Uganda Journal of Agricultural Sciences, 2003, 8 : 367 - 376 ISSN 1026-0919
Printed in Uganda

A study on the management and quality of farmers' home-saved bean seeds in Lira and Masindi Districts

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Abstract

A baseline study was conducted in Lira and Masindi districts to determine farmers' practices of harvesting, processing, storage and protection of home-saved bean seeds. Two parishes from two counties in each district were selected as sampling sites. Farmers' seed source; seed preparation and planting practices; bean harvest and harvesting techniques; primary processing, storage and seed protection methods were investigated. Representative seed samples were obtained from farmers in March and in August 1999, the months preceding the first and second planting seasons, for quality analysis in the laboratory. The blotter method was used to determine seed health status. The results showed the predominant reliance on home-saved seeds as source of planting materials by farmers. Seeds were salvaged from grains, only at the time of planting. The quality of farmers' home-saved seeds was poor and this was compensated for during planting by high seeding rate. The main constraint to bean storage were bruchids and they adversely affected the germination capacity of seeds. Improved grain processing, storage and protection technologies that are "seed friendly" have been recommended for application on home-saved seeds.

Key Words: Post-harvest, farmers' seeds, home-saved, quality, management, pests and diseases, beans

Introduction

Inadequate supply of improved and high quality seeds, especially, at planting time is a major setback in Uganda's subsistence economy. This factor impacts negatively on the efforts being made to eradicate poverty through improved farming practices.

Although certified seeds have been produced for nearly 30 years, only 5-10% of it is sown in Uganda. Certified seeds of most traditional crops like field peas, pigeon pea, cowpea, green grams, etc. are not produced in Uganda. Farmers therefore, take it upon themselves to salvage planting materials from the previous season's harvest, that are often of poor germination capacity, and this results in poor crop stand. Planting more than the required number of seeds per hole makes up for the poor germination. This is considered a threat to grain availability for consumption and/or trade.

Most Ugandan farmers, especially small-scale rural producers do not differentiate between grain for food and seed for sowing. What they harvest is what they eat, sow or sell. The majority of farmers therefore sow home-saved seeds from the previous seasons crop harvest. ADC/IDEA (1996) reported that the other major sources of seed are village markets and retail shop. Seeds sold are basically bulked grain from many small-scale farmers. There is however, lack of information on the quality, and indigenous knowledge on home-saved seed management.

Details on and factors affecting quality of home-saved seeds are lacking. Acasio and Borsdorf (1994) reported several factors, especially the handling and storage methods that result in poor grain quality, and presumably these are the same factors that constrain availability of good seed on-farm. Results of a baseline survey conducted in Masindi, Kasese, Iganga and

Kapchorwa indicated poor field emergence of home-saved maize and bean seeds (Akwang *et al.* 1997) and this resulted into low yields.

Although production of home-saved bean seeds is being encouraged by CIAT (Buruchara and David, 1995; David and Kasozi, 1997), there is paucity of information on seed quality, germination capacity, tolerance to pests, diseases and edaphic factors and yield.

Currently, there are improved technologies that have been generated by NARO, especially on grain processing, storage and protection. It is envisaged that these technologies are relevant for seeds, and thus the need for a baseline study and subsequently on-farm validation, demonstration and/or dissemination. This study was conducted to appraise constraints, techniques and practices that impact on the quality of home-saved seeds in Lira and Masindi districts. The findings of the study provide greater insight on areas of focus for a sustainable supply of high quality seed to smallholder farmers, leading to increased crop productivity and income generation.

Objectives

The main objective of the study was to underscore the economic importance of farmers' home-saved seeds. The specific objectives were to:

i. investigate farmers' practices in processing, handling and storage of home-saved seeds in Lira and Masindi,
ii. determine the quality of home-saved seeds,
iii. determine the major constraints affecting the quality of home-saved seeds and
iv. establish the occurrence of different microflora on home-saved seeds .

Hypotheses

i. The quality of home-saved seeds is poor.
ii. Farmers' methods of processing, handling and storage of seeds for planting differ from that of grain for food.

