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*Full Length Research Paper*

# Indigenous knowledge of field insect pests and their management around lake Victoria basin in Uganda

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**Food security and poverty alleviation has remained the primary agenda in the Eastern Africa regional food policies, and Uganda is no exception. Field pests that attack crops are among the greatest threat to increased food production. The subsistence farmers in the Lake Victoria Basin (LVB) rarely use synthetic pesticides in the field due to the high cost and availability issues. Therefore, some rely on the use of botanical pesticides and other natural methods of pest control. However, this indigenous knowledge (IK) on botanicals has remained largely unexploited with limited regional research and resources committed and these are the premises upon which this ethnobotanical fieldpests management survey was launched and conducted. Most of the respondents were women (59%). The study findings revealed that the major field pests reported by farmers in declining order of importance, included banana weevil, bean fly, cereal stem borers, pod feeders, grain moth, rodents, moths, termites, birds, aphids and cutworms. The anti-pest plants documented included, *Capsicum frutescens, Tagetes* spp, *Nicotiana tabacum, Cypressus* spp., *Tephrosia vogelii, Azadirachta indica, Musa* spp, *Moringa oleifera, Tithonia diversifolia, Lantana camara, Phytollacca dodecandra, Vernonia amygdalina, Aloe* spp., *Eucalyptus* spp., *Cannabis sativa, Cofea* species and *Carica papaya*. The study has demonstrated that usage of botanical pesticides in field pest management is normal around Lake Victoria basin for the subsistence farmers since all the 117 respondents had ever tried or used botanical pesticides. We recommend more specialized studies in the usage of the plant-based pesticides to ensure safety and effectiveness that will enhance food security and environment protection. In addition, appropriate recommendations generated on the issues investigated will be advanced as leads for further research, extension and regional industrial endeavors in the LVB.**

**Key words:** Indigenous knowledge, field pests, pesticide plants, Uganda, Lake Victoria Basin.

## INTRODUCTION

Agriculture employs more than 80% of the labor force and also accounts for more than 90% of export earnings in Uganda (Coen, 1998; UNBOS, 2002). Agricultural production is however affected by a number of constraints including abiotic and biotic factors. Insect are considered key pests and a reason behind the use of many plant products. Hence, the history of use of botanical extracts in African cultures for the protection of field crops and stored grains for very long (Berger, 1994). The introduction of synthetic pesticides drastically reduced the use of botanical extracts. Today, the use of botanical extracts for controlling pests has been limited to small holder farmers, who in most cases have been supported by various groups such as women groups and Non Govern-ment Organizations (NGOs) that have been training peo-

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ple in use of indigenous knowledge in pest control.

The use of synthetic pesticides has raised a number of both ecological and medicinal problems yet their use has not substantially reduced the pest losses, (Blackman and Eastop, 1999) . There is a lot of hope that botanical pesticides will take us along way in fighting the dangers associated with conventional pesticides, however, botanical pesticides also need risk assessment and hazard characterrization in relation to human intake for a given time (Kroes and Walker, 2004).

Botanical pesticides are extracted from various plant parts (stems, seeds, roots, leaves and flower heads) of different plant species. Botanical pesticides are hailed for having a broad spectrum of activity, being easy to process and use, having a short residual activity and for not accumulating in the environment or in fatty tissues of warm blooded animals, (Philip and Robert, 1998). However, it is important to note that botanical pesticides, much as they are derived from plants, do no guarantee safety to humans and the environment. Some may be quite toxic such as the rotenoids. Toxicological studies aimed at assessing their safety should be done before they are used to avoid possible dangers, Belmain et al. (2001).

Some plants have been scientifically tested and have been found to have good pesticidal properties. There is a concern however, as most of the studied plants are from western origin (Jaya and Dubey, 2005). There is a need to carry out intensive studies on African plants and there possible usage in pesticide compositions. Botanical pesticides, if sufficiently exploited, can play a big role in reducing pollution, health risks and crop losses to pests.

The survey was conducted with an aim of documenting information about key field pests associated with mainly legumes and cereals (major crops focused on in this study), their control methods. The role of gender in pre and post harvest pest management in the four Lake Victoria basin districts of Uganda namely, Masaka, Rakai, Jinja and Mukono was part of this study. The study involved also taking into account the ages of the farmers/respondents involved in the farming activity since age distribution a key parameter in indigenous knowledge utilization and preservation.

