from yam cropping systems in West Africa is the scarcity of healthy and reliable planting material. In Ghana, there is a paucity of information available on the primary pathogens or pests causing the poor survival or growth of yams. Various methods for controlling disease, for seed treatment, or agronomic practices through the growing season, at harvest or during storage, have shown promise in improving yam health in many yam growing regions. However, the efficacy of these treatments and their acceptance to farmers in Ghana has not been investigated.

This project now aims to integrate the current knowledge, and to identify the principal diseases and pests infecting yams in Ghana. Therefore work will be undertaken to investigate the interactions between fungal pathogens and nematodes attacking yams in the field, and ascertain their effect on the health of tubers in storage. The economic impact of yam diseases will be verified by way of crop loss assessments. The importance of using clean or treated planting material will be determined by assessing the extent to which diseases are tuber-borne. Based on these results and on the findings of previous projects, improved and sustainable control practices will be developed and tested in close consultation with smallholder farmers, with special attention to women's concerns.

The project is led from England by Dr. J. Peters, Department of Agriculture, the University of Reading. Other collaborators include the Crops Research Institute (CRI) in Kumasi, Ghana; the Savannah Agricultural Research Institute (SARI), Nyankpala, Ghana; the Department of Botany, the University of Ghana, in Legon, Ghana; the Natural Resources Institute (NRI), in Chatham Maritime, England; and the International Institute of Tropical Agriculture (IITA), in Ibadan, Nigeria.

This report presents the results of a survey implemented between September 19 and October 7, 1996, to study the geographical extent and nature of field diseases and pests in yam in Ghana. The authors are:
Dr. J. Peters is a Plant Pathologist from the Department of Agriculture, the University of Reading, UK. Dr. Peters is the Project Co-ordinator.
Drs A.O. Danquah and J Lamptey are plant pathologists from the Crops Research Institute in Kumasi, Ghana.
Mr F. Andan is a Root and Tuber Specialist at the Ministry of Agriculture District Office in Tamale.
Mr. Francis Tsigbey is a plant pathologist at the Savannah Agricultural Research Institute (SARI), Nyankpala, Ghana.
Ir. W. Ellenbroek is an Agricultural Economist at NRI, Chatham Maritime, UK.

Acknowledgements

A special word of gratitude is due to the Ministry of Agriculture, it's District Officers and extensionists in the sample districts, for their valuable assistance in organising and facilitating the surveys.

1 Study Objective and Methodology

1.1 General introduction.

The survey documented in this report, is one of the starter activities of the project Control of Yam Diseases in Forest Margin Farming Systems in Ghana. It had as objective the collection of base-line data on diseases of yam in Ghana, and to learn about the farmers' attitudes about them and what methods are used to control them.

The study was timed in September/October 1996, with crops still on the field, so that foliar diseases could be observed and scored, and farmers would still have a fresh impression of the extent and severity of crop diseases.

Since the character of the survey was exploratory, with time restricted to four weeks, preference was given to a rapid appraisal study relying on so called PRA (participatory rural appraisal) techniques. The survey combined on the one hand PRA techniques principally to bring to light the farmers' perception of the importance of yam diseases, together with direct scoring of yam diseases in the field to get more objective and precise estimates of the incidence of yam diseases.

The data collection was undertaken by two teams of researchers between September 19 and October 21, 1996. One team, from the Crops Research Institute (CRI), Kumasi, Ghana, sampled the Brong Ahafo and Ashanti regions, between September 20 and October 21. The following staff from CRI participated in the survey: Dr. A.O. Danquah (Plant Pathologist); Dr. J. Twumesi (Plant Pathologist); Dr. J. Lamptey (Plant Virologist); Mr. A. Apau (Agricultural Economist); Mr. A. Missah (Nematology/Plant Pathology PG student). Between September 19 and 21, they were assisted by Dr. J. Peters (Plant Pathologist), the Department of Agriculture, the University of Reading, UK, and Ir. W. Ellenbroek (Agricultural Economist) NRI, Chatham Maritime, UK.

A second team was formed with staff from the Savannah Agricultural Research Institute (SARI), Nyankpala, Ghana, who sampled the Northern and Upper West regions between September 25 and October 4. This second team consisted of Dr. J. Peters (Plant Pathologist), the Department of Agriculture, the University of Reading, UK; Mr. Cecil Osei (Agronomist, SARI); Mr. Frances Tsigbey (Plant Pathologist, SARI); Mr F. Andan (Root and Tuber Specialist, Ministry of Agriculture District Office, Tamale); and Ir. W. Ellenbroek (Agricultural Economist) NRI, Chatham Maritime, UK (until September 26).

1.2 Scope of the PRA exercise.

Following the objective of the study, as outlined above (to collect base-line data on diseases of yam in Ghana, and to learn about the farmers' attitudes about them and what methods are used to control them), it was decided to implement a survey using participatory rural appraisal (PRA) techniques. It was felt that a PRA would be a flexible and relatively low-cost best instrument to rapidly investigate farmers' perceptions of the severity of pests and diseases in yam production.

When designing the outline for the PRA, it was further decided that the survey would focus narrowly focusing on the identification and ranking of yam diseases. Deeper study into possible covariance between the occurrence of yam diseases and socio-economic, biophysical, or agronomic variables would be made dependent on the outcomes of this first survey. (Strictly speaking, it is more appropriate to label our survey a topical RRA (rapid rural appraisal), for its exploratory nature and accent on appraisal. PRA's (participatory rural appraisals) on the other hand emphasise the element of participation, and rather are consultation exercises with beneficiaries more geared towards problem resolution.)

Notwithstanding the fact that the survey was not designed to validate prior hypotheses concerning socio-economic, biophysical or agronomic factors influencing the occurrence of pests and diseases in yam production, the survey was designed with a few prior assumptions in mind:

- seed selection: criteria for selection, treatment of seed, sources of seed, problems cited by farmers, solutions suggested by farmers (or expression of needs).
- yam varieties grown and their susceptibility to diseases: varieties grown, nature of diseases, spatial and inter-temporal distribution of yam diseases, farmers' knowledge of symptoms and causes, farmers' remedies known and applied, farmers' concerns relating to disease control (expression of needs).
- estimation of pre-harvest crop loss due to different diseases.
- estimation of post-harvest crop loss due to different diseases.

Only limited background data were collected during the visits to the villages, such as relating to gender of the respondents, area of yams cropped, and the local yam cropping calendar. The PRA guideline for conducting the interviews can be found in Annex 1.

1.3 Survey preparations.

With a draft PRA outline in hand, half a day was spent with each team (CRI and SARI) for review of the outline, and sample preparation. Such little time was sufficient on grounds of the familiarity of the team members with the subject and their earlier experience with farmer surveying.
Testing of the PRA guideline was limited to one day. Partly due to limited testing, amendments were made during implementation to the PRA guideline and the form of implementing the ranking exercises. Therefore, there is no strict uniformity in data collection. It must be added though that over the course of implementation a shift in the researchers' focus of interest also led to amendments in the PRA guideline when common practice started to become distinguishable. Contrary to formal surveys with pre-structured questionnaires which have to be followed in detail, RRA/PRA-like surveys as this one only use guidelines, indicating areas of interest, so that changes in questioning and data collection in fact are part of the process of exploration.

Villages selected were given advance notice of the team's arrival through intervention of the extensionists of the Ministry of Agriculture.

For each team, the roles were divided into one acting as spokesman (both spokesmen of both groups had very good communication skills and a good command of local

dialects), notulists, and observers who digested information obtained and asked special interest questions. Reporting was done daily upon returning from the field.

1.4 Survey techniques.

The PRA techniques used were group interviewing and matrix scoring exercises. In selected villages, around 10 respondents were sought (in practice, 11 on average). Often, the audience was quite numerous but by-standers would be discouraged to intervene. For some subjects, a common opinion would be sought from the group, as for instance, regarding the yam cropping calendar, or the range of sorts of diseases affecting yam crops. But for such elements as the nature of diseases affecting their crop, the frequency of occurring, and the level of damage observed, each respondent was interrogated individually.