Materials and Methods

The study was carried out in Lira and Masindi Lira districts in which farming is the major pre-occupation. Masindi district falls within agro-ecological zones (AEZ) 17, 18, 22 and 3; and Lira is largely in AEZ 3 (Wortmann and Eledu, 1999). Farming in both districts is mainly at small–scale subsistence levels, and the production of cereals, legumes, roots and tubers and oil seeds is dominant. A general investigation was made on the management and quality of maize, beans, sorghum, pigeon peas, cowpeas, groundnuts and sesame home-saved seeds. An in-depth analysis was, however, made on beans since it was highly regarded in both districts as a major source of food and income. Information on weeding regimes, field pest and disease management, and duration of crop maturity periods was not obtained. It was assumed that these did not dictate farmers' practices of home-saved seed management.

Two counties were selected from each district and the study sites were limited to parishes in two different sub-counties. The "fish bowl" sampling method was used to randomly select study sites (Dillon and Hardaker, 1993). In Masindi, the selected parishes were Kahembe and Kyankende in Bujenje and Kibanda counties, respectively. In Lira, the parishes were Omarari and Abalang in Moroto and Dokolo counties, respectively.

Informal and formal surveys were conducted in February, March and April, the months proceeding the first planting season of 1999. A participatory community meeting that involved the research team, extension agents and farmers was held in each parish to sensitize farmers about the study and to obtain general information on seed availability, handling and storage.

During the formal survey, a structured questionnaire was used to obtain information on farmers' home-saved seeds in the respective sampling sites. Target respondents included both men and women, especially those engaged in farming, and/or trade. Aspects of seed source, crop production, harvesting, processing, storage and seed handling were addressed. Post-harvest constraints, constraint-mitigating factors and processes were underscored.

During the survey a total of 123 bean seed samples weighing 1-2 kg were obtained from either farmers' stores, village markets or trading centres for laboratory analysis. Seed sample collection was made in March and August, the months preceding next season's planting dates. Seed moisture content (MC), seed damage levels, germination capacity and health status were determined. The oven-dry method was used to determine the MC, using 5-g ground bean samples at 130 °C for 1 hour (ISTA, 1996) in an ELE International Limited electrical oven. Germination capacity was determined by planting 200 seeds in moistened lake sand contained in plastic bowls, and 9 days were allowed for normal seedling development to occur (ISTA, 1996). Seed damage was determined by selecting those seeds that had mechanical and weevil damage and was scored separately. Weevil damaged grains had neat round holes, unlike the mechanically damaged ones that were irregular or had cracks.

The blotter method was used to determine seed health status (ISTA, 1996). Two hundred seeds of each sample were separately placed into 200-ml beakers, to which 100 ml of 1% sodium hypochlorite (Jick-Rickett and Colman Ltd.) was added under a laminar flow cabinet to submerge and disinfect the seeds. The sodium hypochlorite was decanted after 5 minutes, and the seeds rinsed with sterile water under the cabinet. The seeds were then placed on blotters for 10 minutes to dry. Untreated 200 seeds from the same sample were obtained and used as the control i.e. no surface disinfection was carried out. The non-surface and surface disinfected seeds were separately plated on wet sterile blotters in sterile petri-dishes of diameter 9 cm. Ten seeds were plated in each petri-dish and were incubated at prevailing room temperatures and relative humidity under Near Ultra Violet lights for 7 days. Individual seeds were examined under a stereoscopic microscope and the fungi were identified by their morphological characteristics. Identification was confirmed by examining the conidia under a compound microscope (Neergaard, 1979). Except *Bacillus subtilis* which was identified by its wrinkled, butter-like appearance, other bacteria were not studied.

Table 1. Relative importance of grain legumes and cereals grown in Lira and Masindi districts (1= most important, 6= least important).

Crop	Rank in Lira	Rank in Masindi
Maize	5	1
Beans	1	2
Groundnuts	6	3
Sorghum	3	4
Pigeon peas	2	5
Sesame	4	6

Results of seed quality were compared with the seed certification standards used by the National Seed Certification Service (NSCS), Ministry of Agriculture, Animal Industry and Fisheries. Comparisons were however, only made for MC and germination capacity. There are no established standards for seed health, insect or mechanical damage for Uganda seeds.

The number of replicates for each analysis equaled the number of bean samples collected from individual farmers. The data were analysed using SPSS and MSTAT statistical package to obtain means, standard deviations and frequencies and percentages.