## MATERIALS AND METHODS

The first step of the research involved conducting a rural assessment between March and December 2007 in the areas of Mukono, Jinja, Masaka, and Rakai districts of Uganda. A relatively detailed questionnaire to be administered in the region was developed, pretested and was used by the research team to conduct semi-structured interviews and discussions with the farmers for comprehensive rural assessment. The team targeted households in rural areas and the research team visited the households and administered the questionnaire to the farmers on spot (attached summary of questions). The introductory letter of the research team to visit the districts, local council leadership and local government officials was written and signed by the Head of Department of Botany, Faculty of Science, Makerere University. The introductory letter was for purposes of good community entry, and to assure the respondents and local leadership that the study is taking place in their district such that they can spare time to discuss with the team. Normally the interviews and discussions lasted an average of 2 hours which is substantive time to a busy farmer.

To reach the farmers in the specified districts, the district and sub-county officials in the agricultural extension were the guides. The district offices of National Agriculture Advisory Services (NAADS) and their sub-county coordinators as well as the sub-county local government leadership were part of the team that visited the farmer households. The importance of the team was 3-fold to provide the technical expertise needed in crops and pests identification, identify the relevant farmers and build trust and subsequent follow ups to the farmers have been established. The questionnaire was administered to the farmers by the members of the research team and all the necessary discussions were conducted face to face with the respondents. All these were done to identify areas and households that actively engaged in the use of botanicals in the control of field and storage pests. During this process, key farmers were identified and were later interviewed by the research team about their involvement in the use of botanical pesticides in their day to day farming. The trained farmers (those with basic knowledge trained by agriculture extension agents, NAADS etc.) and groups of farmers, like women groups, were also visited interviewed and key respondents who were actively involved in farming followed up for further discussions. The local council leaders were also instrumental in this rural assessment to ensure that households were free and secure to release or share their knowledge with the research team.

Respondents were asked about various issues including their residential address [village, sub-location and division (these are political demarcations but useful in easing administration and service delivery in rural areas)] within the district, age, farming experience, education level, land ownership and responsibility in the household. Furthermore, some of the questions asked during the study included the farmer characteristics, farmers' identity, the crop enterprise grown, the acreage, the common pests, methods of controlling the pests in the field and the methods of botanicals application and administration were all documented. Also gender roles and contributions information at household level in field pest management were established.

Identification of field pest species and plant pesticides used against them was also done. The ethnobotanical information was documented in details from the respondents. Thus, the available pesticide plants shown to the research team, voucher specimens were collected and identified in the department of Botany Herbarium, Makerere University. This was extremely important because sometimes several local language names could refer to the same plant species.

Identification of field pests was partly done by an entomologist from the National Crop Resources Research Institute, Namulonge and one research assistant from Faculty of Agriculture Makerere University in Uganda. Identification also relied on the respondent's description and ability to recognise the pest from amongst other species by use of pictorial aid availed by the survey team. The use of extension agents/staff who were all agriculturalists was to also help in pests identification on spot based on their experience and also had prior knowledge of farmers pests challenges since they were responsible for the extension services in the sub-counties and districts. However, some of the pests were not readily seen for identification since the research team was not able to see them but the farmers description and extension workers prior knowledge was used to bridge some of the gaps that existed during field data collection. The period of the study coincided with field preparation time not planting or harvesting season but the research team was competent enough since we had extension workers as part of the team.

A total of 117 respondents/farmers were interviewed and the

**Table 1.** The numbers and percentage of respondents in different age ranges

| Age range of respondents | Number of Respondents | Percentage of Respondents |
|---|---|---|
| 21–30 | 14 | 12.0 |
| 31–40 | 31 | 26.5 |
| 41–50 | 32 | 27.4 |
| 51–60 | 22 | 18.8 |
| 61–70 | 11 | 9.4 |
| 71–80 | 7 | 6.0 |
| **Total** | **117** | **100.0** |

**Table 2.** Major crop enterprises grown in the study areas

| Crop enterprise | Number of respondents | Percentage of respondents (%) |
|---|---|---|
| Beans | 112 | 23.0 |
| Maize | 109 | 22.4 |
| Bananas | 87 | 17.9 |
| Sweet potatoes | 46 | 9.5 |
| Cassava | 40 | 8.2 |
| Horticulture/vegetables | 35 | 7.2 |
| Groundnuts | 30 | 6.2 |
| Coffee/cotton | 27 | 5.6 |

sampling strategy used was stratified selective sampling targeting the practicing farmers. The data were analysed using the Statistical Package for Social Sciences (SPSS 10.0) soft ware.