The matrix scoring exercise was implemented as follows. After having asked the group to identify the various sorts of yam diseases commonly found in their locality, corresponding representations of yam diseases would be put to display, using pictures (photographic images), live specimens, or, if neither was available, sketches of the disease in question were made. Going round the circle of respondents, they were asked to indicate, using peanuts or pebbles found nearby, how often, out of the last three years, they had encountered a specific yam disease on their fields. Distinction was made between yam varieties grown. Secondly, they were asked to indicate the number of plants or tubers damaged out of every 100 mounds. Thirdly, they were asked to describe (in words) the % damage to the tubers resulting from that specific disease. The session would end with an open consultation with all farmers, culminating in a priority ranking of yam diseases by the group of respondents.

The PRA exercises lasted about 2.5 hours on average (up to 3.5 hours maximum).

1.5 Sample selection.

Sample selection was purposeful. Statistical criteria were not applied for determining the sample size, by lack of a sample frame and testing hypotheses. In PRA, purposeful sampling is common practice, on grounds of its impressionistic nature, and on the assumption that local informants can be trusted in the selection of sample areas with socalled average characteristics for that region; this assumes a reasonable degree of uniformity within nearby territory.

Samples were taken from four principal yam producing regions of Ghana, to wit, Brong-Ahafo, Ashanti, Northern, and Upper West Region. For their geographic location, c.f. figure 1.

The final sample composition is given below in Table 1. Again, the number of villages sampled per region is not based on statistical criteria.

Table 1. Villages visited during the survey

List of sample villages, and number of respondents.							
					Respondents		
VNo.	Date	Village	District	Region	Female	Male	Total
1	20/9	Seikwa/adiyiakrom/Nassan	Berekum	Brong-Ahafo	9	4	13
2	20/9	Abi	Berekum	Brong-Ahafo	5	5	10
3	21/9	Asuhyiai nje wamfie	Berekum	Brong-Ahafo	3	7	10
4	21/9	Senase	Berekum	Brong-Ahafo	6	0	6
5	23/9	Hiawoanwu	Ejura	Ashanti	4	11	15
6	25/9	Bamiri	Techiman	Brong-Ahafo	3	6	9
7	25/9	Gusheigu	Gaa	Northern	0	10	10
8	26/9	Dromankese	Nkoranza	Brong-Ahafo	2	8	10
9	26/9	Gbungbalga	Yendi	Northern	0	10	10
10	26/9	Sambu	Yendi	Northern	0	11	11
11	27/9	Jema (town)	Kintampo	Brong-Ahafo	4	10	14
12	28/9	Masaaka	Salaga	Northern	1	11	12
13	27/9	Demon-naya	Nanumba (Bimbilla)	Northern	0	10	10
14	1/10	Laribanga	Damongo (W.Gonga)	Northern	0	12	12
15	1/10	Jentilpe	Bole	Northern	0	12	12
16	2/10	Mandari	Bole	Northern	1	10	11
17	3/10	Mangwe	Wa	Upper West	0	10	10
18	3/10	Boli	Wa	Upper West	0	10	10
19	4/10	Dafearli	Bole/Tuna	Northern	0	10	10
20	21/10	Konkrompe	Attebubu	Brong-Ahafo	1	8	9
				TOTAL	39	175	214
				Average	18%		10.7
				Maximum			15
				Minimum			6

A total of 20 villages was visited: one in the Ashanti Region; eight in the Brong-Ahafo Region; nine in the Northern Region; and two in the Upper-West Region. To place this in an agro-ecological context, nine of the villages were in the southern forest margin 'humid' zone, and eleven villages were in the northern 'savanna' zone.

The total number of respondents was 214; of whom 39 were women. The number of women interviewed is discussed in Section 3.

1.6 Field scoring of yam diseases.

During the PRA exercise, scientists from the UK and CSIR institutes visited two farmers' yam fields per village in order to directly assess the severity of foliar diseases. Plants were scored along a random walk for severity of anthracnose, other fungal lesions and viral symptoms. Disease severity was assessed on a seven point scale[1]. Ten plants per main cultivar per field were scored.

[1] Sweetmore, A., Simons, S.A. & Kenward, M. (1994). Comparison of disease progress curves for yam anthracnose (*Colletotrichum gloeosporioides*). *Plant Pathology* **43**: 206-215.

2 Background Information On Yam Production In Ghana

2.1 Yam producing areas in Ghana.

The focus regions visited in the survey were the Northern, Upper West and Brong-Ahafo. These three regions accounted for over 65% of the total yam production in Ghana[2], with the Northern and Brong-Ahafo Regions producing 40% and 23% of the national harvest during 1990, respectively.

2.2 Features of yam production in Ghana.

A summary of the yam cropping calendar (assimilated during the survey) is presented in Table 2.

Table 2. Cropping calendar for yam

Cropping calendar for yam, according to regions.				
	WHITE YAM		WATER YAM	
	South	North	South	North
land clearing		oct		oct
1st ploughing		oct		
2nd ploughing		oct		
mounding		nov		dec
seed harvest	dec	dec		
planting	jan	jan	feb	feb
mulching		feb		feb
planting intercrop		aug		
staking		apr		apr
1st weeding		may		apr
2nd weeding		july		jun
3rd weeding		july		jul
milking	aug		jul	
harvesting	oct	aug	oct	jan

3 SURVEY RESULTS

3.1 Size of yam farms.

In total 214 respondents were interviewed in 20 villages. The distribution of yam farms among respondents is presented in figure 3 below (note: a density of 1,600 mounds/ha was assumed):

Women in the sample had smaller farms than men. Table 3 shows that shows that the biggest proportion of respondents falls in the 1.5-3.0 ha group (2,400 mounds) for men (37%) and the under 0.5 ha range (<800 mounds) for women (42%). A striking feature is that women yam farmers almost exclusively were found in the southern regions (Ashanti and Brong-Ahafo). There, 39 % of the respondents were women. In the Northern and Upper-West Region, farmers quite categorically stated that yam farming is considered too demanding for women. An illustration of this may be the

[2] Source: Natural Resources Institute (1996). *Ghana renewable natural resources profile.* NRI publication, Chatham, UK.

fact that women themselves in the north declined to participate in the PRA sessions when directly invited to do so (two cases excepted). Women themselves explained that locally, women in general tend not to grow yams. They may do minor tasks though as carrying yams from the field to the storage at home.

In the southern regions, women help their husbands principally with lighter tasks in land clearing (application of fire to kill off weeds and tree butts); carrying the seed yams to the farm and putting them besides the mounds; some weeding; transport of harvested yams to the home-stead or the selling point; and marketing (Appendix 2). Single women would do all farming operations themselves or with help from their children, and contract hired labour especially for the heavier tasks as land preparation, mounding, and weeding. In Jema town (Kintampo District, Brong-Ahafo Region) distinction is made between so called 'indigenous' and 'settler' farming families. The distinction being that settlers tend to be Moslems from the north, whose wives only carry seed yams to mounds for planting, or remove them from the field at harvesting time. All other work is done by the men.

Table 3. Distribution of yam farm size amongst male and female farmers.

	Proportion of Respondants[1] (%)	
Yam production (hectare)	**women**	**men**
<0.5	42	6
0.5-1.5	38	26
1.5-3.0	13	37
3.0-4.0	4	13
4.0-7.5	4	16
7.5-10	0	2
>10	0	0
Total	100	100

[1] Total number of respondents = 189

Table 4 indicates the differences between size of yam farms held by men, between the southern regions (Ashanti and Brong-Ahafo), and the northern regions (Northern, and Upper West). In general, the yam farms in the south were evenly distributed amongst the size categories. Whereas, the majority (42%) of yam farms in the north tended to be in the median size category (1.5-3.0 ha).

	Proportion of farms (%)	
Yam production category (ha)	**Southern regions**	**Northern regions**
<0.5	13	2
0.5 – 1.0	27	28
1.1 – 3.0	20	42
3.1 – 4.0	12	17
4.0 – 7.5	21	11
>7.5	6	1

Table 4. Distribution of yam farms, according to size, in the southern (Brong-Ahafo and Ashanti) and northern (Northern and Upper West) regions

3.2 Species grown, and sources of seed.

Figure 1 shows the proportion of respondents growing the different yam species. In the regions visited, 96% of farmers grow water yam (*D. alata*) and 92% of farmers grow white yam (*D. rotundata*). Other yam species are grown but to a lesser extent: 25% grow aerial yam (*D. bulbifera*), 11% grow bitter yam (*D. dumetorum*), and 9% grow yellow yam (*D. cayenensis*).