Results

Among the grain cereals and legumes cultivated, beans were the most popular in both Lira and Masindi districts. It was ranked as the 1st and 2nd most important crop in Lira and Masindi, respectively (Table 1). Although maize was ranked as the number 1 crop in Masindi, it was considered of a low priority in Lira district.

Table 2. Percentage of farmers growing different bean varieties in Lira and Masindi districts

Bean variety	Farmers growing v ariety in Lira (%)	Farmers growing variety in Masindi (%)
Mudugavu	64.4	5.3
White haricot/Kibula	62.7	14.0
Yellow/Kagusuru/Kanzari	0.0	77.7
Mwetweke/Mutike	0.0	22.8
Kanyebwa	1.7	3.7
Chwara chwara	3.4	0.0
Bujwagole	0.0	1.8
Brown	0.0	1.8
Grey	0.0	1.8
Tanzania	0.0	1.7
K20/Bukalasa	20.3	28.1
K131 (MCM5001)	1.7	3.5
K132 (CAL96)	1.7	0.0

It was noted that very few farmers in Lira (11.7%) and in Masindi (6.5%) solely cultivated beans for seed purpose. To the majority of farmers interviewed (Lira = 88.3%, Masindi = 93.5%) bean cultivation was for the dual purpose of domestic supply (food and seed) and markets (income generation).

Seed source

In Lira, 69% of the farmers interviewed obtained their seeds from own savings of the previous harvest and 51.7% of the farmers supplemented by buying from the local market. A very small percentage of the farmers (3.5%) obtained seeds from friends and relatives. None of the farmers interviewed bought or planted certified seeds from Uganda Seed Project. In Masindi, the majority of farmers (87.5%) relied predominantly on their home-saved seed for planting, although some bought seed from the market to mitigate inadequacy. Only one farmer planted certified seeds from the Uganda Seed Project.

Farmers in both districts preferred home-saved seeds because of the following reasons: (a) ease of availability, (b) lack of money to buy other seeds, (c) seeds are of better quality, (d) assurance of variety of choice, (e) no any other source during planting time, and (f) no added cost.

Different varieties of beans are grown in Lira and Masindi districts. Variety names, however, varied in some instances, depending on colour, origin of variety and local sentiments. The most widely grown bean varieties in Lira were Mudugavu and Kibula, and in Masindi was "Yellow"/Kagusuru/ Kanzari (Table 2). Bean seed samples from Lira were commonly of mixed varieties.

Farmers' choice for any particular variety depended on the availability of planting materials, market demand, storability, cooking duration and organoleptic taste.

Seed preparation, planting and germination period

The majority of farmers in Lira (62.3%) and in Masindi (78.6%) made some special preparation on seeds prior to sowing. Most of the farmers re-dried and/ or sorted the seeds. These practices helped in ensuring high germination percentage and seedling emergence, and getting rid of weeviled and shrivelled seeds. A small percentage (3.2%) of the farmers in Masindi admixed seeds with Actellic 1% a.i. to control bean weevils.

Farmers in Lira and Masindi practised two methods of planting viz. chop and plant (Lira = 45%, Masindi = 93.1%), and broadcast (Lira = 75%, Masindi = 6.9%). Where broad cast method is practised, especially, in Lira, farmers were not able to quantify how much seed is sown per unit area. Those farmers that used the chop and plant method planted between 1 and 6 seeds per hole. In Lira, the mean number of seeds planted was 3.3 ±1.0 seeds per hole with a range of 2 to 5 seeds per hole and in Masindi the mean was 3.2 ±1.0 seeds with a range of 1 to 6 seeds. The majority of farmers in Lira (57.1%) and in Masindi (70.2%) planted 3 seeds per hole.

The reasons given by farmers why they planted more than the recommended (by the Uganda Seed Project) 2 seeds per hole (a) insurance against poor germination, (b) ensuring optimal plant density, (c) insurance against soil-borne pests and diseases, and (d) adherence to traditional norms. The majority of farmers in Lira (73.9%) and in Masindi (62.5%) indicated that poor germination was the main over riding factor.

In both districts the farmers interviewed observed that bean seeds took between 2 and 7 days to emerge. It was noted that planted seeds took on average 4.0 ±1.1 and 5.5 ±1.2 days to emerge in Lira and Masindi, respectively.

Bean harvest, harvest techniques and period

Farmers used different methods that depended on the maturity characteristics of beans to determine the harvest time of beans. Farmers used characteristics such as yellowing of plant and shedding of leaves (Lira = 96.5%, Masindi = 94.6%), drying of pods (Lira = 50.9%, Masindi = 33.9%) and shattering of mature pods (Lira = 10.5%, Masindi = 16.1%).

Almost all the farmers interviewed (Lira = 98.3, Masindi = 100%) carried the beans home immediately after uprooting from the field. Crop harvest period varied between 1 and 14 days before the final completion. Farmers spent on average 5.4 ±4.0 and 4.2 ±3.7 days to harvest the whole garden in Lira and Masindi, respectively. Harvested beans were not dried immediately but delayed until the all harvest has been made. Delayed harvesting of beans was attributed to labour competition with other crops, non-uniformity of maturity, ill health and drudgery.

In both districts bean harvesting began in May and continued until January the next year. The peak months of bean harvest were June for Masindi and September for Lira (Fig 1). Bean harvest months were more evenly spread in Masindi than in Lira.

Primary processing of harvested beans

In both districts the unthreshed beans were dried prior to threshing and the drying period varied between the two districts. In Lira, drying was conducted for 3.7 ±2.1 days, and in Masindi it was for 3.5 ±3.0 days. The shortest and longest period for drying of beans was reported as 1 and 14 days, respectively. The commonest

Table 3.Percentage of farmers using different methods to determine bean dryness prior to threshing

Method	Farmers using method (%)	
	Lira	Masindi
Biting	17.9	1.9
Shattering of pods	35.7	37.8
Rattling	33.9	26.7
Change in colour and texture	17.9	11.1
Ease of pod threshing	32.1	26.7

Table 4.Percentage of farmers facing different problems during drying of beans in Lira and Masindi districts

Constraint	Farmers affected (%) Lira	Masindi
Rain	49.9	73.5
Seed contamination	18.0	14.3
Moulding	8.2	0
Drudgery	16.4	23.8
Lack of storage space	3.2	2.0
Termites	11.5	2.0
Thieves	1.6	0.0
Sprouting	3.3	4.0
Domestic animals	3.3	0
Itching	1.6	0
Shattering/spillage	0	6

Table 5. Percentage of farmers sorting seeds in Lira and Masindi districts

Materials sorted out	Farmers sorting (%)	
	Lira	Masindi
Soil and stone particles	44.4	17.4
Immature seeds	18.5	22.6
Discoloured	7.4	54.8
Rotten seeds	51.9	67.7
Mechanically damaged seeds	25.9	16.1
Other varieties	3.7	0
Chaff	14.8	0
Weeds	7.4	0

method of drying was open sun drying on bare ground. In Lira about 88% of the farmers interviewed used this method, and in Masindi 78% of the farmers practised the method. Other methods of drying, but to a lesser extent, included use of biomass driers, cribs, hanging on the eaves of the veranda or above fire kiln.

Table 6. Percentage of farmers with different reasons on choice of bean storage units

Reasons	Farmer respondents (%)	
	Lira	Masindi
Maintain varietal purity	**46.6**	**84.2**
Prevent insect damage	**13.8**	**1**
Differences in maturity periods	**19.0**	**0**
Market preferences/demand	**12.1**	**12.8**
Taste differences	**1.7**	**1.8**

Farmers used different methods to determine the dryness of bean pods prior to threshing. The methods included biting of bean seeds between the teeth, pod shattering, rattling of seeds within the pods, changes in pod colour and/or texture (Table 3). Once threshed and cleaned, the dryness of bean seeds was determined by biting between the teeth, squeezing between fingers or the ease with which the bean could be ground (in Lira district). The majority of farmers (Lira = 65%, Masindi = 92%) preferred the seed biting method.