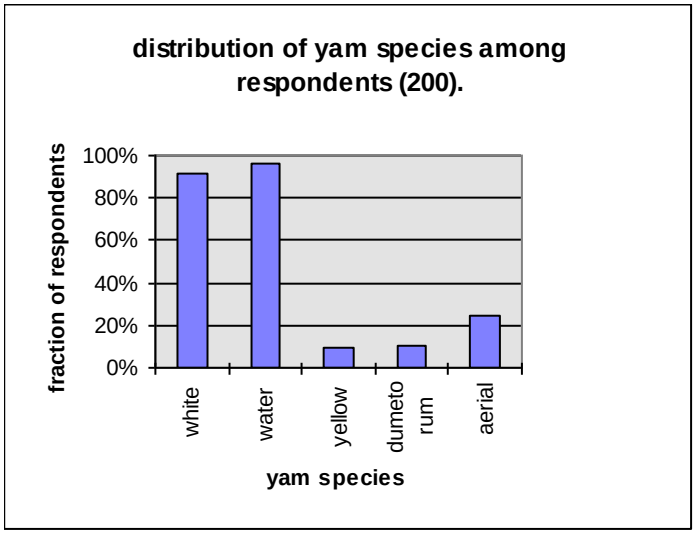
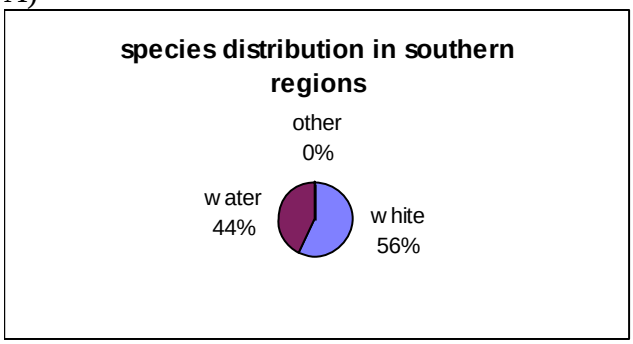


Figure 1. Distribution of yam species grown by yam farmers in the farms visited on the survey.

A different picture emerges, however, when we look at the regional differences in area of yam species grown (Fig 2). In the north, 73% of yams cultivated is *D. rotundata*, 23% is *D. alata*; and 4% is the other species. In the south, the proportion of *D. alata* cultivars grown is greater than in the north (44% compared to 23%). The proportion of 'other' species accounted for less than 1%.

A)



B)

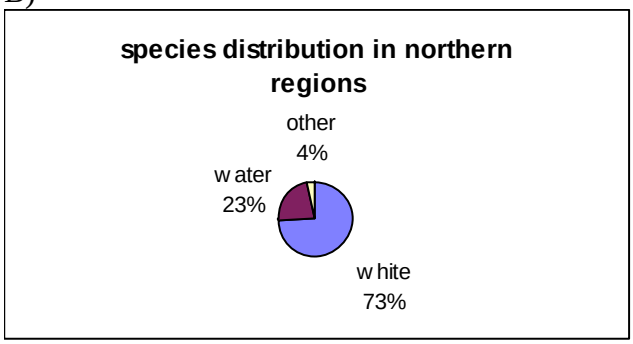


Figure 2. Distribution of yam species grown in A) the Northern and B) Brong-Ahafo Regions.

3.3 Farmers' perceptions of pests and diseases on yam.

Estimates of the importance of yam diseases, based upon the PRA matrix ranking exercises, by species is presented in Table 5. Foliar lesions (farmers confirmed, using photographs that they were referring to yam anthracnose) were considered to cause the greatest yield losses in both the *D. rotundata* and *D. alata* (70% and 75% losses respectively). Mealybugs were considered to be the next most destructive by those in both *D. rotundata* and *D. alata* (40% and 47% respectively). Table 6, compares the farmers' perceptions of pests and diseases between regions. Mealybugs were considered to be the cause of greatest annual losses in the central regions (40%). However, in the northern regions, anthracnose was considered to cause the greatest losses (73%). An attempt was made to rank the pests and diseases based on frequency and extent of losses (Table 7). Anthracnose (or leaf spots) and mealybugs were ranked the 1st and 2nd most important constraints respectively in both northern and central regions. However, when farmers in the northern regions (this exercise was not carried out in the central regions) were asked as a group to rank the pests and diseases in order of importance, a slightly different picture emerges. Mealybugs and termites were considered the most important constraints in the Northern Region and mealybugs and termites were considered the 1st and 2nd most important constraints in the Upper West Region. Anthracnose was placed 3rd and 4th most important constraint in the Northern and Upper West Regions respectively.

Table 5. Farmers' perceptions on the effects of yam pests and diseases on production of white and water yam

	White yam				Water yam			
	Frequency	**Degree of infection**	**Damage level**	**Expected annual loss**	**Frequency**	**Degree of infection**	**Damage level**	**Expected annual loss**
nematodes	90%	29%	65%	17%	87%	33%	50%	14%
termites/rot	89%	33%	72%	21%	78%	28%	80%	18%
virus	88%	38%	72%	24%	81%	35%	75%	21%
tuber beetle	57%	35%	63%	12%	67%	23%	100%	15%
anthracnose	100%	23%	68%	16%	88%	60%	50%	26%
die-back	83%	17%	83%	12%	93%	22%	77%	16%
foliar beetle	100%	75%	50%	38%				
mealybug	94%	43%	100%	40%	100%	47%	100%	47%
foliar lesions	88%	80%	100%	70%	100%	75%	100%	75%
wet rot	90%	27%	79%	19%	100%	30%	100%	30%

Table 6. Farmers' perceptions on the effects of yam pests and diseases on production of yam in the northern and central regions

	Central regions				Northern regions			
	Frequency	**Degree of infection**	**Damage level**	**Expected annual loss**	**Frequency**	**Degree of infection**	**Damage level**	**Expected annual loss**
nematodes	98%	31%	46%	14%	76%	31%	79%	19%
termites/rot	100%	28%	53%	15%	56%	33%	96%	18%
virus	100%	33%	65%	22%	71%	39%	81%	22%
tuber beetle	100%	45%			54%	18%	81%	8%
anthracnose	100%	37%	59%	22%	94%	78%	100%	73%
die-back	88%	20%	80%	14%				
foliar beetle					100%	75%	50%	38%
mealybug	100%	38%	100%	38%	94%	54%	100%	50%
wet rot					95%	28%	89%	24%

Table 7. Ranking, by region, assessed upon PRA matrix scoring exercises:

Central regions			Northern regions		
Pest/disease	PRA matrix score	Rank	Pest/disease	PRA matrix score	Rank
leaf spot (frog eye)[1]	47%	1	Anthracnose	73%	1
mealybug	38%	2	mealybug	50%	2
virus	22%	3	foliar beetle	38%	3
anthracnose	22%	4	wet rot	24%	4
termites/rot	15%	5	virus	22%	5
die-back	14%	6	nematodes	19%	6
nematodes	14%	6	termites/rot	18%	7
tuber beetle			tuber beetle	8%	8

[1] Anthracnose and 'frog eye' are two stages of the same disease (caused by *Colletotrichum gloeosporioides*). 'Frog eye' is the initial stage where lesions are discrete necrotic patches with yellow borders before lesions coalesce forming the typical anthracnose-type lesions.

Table 8. Overall ranking, by region, assessed upon farmers' overall ranking of diseases when asked "what is the most important pest/disease":

	Ranking order	
	Northern	Upper West
nematodes	4	7
termites/rot	=1	2
virus	7	6
tuber beetle	=5	5
anthracnose	3	4
foliar beetle		3
mealybug	=1	1
wet rot	=5	

3.4 Control methods

In general, no control methods were known or were available for controlling field diseases. Some farmers mentioned removal of seed tubers that are infested with nematodes. Also, staking was mentioned as a means to increase yields. Extension staff were seen as providing no information on crop protection for yams. Yams were considered the "neglected crop".