Table 7. Percentage of farmers using different control methods against losscausative factors of stored beans

Control method	Farmers using control methods (%)	
	Lira	Masindi
Regular inspection and re-drying	**55.6**	**30.2**
Actellic 1% dust	**11.2**	**28.3**
Tobacco	**7.4**	**1.9**
Pepper	**29.6**	**22.6**
Ash	**16.7**	**35.9**
Millet husk	**0**	**1.9**
Sell of grain	**0**	**7.6**
Rodenticide	**7.4**	**3.8**
Rat trap	**1.9**	**0**
Termiticide	**1.9**	**0**

Quality of seeds obtained from farmers

Table 8. Quality of home-saved seeds obtained from Lira and Masindi

Quality parameter	Seed quality (Mean ± SD) (%)				NSCS recommended level (%)
	Lira		Masindi		
	March	August	March	August	
Moisture content	12.4 ± 1.2	16.1± 2.5	12.9 ± 1.7	15.0 ± 2.5	13.0
Insect damage	2.2 ± 0.7	4.0 ± 2.4	4.5 ±1.6	8.4 ± 2.7	NA
Mechanical damage	0.9 ± 0.2	0.2 ± 0.1	1.7 ± 0.3	0.6 ± 0.1	NA
Germination capacity	82.7 ± 16.4	79.1 ± 18.5	75.2 ± 23.2	72 ± 24	80

In terms of relative percentage seed samples that passed NSCS germination standard were obtained from Lira in March (85%) and the least those from Masindi in August (56%).

Table 9. Percentage incidence of microflora on bean seeds collected from Lira and Masindi districts in March 1999

Microflora	Lira (n=29)				Masindi (n=33)			
	Non-surface disinfected		Surface disinfected		Non-surface disinfected		Surface disinfected	
	Infection (%)	Range (%)	Infection (%)	Range (%)	Infection (%)	Range (%)	Infection (%)	Range (%)
Bacterium								
Bacillus subtillis	6.3	0.5 – 39.5	12.2	0.5 - 49	2.0	0.5 – 18.5	4.0	0.5 – 23.5
Field fungi								
Botrydiplodia theobramae	0.2	0.5 – 3.5	0.2	0.5 – 2.0	0.4	0.5 – 4.5	0.2	0.5 – 4.0
Cladosporium spp.	**0.1**	**0.5 – 1.0**	**0**	**0**	**0.2**	**0.5 – 2.5**	**0**	**0.0 – 0.5**
Colletotrichum lindemuthianum	**0.1**	**0.5 – 1.0**	**0.1**	**0.5 – 1.5**	**0.1**	**0.5 – 2.5**	**0.1**	**0.5 – 1.0**
Fusarium oxysporium	**0.1**	**0.0 – 4.0**	**0**	**0.0 – 0.5**	**0.2**	**0.5 – 1.5**	**0.2**	**1.0 – 4.5**
Fusarium solani	**2.2**	**0.5 – 8.0**	**1.5**	**0.5 - 5.5**	**4.0**	**0.5 – 16.5**	**3.0**	**0.5 – 15.0**
Macrophomina phaseolina	**0.4**	**0.5 – 1.5**	**0.4**	**0.5 – 1.5**	**1.0**	**0.0 – 6.5**	**0.4**	**0.5 – 3.0**
Phoma spp.	**0.1**	**0.5 – 3.0**	**0.1**	**0.5 – 1.0**	**0**	**0.0 – 0.5**	**0**	**0**
Storage/Saprophytic fungi								
Aspergillus flavus	1.4	0.5 – 11.5	2.0	0.5 – 12.5	4.0	0.5 – 22.5	3.0	0.5 – 21.5
Aspergillus niger	**2.1**	**0.5 – 22.0**	**1.4**	**0.5 – 22.0**	**6.3**	**2.0 – 54.0**	**2.0**	**0.5 – 9.5**
Penicillium spp.	**2.1**	**0.5 – 32.0**	**0.1**	**1.0 – 1.5**	**7.2**	**0.5 – 43.0**	**1.0**	**0.5 – 7.0**
Rhizopus spp.	**4.0**	**0.5 – 19.0**	**2.1**	**0.5 – 19.5**	**3.5**	**0.5 – 28.5**	**2.0**	**0.5 – 7.0**

In both Lira and Masindi districts, the farmers interviewed faced several problems while drying beans. Generic problems included rain, contamination from dust, soil, stones or animal droppings, drudgery and termites (Table 4). Continuous rain, however, posed the greatest problem. The majority of farmers interviewed did not have a solution to these problems.

The traditional norm of threshing beans by beating with a stick on bare ground was practised by the majority of farmers in Lira (95.2%) and in Masindi (94.5%). A very small fraction of farmers packed the unthreshed beans into bags and threshed by beating with a stick.

The major problems faced by farmers while threshing beans included drudgery, soil contamination, health hazards (dust inhalation, blisters on hands, itching), kernel damage, and rain. Whereas drudgery was mentioned as the greatest setback in Lira (56.6%), soil contamination was for Masindi (49.0%). A small percentage of farmers in Lira smeared the threshing yard with cow dung to reduce soil contamination and dust pollution. Otherwise, the majority of the farmers interviewed did not have any counter measures to the problems cited.

Threshed beans are winnowed immediately using traditional winnowing trays in order to remove the chaff and small-shrivelled seeds. To further clean the beans, sorting was conducted, and in Masindi and Lira, 66.7% and 41.3%, farmers, respectively, sorted beans. The main reasons for sorting was to have clean seeds free from extraneous materials, obtain single coloured varieties, obtain seeds of uniform size and meet market demand of either clean materials and /or single coloured varieties. The materials sorted out included discoloured and rotten seeds, soil and stone contaminants, immature seeds, damaged seeds, chaff, other varieties and weeds (Table 5).

Farmers that did not sort the grain/seeds after winnowing claimed that winnowing was a thorough process (Lira=100%), Masindi=95.5%). A small percentage of farmers mentioned preference for mixed varieties, lack of time, and seed germination remaining, as some of the reasons why additional sorting was unnecessary.

Bean storage and protection

For long term storage, beans were generally stored when threshed (Lira = 96.5%, Masindi = 94.6%). A very small percentage of farmers stored beans in the unthreshed form (Lira =1.8% and in Masindi =3.6%). In Lira, 74.1% of the farmers interviewed stored different varieties separately, although 31% of the farmers stored as mixed varieties. In Masindi, 93 % of the farmers interviewed stored beans as single varieties, and only 5.3% stored as mixed. The reasons why bean varieties are stored separately are presented in Table 6.

Most of the farmers interviewed stored their beans in the sack (Lira = 100%, Masindi = 96.1%). Apart from storing beans in sealed pots in Lira (4%), other types of storage methods used in Masindi included cribs (2%), on-the-floor (2%), basket (2%) and granary (9.8%). The mean storage duration of beans was 6.1 ±2.4 and 4.6 ±2.7 months in Lira and Masindi, respectively, and the range in both districts was 1 to 12 months.

Farmers mentioned several problems that contribute to bean losses while in storage. The loss causative factors included weevils, moulds, rats, termites and pilferage. More than 96% of the farmers in Lira and Masindi observed that bean weevils posed the greatest threat to protracted bean storage duration as well as food security and income generation. To contain and /or control storage losses, farmers in both districts used several constraint mitigation strategies that included physical, ethnobotanicals and insecticides (Table 7). The methods used, however, varied between the two districts. For instance, in Lira, more farmers conducted regular inspection and re-drying, but in Masindi, more farmers preferred ash treatment (Table 7). A small fraction of farmers in Masindi accepted the losses and did not apply any counter measures to solve the problem.

The quality of farmers' home-saved seeds varied between districts and seasons (Table 8). For instance, MC of seeds sampled during March was within the acceptable recommended level of 13%, unlike that of seeds sampled during August. It was also observed that seeds from Masindi had higher insect damage levels than those obtained from Lira. Likewise, the germination capacity of seeds received from Lira was more superior than those from Masindi.

Health status of home-saved seeds

Eight field and four storage fungi, and one bacterium were detected on bean seeds samples from Lira and Masindi (Table 9). Some pathogenic field fungi viz. *Colletotrichum lindemuthianum, Botriodiplodia theobromae, Macrophomina phaseolina* and *Fusarium solani and F. oxysporum* were present on the seeds. *F. solani* had the highest incidence (0.5 to 16.5%) but the other field fungi occurred in low levels, ranging from 0 to 6.5%. Most of the field fungi and *Bacillus subtillis* were internally borne, and they persisted in seeds after surface disinfection. The incidence levels of storage fungi were higher (0.5 to 54%) than those of field fungi (Table 9).