3.5 Disease assessments on field yams

Anthracnose was present on all yam plants assessed during late season (September). The mean severity ranged from 2% to 40% on 'Puna', the most popular and widely grown cultivar of *D. rotundata*; and between 5% and 40% on *D. alata* cultivars 'Matches' and Seidu bile'. In fields where the disease was prevalent, many individual plants had been severly affected (ie severity in excess of 50%). This level of infection would considerably reduce yield.

Mean anthracnose severity on yams (*Dioscorea* spp.) in farms visited during the participatory rural appraisal.

		Mean anthracnose severity (%)	
Location	**Region**	***D. rotundata* 'Puna'**	***D. alata*[1]**
Odusani	Brong-Ahafo	2.6	9.3
Abi	Brong-Ahafo	2.7	9.5
Adenim	Brong-Ahafo	1.6	24.6
Asuhyiae	Brong-Ahafo	Not grown	9.0
Hiawoanwu	Ashanti	22.9	5.7
Bamiri	Brong-Ahafo	23.5	14.8
Dromonkese	Brong-Ahafo	3.2	16.3
Jema	Brong-Ahafo	6.5	6.7
Komoayili	Northern	3.7	7.5
Gaa	Northern	40.3	8.3
Gbungbalgba	Northern	17.3	19.6
Sambu	Northern	2.3	17.6
Demon-nya	Northern	21.3	40.3
Masaka	Northern	2.8	38.1
Mandari	Northern	13.8	9
Mangwe	Upper West	22.2	Not grown
Dafierli	Northern	19.6	9.0
Boli	Upper West	6.5	5.5

[1] The cultivar was either 'Seidu bile', in the north, or 'Matches' in the central regions.

4 Conclusions and Recommendations

Farmers considered anthracnose and mealybugs to be the most important biotic constraints to yam production (in terms of reducing annual yields). However, when asked directly to rank pests and diseases in order of importance, farmers in the Northern Region ranked mealybugs and termites as the most important biotic constraints. Anthracnose was the next most important constraint.

In general, no control methods were known or were available. Extension staff were seen as providing no information on crop protection for yams.

Assessments of anthracnose levels on yam foliage found that the incidence of disease was 100% during the late season. Disease levels between locations varied considerably. However, moderate to severe levels of anthracnose (20% or over) were found on *D. rotundata* in 30% of farms and on *D. alata* in 26% of farms. These farms that had high and low levels of anthracnose on the yam crop were asked to supply subsequent seed tubers for the field trials to investigate the importance of seed-borne infection on yield.

The following recommendations are suggested from the study:
A follow-up survey is required that will focus on yam seed production. In particular, determine farmers' knowledge of disease transmission and methods for maintaining healthy (disease free) seed. In addition, the survey should investigate the importance of pests and diseases on yam production within the wider context of all the production constraints.

Appendix 1: PRA CHECKLIST

1. Arrival at location.
2. Explanation of the exercise to the farmers assembled.
3. Introduction of the team to the farmers.
4. Farmers' introduction to the team.
5. Orientation on the local cropping system and calendar.
6. PRA exercises as given in the following.

subject	***data collection method***
I VARIETIES GROWN	
1.1 Listing of yam species grown (white yam, water yam, yellow yam, etc.).	For each group participant, the yam species grown are listed on cards and laid out in front of the participant.
1.2 Identification of principal and secondary species grown.	Each respondent in the group ranks the yam species on his/her farm according to importance. (Document answers for women and men separately.). In addition, ask every respondent, upon identifying the principal and second yam species, how many, out of every 100 mounds of yam, is for the principal species, for the second, and others. Example: 70 mounds for white yam, 20 for water yam, 10 for an other species.
1.3 Listing of yam cultivars grown.	For each group participant, the yam cultivars grown are listed on cards and laid out in front of the respondent.
1.4 Identification of principal cultivars grown (as measured by area).	Each respondent puts his/her principal cultivar of white yam and water yam on top of the list (further ranking is not necessary). Ask farmers for a motivation of this preference for certain varieties.
1.5 Classification of yam varieties according to uses.	Group participants split all varieties listed into varieties grown principally for the market, or principally for home-consumption, or other purposes.
II SEED SELECTION.	
2.1 Annual sources for seed yams.	Ask respondents to indicate (with a marker, e.g. a stone) those varieties for which they will buy the seeds on the market every year.
2.2 How do farmers select their seed yams (from own farm)?	Group discussion.
2.3 How do farmers preserve their seeds? (Ask for treatment and storage methods)	Group discussion.
III INCIDENCE OF YAM DISEASES DURING PRODUCTION (by variety).	
3.1 Listing of yam plant diseases known by farmers.	Conduct a brainstorming session with group participants to identify known yam diseases, aided by Jeff's picture images.
3.2 Estimation of the probability of a disease	Respondents are divided into pairs (one pair

occurring (by variety).	for every disease identified). They are asked to indicate for their principal varieties, how often, out of every 3 years, that particular disease will affect these yam varieties. Thus, they give a score of 0, 1, 2, or 3 (use stones or grains for scores).
3.4 Estimation of the potential damage level per plant.	Using the same groups, ask respondents to give an estimate (in figures) of the average damage that disease does to a single yam plant (say, complete destruction=100%, reduced tuber growth=50% yield loss, or slight effect).
3.5 Estimation of the number of plants affected if the disease occurs.	Ask respondents to estimate the number of yam plants to be affected if that particular disease occurs; say, out of every 10 mounds, how many will be affected? (Distribute cards to write down the estimated figures)
3.6 Plenary discussion of 3.2-3.5	Group session.
3.7 Grouping of yam plant diseases into diseases with are becoming more prevalent, and less prevalent.	Group distributes diseases in 2 classes, using cards/Jeff's picture images.
3.8 Methods known and used to respondents to control diseases in yam plants.	Group discussion of control methods, and head-count of respondents using these methods.
3.9 What is the price penalty for diseased or nematode-damages tubers?	Group discussion; try to get estimates for price deductions.
IV ON-FARM STORAGE OF YAMS.	
4.1 Are there any special structures used for storing yams?	Group discussion, and a head count of methods used. Ask for their motivation to use the methods given.
V WOMEN AND MEN'S TASKS IN YAM CULTIVATION.	
5.1 Identification of men's and women's tasks in seed selection, crop husbandry, harvesting, and on-farm storage.	All different activities are detailed on cards (in words, or pictogrammes). It is then specified what tasks are performed predominantly by men, women, or either of them indifferently (using symbol cards); distinction is made between a man's field, on a woman's field.

Appendix 2: MEN'S AND WOMEN'S TASKS IN YAM PRODUCTION.

Below, a list is given of the number of times a group of respondents indicated whether men or women were involved in a specific tasks in yam production.

Task	Women	Men
Seed selection	1	7
Land clearing	0	6
Burning weeds and tree stumps	5	0
Mounds preparation	0	6
Transporting seed yams to farm	7	5
Seed planting	0	6
Planting intercrops	1	0
Weeding	2	6
Harvesting	1	5
Transporting seed yams to farm	0	3
Transporting yams to selling point	3	2
Marketing yams	2	2

Appendix 3. Summary of consultations with farmer groups

Survey team:

Fusaini Andan
Cecil Osei
Frances Kodjo Tsigbey
Wim Ellenbroek
Jeff Peters

District: Berekum
Village: **Abi**
20 September 1996

Programme Implemented: Sampled 3 fields around Abi Road (s 14:30 - 15:30)
PRA in Abi village (16:00 - 18:00)
Yam Cropping System: Dominant crop yam (cocoyam - bean intercrops)
(cassava - cocoyam intercrop)
(relay planting of cassava; after White & water yam matured)

Cropping calendar

White yam harvest July/Aug
plant Feb/Mar/April
Water yam Feb/Mar
Staking; no fertiliser

RESULTS

Relative production of yam species

Respondent	rotundata	alata	cayenensis	dumetorum (bayereKokoo)	sex
1		1(60)	2(30)	3(10)	
2	2(30)	1(70)			
3	2	1			
4	2	1			
5		1	2		
6	2	1	3		
7		1	2		
8	3	1	2		
9		1			
10		1	2		

Cultivars grown

Respondent	rotundata	alata	cayenensis	dumetorum (bayereKokoo)	sex
1		Gwaa (Dahotine)	Afuu	Nkamfo	f
2	Teela	matches			f
3	Asobyre	Gwaa			m
4	(Ejura Bayere	Gwaa			f
5		Gwaa	Afuu		f
6	Dooben	Gwaa	Afuu		m
7		Gwaa	Afuu		f
8		Gwaa	Afuu		m
9		Gwaa			m
10	Asobyre	Gwaa	Afuu		m

Reasons for Choice
Main choice appears to be dependant on availability of planting material.
Gwaa: Good cooking/ makes good fufu
High yielding

Good storage

Matches: Multiplies rapidly
Palatable (good ampasi, boiled yam slices)
High yielding

Osobyre: Milks well
very tasty

Generally grew water yam because high yield availability of planting material.