Discussion

The results indicate that seed processing, handling, storage and protection methods in Lira and Masindi districts were equable to that of grain for food on-farm. This was demonstrated by the lack of special treatments given to seeds that were characteristically different from that of grains. It is therefore apparent that the same factors that affect grains are also the same for seeds. It is suggested that the technologies currently available for grain constraint mitigation be availed to farmers in the two districts, and also be validated on seeds. The effects of the grain protection technologies, for instance, should be determined on seed germination and seeds borne diseases. Agona and Silim-Nahdy (1998) noted that solarisation was only suitable for grain protection but not for seeds since germination was highly impaired. The use of ethnobotanicals e.g. neem products, especially, neem oil and neem kernel powder, should also be treated with caution since the products also get invaded by *Aspergillus flavus* (Agona pers. comm.) that adversely affect germination.

It was noted that the germination capacity of seeds from Masindi was lower than that of seeds from Lira. Considering all the seed quality parameters determined, in relation to germination, the results suggest that germination capacity is greatly influenced by the level of insect damage more than any other factor. Bruchid infestation of beans is known to reduce the seed germination power by selectively feeding on the germ tissues. The use of ethnobotanicals, especially, tobacco powder as grain admixture (Silim and Agona, 1993; Silim and Agona, 1996; NRI Report no. 2551) is recommended for seed treatment.

Farmers' practice of heaping beans for some time at home and only drying when harvesting is completed prolonged high MC conditions in seeds and probably encouraged invasion of seeds by storage fungi and saprophytic bacteria. When wet beans are tightly packed and there is poor aeration, hot spots are created and the withholding humidity rises. These conditions favour microbial growth, and thus the different storage fungi and *Bacillus subtilis* detected on the seeds could have been due to these phenomena.

Other sources of storage/saprophytic microflora could have been due to the delay in harvesting of beans after physiological maturity, drying and threshing of beans on bare ground, and threshing of beans using the beating-with-stick method that led to the bruising of beans and thus easy penetration into the seeds.

It was noted that the moisture content of the first season beans was much higher than that of the second season, and was above the recommended level. This could possibly be due to inadequate drying during the long first rains, and therefore the use of biomass dryers or cribs is suggested. Furthermore, to improve the quality of seeds, drying and threshing of beans can be done on stabilized platform drier and threshed using the KARI bean thresher (Mutyaba *et al.*, unpublished).

It was observed that the seed issue becomes very important to the majority of farmers at planting time. This was particularly true when they either salvaged planting materials from the damaged grain stock by cleaning and sorting out damaged and/or rotten seeds or supplemented by buying from the market. It is thus suggested that farmers' confidence in home-saved seeds is built by availing modern techniques of seed handling, storage and protection immediately after bean harvest.

Conclusion

The study has showed that to the majority of farmers, the grain only becomes seed at planting time, and as such there are no special treatments seeds are subjected to during processing and storage. Secondly, the quality of farmers' home-saved seeds is poor, and farmers buffered the problem by high seeding rates, despite the cleaning and sorting. This results in double loss of grain which would otherwise be used for improving food security and income generation.

The main problem that limits protracted seed storage and that results into poor germination capacity is bruchid infestation. It is therefore recommended that pest management technologies that reduce and/or control insect infestation, e.g. use of tobacco admixtures be availed to farmers. Additionally, practices that include harvesting of beans at physiological maturity, drying of beans in bean cribs or platform dryers; and threshing using the KARI bean thresher is recommended. Field studies on the pathogenecity of the different fungi detected on the seeds and their effects on bean yields are recommended. A similar study should be conducted in other agro-ecological zones to give an overall strategy of improving the quality of home-saved seeds in Uganda.

Acknowledgement

The authors sincerely appreciate the Rockefeller Foundation for funding the study through the African Science-based Career Award Programme, and the Director General NARO, Director of Research KARI and the Head National Post-Harvest Research Programme KARI, for granting the opportunity, laboratory and vehicles. The District Agricultural Officers, extension staff and farmers in Lira and Masindi districts are commended for the interest and timeless patience during the study. Special thanks also go to Dr S. David and Dr. R. Buruchara of CiAT at KARI, Mr P. Kalunda, Ms L. Busingye, Mr Musitaala and the entire staff of Post-harvest Programme for their support and contribution in various ways that contributed to the success of the study.

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