Yellow yam: Stores v well (more than 1 year)

Dumetorum: High yielding
After cooking will keep for several days; boil in skin (like new potatoes)

Uses:
All vars sold to market but the higher proportion of tubers is kept for home use (feed family first then sell to market)

Source of seed:
White yam - seed buy majority of from market
Water yam - seed recovered from own farms
(white yam does not store; seed is expensive therefore tend to grow white yam)

Seed selection:
Tend to select the small tubers for seed
(larger tubers are cut into smaller portions)

Seed treatment:
Cut and sun dry (plant same day)
can store for around three months before planting (5 tie seed on bamboo frame; 2 store on platform covered with straw; 1 (old lady) kept in house - but tubers prone to spoilage).

DISEASES

Occurrence[1]

yam type	bieback	virus	anthracnose	nematode	rots
Gwaa	3/3	3/3	3/3	3/3	3/3
Yellow	0/1	3/3	3/3	0/3 (termites 3/3)	3/3
Asobyre	3/3	3/3	3/3	0/3	3/3

Incidence[2]

Gwaa	20-30%	70-100%	30-100% (lower leaves and older plants)	40%

Damage levels[3]

Gwaa	100%	50% (deforms tubers)	70 – 100% (deformed)	80% (cannot sell)
Yellow	-	50% (-do-)	70 – 100%	-
Asobyre	100%	50% (-do-)	70 – 100%	-

[1] The amount of times in the previous 3 years that problem occurred.
[2] If problem exists, what proportion of crop is affected
[3] The severity of yield loss

All above disease were increasing in importance; as are termites

Control:

No knowledge of control practices; try to select healthy seed.

Comments:
Villagers would like to grow Apoka (?D. alata) because of lack of capital to buy seed
Generally would like to grow more white yam because more export potential (better marketability).
Would be prepared to pay premium for guaranteed healthy seed if they had the money.
Also, saw an extremely well maintained (weeded, spaced) and fungal disease levels were low; however, virus levels were high.

Village: **Asuhyiai nje wamfie**
Date: 21-9-96
Team: Jeff Peters/Alex Apau/O-A Danquah

Cultivation practices: no data
all will milk first, then produce seeds

respondents	mounds	white	water	yellow
1 (female)	500	80% DENTE	20% dahotane	
2 (female)	600	40% dente	60% dahotane	
3				
4	1250	20% tela, kampa	80% matches, guaa	
5	400	40% dente	60% guaa, afasetoa, dahotane	
6	100		100% matches, guaa	
7	200		100% afasetoa	
8	210	10% ajura bayere	90% matches, guaa	
9	250		80% matches	20% nkanfu
10 (female)	48	4% kampa	96% guaa, adiammawoba	
11	2500	40% tela, dobre	60% doboo, matches	

principally sell, after satisfying household needs 7/10

reasons for choice:
tela yields well and is tasty
dobre/doboo good for fufu
afese adiammawaba expands when cooked
kampa yellow looks like plantain when cooked
dahotane good poundability, good yield
anakasa high yield, good poundability (milly)
dente good for fufu
matches good yield and tasty
guaa is soft like potatoes
dahotene is high yielding and 1 plant feeds the family.
Afase toa high yielding and gourd shaped
metela good for fufu

Source of seed: own
selection: large goes to market, small and whole tubers are used for seed for white yam. Water yam can be cut.

Diseases:

	die-back	anthracnose	virus	nematodes	rot
occurrence: water yam	water yam: 2/3	0/3, 1/1, 2/2	3/3	3/3	3/3
occurrence: White yam	0/3	3/3	3/3	3/3	3/3
incidence	40%	50%	30%	50%	30%
damage water yam	30%	50%	50%	50%	60%
damage white yam	30%	70%	70%	30%	60%

Control: no methods used, but the respondent with the bigest number of mounds uses fertilzer to control anthracnose, and rotten tubers are discarded.

Storage: seed yams are cured on poles.

Village Senase (Berekum District)
Date: 21 September 1996

No respondents: 6
Team members: Joseph Lamtey
Augustus Missah
JK Twumasi
Wim Ellenbroek
Programme Followed: 12:00 scored & collected field samples
13:00 PRA - 14:40
Cropping System: Mixed farming; shifting cultivation every year; Planting date April/May water & white yams; harvesting Dec/Jan; one harvest (no milking)

Results
Species Grown: White yam
Water yam
Yellow yam
Nkamfo (Dumetorum)
Chinese yam

scores out of 10 (or 20)

Respondent	rotundata	alata	cayenensis	dumetorum (bayereKokoo)	Chinese yam	sex
1 (3 farms; 810 mounds)	3 (Asobyre)	8 (Guaa)	4(dkoko)	3 (Nkamfo)	2 (Broni Asobyre)	f
2 (250 mounds)	3 (Asobyre)	5 (Afaseenanka)	2 (Afun)			f
3 (40 mounds)		10(Apoka)				f
4 (30 mounds)		10 (Apoka)				f
5 (200+)		10(Apoka)				f
6 (2 arms, 1750 mounds)		10(Apoka)				fm

Reasons for choice:
Apoka - Good for ampasi; fills you up; good poundability; soil well suited for that cultivar.
Asobyre: good taste; early yielding.
Nkamfu: good taste; early yielding; old yam therefore wish to preserve it.
Chinese yam tasty.
Afasynanka - high yielding; tubers large therefore feed all family; good for fufu & ampasi.
Yellow yam (dikokoo) - good for fufu; early maturing; heavy therefore fills you up.

Reasons for growing water yam - good for forest margin regions & can cope with surrounding vegetation; because of regulation in restriction to slash/burn farming (which favours white yam) need to grow water yam.

Uses:
Home consumption, then cash

Source of seed:
Own stock; select seed after harvest

Seed treatment:
cure on sticks; select smaller tubers; no chemical treatment of seeds; cut then dry in sun.

DISEASES

	Virus	Dieback	nematode	scale insect	anthracnose	rot
Occurrence	3/3 (25% I) (50% damage)	3/3 (10% I) (100% damage)	3/3 (20% I) (low tuber quality)	3/3(20% I)	3/3 (50% I) (50% damage)	3/3 (25% I)
Incidence	25%	10%	20%	20%	50%	25%
Damage	50%	100%	Low tuber quality		50%	

Disease Control:
None

Gender Issue:
Both plant & stamp; hired labour prepare mounds and slash; weed 2-3 times with hired labour. Both select seed.

Village: Asuhyiai nje wamfie
Date: 21-9-96
Team: Jeff Peters/Alex Apau/O-ADanquah

Cultivation practices: no data
All farmers produce seed through 'milking' (ie early harvesting, collect setts on second harvest).

Respondent	mounds	white	water	yellow
1 female	500	80% DENTE	20% dahotane	
2 female	600	40% dente	60% dahotane	
3	1250	20% tela, kampa	80% matches, guaa	
4	400	40% dente	60% guaa, afasetoa, dahotane	
5	100		100% matches, guaa	
6	200		100% afasetoa	
7	210	10% ajura bayere	90% matches, guaa	
8	250		80% matches	20% nkanfu
9 female	48	4% kampa	96% guaa, adiammawoba	
10	2500	40% tela, dobre	60% doboo, matches	

principally sell, after satisfying household needs 7/10

reasons for choice of cultivar:
tela yields well and is tasty
dobre/doboo good for fufu
afese adiammawaba expands when cooked
kampa yellow looks like plantain when cooked
dahotane good poundability, good yield
anakasa high yield, good poundability (milly)
dente good for fufu
matches good yield and tasty
guaa is soft like potatoes
dahotene is high yielding and 1 plant feeds the family.
Afase toa high yielding and gourd shaped
metela good for fufu

Source of seed: own
Seed selection criteria: large goes to market, small and whole tubers are used for seed for white yam. Water yam can be cut.

Diseases:

	die-back	Anthracnose	virus	nematodes	rot
Occurrence: water yam	water yam: 2/3	0/3, 1/1, 2/2	3/3	3/3	3/3
Occurrence: White yam	0/3	3/3	3/3	3/3	3/3
spatial incidence	40%	50%	30%	50%	30%
damage water yam	30%	50%	50%	50%	60%
damage white yam	30%	70%	70%	30%	60%

Control: no methods used, but the respondent with the bigest number of mounds uses fertiliser to control anthracnose, and rotten tubers are discarded.

Storage: seed yams are cured on poles.

District: Salaga
Village Name: **Masaaka**
No Households: 71

Date: 28/9/96

Respondent	mounds	white	water	other	consum/sell
1	4000	Labreko	400 (Akaba [Nawapieli])	100 (bulbif)	40/60
2	2000	Chenchito	100 (Kany [Nawapieli])	-	33/66
3	6000	Labreko	600 (Akaba)	-	80/20
4	8000	Moniyuli	600 (Akaba [Nawapieli])	-	80/20
5	2000	Chenchito	200 (Nawapieli)	-	80/20
6	6000	Yoruba	100 (Akaba)	2000	60/40
7	3000	Labreko	200 (Akaba)	-	80/20
8	7000	Labreko	400 (Akaba)	-	80/20
9	4000	Labreko	-	-	70/30
10	4000	Labreko	300 (Nawapieli)	10	70/30
11	4000	Labreko	100 (Akaba)	100	80/20
12 (f)	200	Moniyuli	100 (Seidu bile [Nawapieli])	-	100/0

Other vars: White: Labreko/Puna; Moniyuli; Limo; Yoruba; Lilia; Chenchito; Baafugu
Water: white - Seidu bile; Akaba
red - Chichibori

DISEASES

	nematode	termite/rot	virus	tuber beetle	foliar lesions	wet rot
occurrence	3/3	2/3	1/3	3/3 (millipede)	2/3	1/3
white	esp. moniyuli	Common	labreko esp.	labreko and other early maturers)		common
water incidence	3/10	1/10	(10/10 in drought; recovers in rains)	5/10	common < 10/10 (attributed to striga)	2%
damage	<100%	50 – 100%	tuber size reduced	little econ damage	reduces tuber size	c 50%

Ranking (1 ranked highest):

Anthracnose	3
Nematode	2
Wet rot	5
Termite	1
yam beetle	4
Virus	6

District:
Village Name: **Gaa**
No Households: Gusheigu

Date: 25/9/96

Respondent	mounds	white (Main var)	water (main var)	other	consum/sell	other
1	2,000	1900 (labreko)	100 (Nawapieli)			
2	1,000	750 (puna)	250			
3	6,000	5500 (puna)	500			
4	7,000	7,000 (labreko)	-			
5	5,000	4,500 (puna)	500			
6	4,000	3,650 (puna)	350			
7	3,000	2,850 (labreko)	150			
8	1,500	1250 (labreko)	150			
9	2,000	1,000 (puna)	1,000 (Nawaji)			
10	2,700	2,700 (puna)	3 (Nawapieli)			

Other vars: White: Labreko/Puna; Moniyuli; Fugla; Bayri; Lilia; Chenchito; Kal
Water: white - Nawapieli
red - Nawaji

Reasons for growing: White yam - Matures early; high price at market; milking produces many seed.
Water yam - Long storage properties

SEED SELECTION

Seed produced from own stock or buy from friend.

SEED Health: Generally satisfied with seed health

DISEASES

	nematode	termite/rot	virus	tuber beetle	foliar lesions	wet rot
occurrence						
white	2/3	1/3	2/3	1/3	3/3	
water	(less common)	0/3	(less common)	0/3	3/3	
incidence						
white	2/10	2/10	17%		10/10	
water		1/10			10/10	
damage						
	tuber useless	Whole tuber may be destroyed	tuber may not develop (setts not used)		yield reduced	

Ranking:

Anthracnose	2
Nematode	4
Termite	3
Virus	1

District: Yendi
Village Name: **Gbungbalga**
No Households: 147

Date: 26/9/96

Background Information: Cropping Calendar

Land Clearing:		Sept/Oct
Mounding:		Nov - Jan
Harvest Seed from previous years crop:		Dec/Jan (main harvest for Water yams)
Prepare seed/ plant:		Dec/Jan (Water yam soon after)
Mulching:	After planting;	Jan - March
Staking:		Mar/Apr
1 weed:		April
2 wed		May/June
3 weed		July
Main Harvest:		July/August

Intercrops
Millet, Sorghum, Pidgeon pea (borders), Okra (borders), Cassava, veg (woman)

Respondent	Mounds	white	water	other
1	4,000	Labreko/Puna	Nawapieli (250)	
2	1,500		150	bulbifera (6)
3	1,550		-	
4	800		-	20
5	4,500		350	
6	2,000		100	50
7	3,000		150	
8	2,200			20
9	2,500		300	
10	5,000		500	

Other vars: White: Labreko, Puna, Chenchito, Bayeri, Lilia, Limo, Momiyoli, Zong
Water: Nawapieli, Nawaji, Taapagri, Djangema (monkey dislikes me)

Reasons for growing: Labreko - early maturing ("bridges hunger gap"), tasty, good texture
Water yam (reasons why not main yam crop) - Late harvest, harvested only once, varieties not used for fufu. Recent introduction (low seed material).
Reasons why grown - stores well, "bridges hunger gap".

SEED SELECTION

Seed from on source or from friends. (If expanding or low yields due to diseases and striga.) Minisett Labreko then store by burying.
After harvest store 3-4 weks under shade, tubers shrink then deroot then cut to size (white), seed selection for water yam: harvest, store, cut (do not need to store therefore get minisett from large tubers). If cortex removed this reduces the final yield of yam.

SEED Health

Satisfied with yam seed but interested to hear of other varieties: ie momiyuli
Why insufficient seed material:
1. Overestimate own harvest
2. animals destroy crop
3. diseases

DISEASES

	Nematode	termite/rot	virus	tuber beetle	foliar lesions	wet rot
occurrence						
white	3/3 (mainly)	3/3 (more on white)	3/3	1/3	3/3	3/3
water			3/3		3/3	
incidence						
white	1/10 (2/10 after harvest)	15%	2/10	2/10 (more on white)	up to 10/10	1/10
water		<15%	2/10			
damage						
	50 – 100%	50 – 100%	tuber v small (more severe on white yam (also severe during drought)	damage not v severe	tuber v small (attributed to striga)	100% (more of a problem on labreko) In storage rot will spread

Ranking:

Anthracnose	1 (botchaa - acid attributed to striga)
Nematode	2
Wet rot	3
Termite	4
yam beetle	5
Virus	6

This ranking was the same as when farmers used mechanisation.

District: Yendi
Village Name: **Sambu**
No Households: 160

Date: 26/9/96

No Participants: 11 (only one woman in village farms yams - 300 mounds; unpopular because highly labour intensive) ; women normally help transport yam from old field to store (hand carry)

Respondent	mounds	white	water	other
1	700		-	
2	3,000		100	
3	4,500		200	aerial 40
4	2,000		300	
5	1,500		200	
6	1,000		300	10
7	3,500		300	
8	2,500		400	
9	1,000		200	8
10	6,000		500	
11	5,000		300	20

5 grow Limo
3 grow Moniyoli
3 grow Labreko/ Puna (? Lost seed material in conflict)

Other cultivars: White: Labreko, Lilia, Moniyula, Limo, Ziglangbo, Chenchito, Afibetua (large tubers highly profitable), kpiriugo, Zong, Bayiri, Fusein.
Water: Nawapieli, Nawazie, Chichibodie

Reasons for growing: Labreko - Early maturing, high premium at market (popular); tasty
Limo - Big tubers; high yield; get many setts; high income; feed whole family
Moniyola - Big; many setts
Water yam (reasons wy not main yam crop) - lost a lot of seed in conflict; not good for fufu

SEED SELECTION

From second harvest

SEED Health

seed stored in temporary structures
Ministry of Agriculture introduced minisett technology to farmers; good for seed production; start the multiplication of new material. Normally cut tuber into two.

DISEASES

	Nematode	termite/rot	virus	tuber beetle	foliar lesions	wet rot
occurrence						
white	2/2	1-2/3	1/3	1/3	1/2	1/2
water	½	0/3	0-1/3	0/3	1-2/2	1/2
incidence						
white	2%	5%	4%	1%	50%	2%
water	2%				100%	
damage	<100%	50-100%	Tuber small	Little damage	Tuber small	100%

?? virus seed-borne.

Ranking:

Anthracnose	2
Nematode	3
Wet rot	4
Termite	1
yam beetle	6
Virus	5

District: Nanumba (Bimbilla)
Village Name: **Demon-naya**
No Households: 72

Date: 29/9/96

Background Information: Cropping Calendar

Land Clearing:			Sept - Oct
1st Plough	Sept	2nd plough	Oct
Mounding:			Oct/Nov
Harvest Seed from previous years crop:			Dec
Prepare seed/ plant:			Feb/Mar
Mulching:			
Staking:			May/June
1 weed:			Apr/May
2 wed			June/July
3 weed			July/Aug
Main Harvest:			Aug/Sept
Intercrops:			July/Aug

Millet, Okra, Cassava, Guinea Corn (Sorghum)

Respondent	mounds	White	water	Other	consume/sell
1	3000	Puna	300 (Nawapieli)		70/30
2	5000	Puna	500 (Nawapieli)		70/30
3	7000	Moninuyla	700 (Nawapieli)	50	50/50
4	3500	Moninuyli	300 (Nawipieli)		20/80
5	1500	Kpulunjo	150 (Nawapieli)		40/60
6	2500	Moninuya	50 (Nawazie)		40/60
7	2000	Chenchito	200 (Nawazie)	21	10/90
8	6000	Puna	1000 (Nawapieli)	2	65/35
9	3000	Labreko	400 (Nawapieli)	5	50/50
10	4700	Puna	500 (Nawazie)	60	30/70

Other cvs: White: Olondo; Puna; Chenchito; Moninuyla; Limo; Lilia; Kpurinjo; Baafugu; Kulkulsi; Abujaasu; Fuseini

Water: White - Akaba; Seiduble; Konborogbam; Gbankagma
Red - Chichibori; Taawili; Dgangema; Karimandi

Reasons for growing: Labreko - Early maturing; Tastes good; high premium; produces big tuber therefore more planting material.
Moninuyli: Large tubers; more setts from tuber; sells for high premium.
Chenchito: Stores longer; lrge tubers; tastes good.
Water yam (reasons why not main yam crop) -
Reasons why grown -

DISEASES

	Nematode	termite/rot	Virus	tuber beetle	foliar lesions	wet rot
occurrence white	3/3	3/3		0/3 usually affects labreko on virgin land	2/3 Common on labreko	3/3 common on white
water			Attacks more			
incidence			<1/10		>50% (associated with striga)	> 50% in wet areas; <50% in dry
damage			not noticeable	If attacks lower or head end, tubers fail to develop	wilts vines; tubers small	100% (but can still eat)

comments: transmission of disease from seed to growing plant recognised by some farmers. Scale insects (? Mealy bug also a problem)

Ranking:

Termites	1
Anthracnose	3
Nematode	2
Wet rot	5
yam beetle	4
Virus	6

During storage, rodents major problem (prob #1); however, during growing season, not a problem.

CONTROL

Nematode infested setts discarded.

District: Damongo (W Gonga)
Village Name: **Laribanga**
No Households: 100+

Date: 1/10/96

Ethnic Group: Kamarasi

Background Information: Cropping Calendar

Land Clearing:	Sept/Oct
Mounding:	Oct/Nov
Harvest Seed from previous years crop:	Dec
Prepare seed/ plant:	Dec/Jan
Mulching:	Jan/Feb
Staking:	Feb/Mar
1 weed:	Apr/May
2 wed	-
3 weed	-
Main Harvest:	July/Aug
Intercrops:	Sorghum; millet; okra

Respondent	Mounds	White		water		Other	Consume/sell
1 Mr Seidu(V)	16,000	14,000	Kluklusi	2,000	Seidu Bile	20 aerial	60/40
2	4,000	2,000	Labreko	2,000	-do-	25	50/50
3		4,600	Sanyanta (Chenchito)	308	-do-	30	60/40
4		2,000	Chenchito	1,000	-do-	-	50/50
5		5,000	Chenchito	2,500	-do-	-	75/25
6		5,250	Puna	2625	-do-	3,000 (1/tree)	
7		2,640	Puna	2,640	-do-	700	
8	7,000	4,000	Puna	3,000	-do-	-	80/20
9		4,000	Puna	1,000	-do-	25	50/50
10		4,200	Puna	1,400	-do-	300	70/30
11		1,400	Puna	2,000	-do-	-	80/20
12		1.320	Santa	1,320	-do-	1,000	70/30

V=farm visited

Other cvs: White: Kluklusi; Puna; Labreko; Chenchito; Lilia; Logpere; dungone; Tayla; Serwah; Bimso; Kangba; Sawgla
Water: Akaba; Seidu Bile; Agba

Reasons for growing: Labreko -
Chenchito - Good storage
Good sprouting
Kluklusi - Big tubers
Water yam (reasons wy not main yam crop) -
Reasons why grown - Many & large tubers (good for seed material); good storage
Aerial yam - Stores even better than water yam

DISEASES

	nematode	termite/rot	virus	tuber beetle	foliar lesions	wet rot
occurrence	3/3	3/3	3/3	1/3	2/3	2/2
white		mainly Labreko, puna				Lilia
water			more common	mainly	mainly	mainly
incidence	<50%	3%	50%	<1%	50%	5%
damage	50% (cannot use as seed but can eat non-infected parts)	<100% (can use undamaged)	severe during drought	can plant uninfected part	tuber size reduced	50% (if lower part infected can plant upper)

Ranking:

Anthracnose	2
Nematode	3
Wet rot	5
Termite	1 (listed as the most serious agronomic issue - apart from credit)
yam beetle	4
Virus	6

District: Bole
Village Name: **Jentilpe**
No Households: ~100

Date: 1/10/96

Respondent	mounds	white		water		yellow (cayenensis	Aerial	Consume/sell
1		4,000	Teila	1,000	Seidu Bile	100	<100	66/33
2		2,000	Puna	2,000	-do-	200	100	50/50
3		3,000	Puna	1,000	-do-	100	50	66/33
4		400	Teila	600	-do-	5	-	
5		4,000	Teila	500	-do-	-	-	
6		2,000	Teila	2,000	-do-	-	200	
7		2,000	Teila	1,000	-do-	60	100	
8		2,000	Teila	1,000	-do-	-	-	
9		2,000	Teila	1,500	-do-	100	20	
10		1,000	Teila	1,000	-do-	-	-	
11		2,000	Puna	1,000	-do-	100	-	
12 Mr Dramani Bakawa (v) V=farm visited		2,000	Teila	1,000	-do-	-	20	

DISEASES

	nematode	termite/rot	virus	tuber beetle	foliar lesions	wet rot
occurrence						
white	1/3	3/3 (esp. Puna	3/3	2/3	3/3	1/3
water	1/3		3/3		3/3	1/3
incidence						
White/water	2/10	9/10	2/10	3/10	10/10	6/10
damage						
White/water		100%	Yield reduced		Yield reduced	Cannot eat

Ranking:

Anthracnose	1
"Nematodes" (but responding to wet rot photograph)	2
Nematodes	4
Termite	3
yam beetle	6
Virus	5

District: Bole
Village Name: **Mandari**
No Households: 300
Ethnic group: Safalba

Date: 2/10/96

	No. mounds (1,600/ha)						
Respondent	White		water		Other	Consume/sell	other
1	-	-	300	Seidu Bile	-		-
2 (v)	10,000	Teila	10,000		200 yellow	40/60	200 yellow
3	150	Labreko	11,000		20	90/10	20
4	1,000	Labreko	2,000		20		20
5	1,000	Krukrupa	6,000				
6	600	Teila	2,000			100/0	
7	2,000	Loekpere	2,000				
8	-	-	1,000				
9 (f)	-	-	200			100/0	
10	100	Bayere	4,000				
11	-	-	1,600				

V=farm visited

Other cvs: White: None
Water: None

Reasons for growing: Labreko -

White yam (reasons why not main yam crop) - not drought resistant; if harvested late get large tuber which cannot be used as seed.

Water yam: Reasons why grown - High yield; bridges the hunger gap; ability to sell; drought tolerant; produces two tubers therefore can have sufficient seed material.

NB - Seidu Bile makes good fufu (possibly tolerant to anthracnose). Before Seidu Bile introduced by Seidu Bile himself, more white yam than water yam was produced in this region.

SEED SELECTION

From already milked yam; from other farmers.

SEED Health

Insufficient seed material may be caused by mealy bug/scale insect; yam disease; termites and yam beetle.

DISEASES

	Nematode	Termite/rot	virus	tuber beetle	foliar lesions	scale/mealy bug	wet rot
	3/3	3/3	3/3	3/3	3/3	3/3	3/3
Occurrence							
White Water	Both	Both	both	both	Both	both	both
	2/10	4/10	1/10	5/10	10/10	3/10	2/10
Incidence							
White Water							
	>50%	<100% tuber not palatable but can be used as seed	Negligible, smaller tubers.	variable	100% smaller tubers if attach occurs early in season	100% attacked before & after harvest; contact spread; no sprouting	<50%
Damage							

Ranking:

mealy bug/scale	1
Anthracnose	2
Nematode	5
Wet rot	6
Termite	3
yam beetle	4
Virus	7

District: Wa
Village Name: **Boli**
No Households:

Date: 3/10/96

Intercrops Millet; Okra; cassava; banbara nuts

Respondent	mounds	white	mounds	water	Aerial	Kangba	other
1	1000	Labreko	100	Sieru Bile	50	60	-
2	8,000	do	1000	do	800	500	200 yellow
3	1,500	Senjanguo	500	do	60	40	20
4	8,000	do	1,500	Wobyni	1,500	-	20
5	9,500	labreko	1,000	Akaba	100	500	
6	8,000	Belangba/ Sanjenguo	100	Sieru Bile	200	1,000	
7	2,000	Labreko	1,000	do	60	40	
8	7,000	Viera	1,000	Gariebanga	100	60	
9	1,000	Labreko	-	-	-	-	
10	1,000	do	250	Sieru Bile	1,000	100	

Other vars: White: Gutugu; Mankiri; Labreko; Kpahajo; Vieri; Sanjanguo; Tiela; Mowao; Gogombi; Bienso; Wasara; Sokiobo; Bilangba
Water: Siedu Bile; Foromungia; Manju; Wobyini; Akaba; Gariebanga

consume 80-90% of produce.
Reasons for growing: White - Used for fufu; high premium; good for gifts/funerals; early maturing
Bilanga & Viera - Stores well; get multiple setts
Water yam (reasons wy not main yam crop) -
Reasons why grown -

DISEASES

Drought induced wilting; leaf defoliating insect at early stages; mealy bug

	nematode	termite/rot	virus	tuber beetle	foliar lesions	leaf beetle	Mealy bug
occurrence white water	2/3 mainly	2/3 both	1/3 both	2/3 mainly	3/3 mainly	3/3 mainly also	3/3
incidence white water	4/10	6/10	5/10	5/10	9/10	5/10	5/10
damage	<100%	100%	no tubers	<50%	small tubers	100% total destruction of young shoots with small tubers	100%. Can be consumed but seed do not germinate

Ranking:

Anthracnose	4
Nematode	7
Termite	2
yam beetle	5
Virus	6
Mealy bug	1
leaf beetle	3

District: Wa
Village Name: **Mangwe**
No Households: ~50

Date: 3/10/96

No Participants: 10

Background Information: Cropping Calendar

Land Clearing:	Sep/Oct
Mounding:	Nov
Harvest Seed from previous years crop:	Dec
Prepare seed/ plant:	Jan/Feb
Mulching:	Mar
Staking:	May
1 weed:	May
2 weed	Aug
3 weed	-
Main Harvest:	July - Sept
Intercrops	Millet (early or dense planting reduces yam yield); Okra; Banbara Nut; Callabash; Sweet Potato on empty mounds; Cassava as border crop

	D. rotundata		D. alata			
Respondent	No mounds	Principal variety	No Mounds	Principal variety	Aerial	Kangba
1	2,000	Labreko	500	Seidu Bile	500	-
2	6,000	Sanjeguo	1,000	do	-	200
3	2,000	do	500	do	500	200
4	500	Labreko	50	do	-	20
5	2,000	do	50	do	150	20
6	1,500	Sanjeguo	150	do	-	
7	3,000	labreko	500	do	40	
8	2,500	Biensu	300	do	100	30
9	3,000	Labreko	300	do	200	
10	1,000	do	50	do	Black Aerial 10	

Reasons for growing: Biensu - More resistant to diseases
Senjanguo - stores better than labreko
Labreko - High quality; early maturing; high premium

White yam grown more because original variety; early maturing

SEED PRODUCTION

Farmers produce own seed but might have to buy in new seed from farmers if expanding farm size or wish to plant new variety or due to disease/pest destruction of previous harvest.

SEED Health

Storage in temporary sheds made from stakes covered with yam vines.
problems: termites; mealy bugs; rotting (attributed to prolonged drought); foliar yam beetle

DISEASES

Farmers' perceptions of pest and disease prevalence and damage

	Yearly occurrence	Incidence (%)	Tuber damage	Species affected	Comments	Ranking
Anthracnose	1/3 - 2/3	80	Small tuber	Water	Associated with soil	4
Foliar beetle	3/3	100	none	White	rains wash away larvae	8
Mealy bug	1/3 - 2/3	100	<100%	White	Farmer lost all of 1993 harvest	2
Nematode	1/3	40	<100%	Mainly white	Not able to consume	3
Tuber beetle	0/3 - 3/3	70	<100%	Mainly white		7
Termite	1/3 - 2/3	80	<100%			1
Virus	2/3	30	reduced tuber development			6
Wet rot	3/3	70	<100%	associated with dry weather		5

District: Bole (Operational area: Tuna)
Village Name: **Dafearli**
No Households:

Date: 4/10/96

No Participants: 10

Main crops grown considered to be: Cereals (sorghum) and Legumes

Respondent	white		water		Aerial	Kangba
1	4,000	Tiela	500	Seidu Bile	-	-
2	3,500	Tiela/labre ko	1,000	Akaba	-	-
3	3,000	Tiela	600	Seidu Bile	-	50
4	3,000	Tiela	1,000	Afasie	-	-
5	1,000	Tiela	500	Seidu Bile	-	-
6	2,000	Tiela/labre ko	-	-	-	-
7	5,000	Tiela/labre ko	700	Seidu Bile	-	-
8	2,500	Tiela/Labre ko	400	Deidu Bile/ Afasie	100	-
9	2,000	Tiela	200	Seidu Bile	-	-
10	3,500	Tiela/Botu	300	Seidu Bile	-	-

DISEASES

	nematode	termite/rot	virus	tuber beetle	foliar lesions	Mealybug	wet rot
occurrence	3/3	3/3	3/3	3/3	3/3	2/2	3/3
white	all	mainly	both	both (but not Kangba)	both	both	both
water							
incidence	3/10	2/10 - 7/10	50%	1%	50%	5/10	3/10
white							
water							
damage	cannot use as seed; may consume some part of tuber if <100%	whole tuber goes bad	tuber does not form	seed yam dies; usable portion of ware yam flesh reduced	seed does not germinate	<100% but if not severe can still consume	cannot consume or use as seed if severe

Ranking (1 ranked highest):

Anthracnose	5
Nematode	2
Wet rot	4
Termite	1
yam beetle	7
Virus	6
Mealybug	3