## RESULTS

### The Respondents characteristics

The characteristics of respondents were also captured during the survey and these included the gender, age and educational background. This was done because individual characteristics play a very big role in agricultural participation regarding issues like access and use of both botanical and synthetic pesticides.

### The Gender of the respondents per sampled districts

Generally, more of the respondents were women (59%) compared to men (40%). More women were interviewed than men in the areas of the survey. This directly implied that more women are actively practicing agriculture based on the 117 farmers sampled as compared to the men.

### The age range of the respondents

Most of the respondent's ages were varied with the least number of farmers being in the age brackets of 71-81 years of age which was represented by 6% (Table 1.). The age bracket of 31 - 50 was represented by over 53% and these tallies with the critical reproductive age and most critical productive age group.

### Education background of the respondents

Over 80% of the respondents interviewed, had obtained attained some formal education. Only 8% had no formal education. Over 80% of the respondents had formal education between primary and secondary levels of schooling. Only 11% had post secondary education such as tertiary institutions and university education.

### Major crops grown in the study areas

The research established maize (grain) and beans (legume) as the most crops in all the sampled areas. These two were followed by bananas and other crops (Table 2). The crops are mixed grown on the farms.

### Economical importance of the crops enterprise

The crops grown by the farmers in the study areas were ranked according to their importance as traditional crops, food and cash crops. In the case of traditional importance, factors considered were crops used for traditional brews, ceremonial functions such as dowry and presentation as gifts. The results show that farmers consider bananas most important for traditional use with 86.5% followed by sweet potatoes with 4.4% (Table 3). Maize, coffee and beans were ranked the most important as

**Table 3.** The socio-economical importance and value of the crop enterprise

| Crop enterprise grown | Value of the crop enterprise | Percentage of respondents valuing the crops |
|---|---|---|
| Bananas | traditional | 86.5 |
| Sweet potatoes | traditional | 4.4 |
| Maize | cash | 29.3 |
| Coffee | cash | 18.7 |
| Beans | cash | 16.5 |
| Beans | food | 26.3 |
| Bananas | food | 22.6 |
| Maize | food | 21 |
| Ground nuts | food | 7.6 |

cash crops, 29.3, 18.7 and 16.5% respectively. Beans were ranked highest (26.3%) in regard to food importance followed by bananas (22.6%), maize (21%) and lastly groundnuts (7.6%).

### Major field pests in the study areas

The major field pests, the number of farmers interviewed who mentioned the pests and the crops affected by these pests are represented in Table 4. For legumes, bean fly pod feeders and aphids were mentioned by farmers. The cereal pests were, stem -borers, grain moth, cut worms and birds. For crops like cassava, sweet potatoes, pests such as the rodents, moths and potato weevil were reported frequently. Bananas -were greatly affected by the banana weevil. Other pests included wildlife, army-worms, millipedes, man and the lesser grain beetles.

### Plants and parts used as pesticides

The research showed *Capsicum frutescens* (pepper) as the most plant used for field protection followed by *Tagetes erecta, Nicotiana tabacum, Tephrosia vogelii, Azadirachta indica, Cupressus lusitanica* (Christmas tree) and *Musa* species and several other plants (Table 5). The plant parts used were mostly the leaves, fruits, bark, bulb, husks and whole plant. In many cases several plants were also burnt to produce plant ash that was then used in the pesticide composition. Ash was the most commonly used pesticide but single plants were hard to identify and farmers were not able to list all the plants used. Therefore ash is mentioned generally.

Generally, plant ash was widely used either alone or as a component of formulations for the control of pests in the field as well as in storage. Notably, other control measures were reported besides the usage of botanical pesticides. These controls included trapping, scaring, cultural practices and mechanical methods but during data analysis were not scored but simply mentioned.

## DISCUSSION

Subsistence farmers throughout Uganda continue to have problems of protecting their crops in the field against insect pest. As a result field losses of crops are common and pose a big threat to food security and household incomes. Subsistence farmers in the sampled areas were unable to purchase commercial synthe-tic/conventional pesticides some farmers rely on botanical pesticides.

A total of 117 farmers were interviewed in these districts and all the farmers rated the use of plant material for pest control as favourable in relation or in comparison to commercial synthetics. Most farmers expressed the issue of the cost being prohibitive but also they had some con-cerns about the toxicity and hazardous effects to the environment, livestock and their lives (http://hgic.clemson.edu) and this is relevant not only to synthetic but also to the botanicals (Kroes and Walker, 2004). Reardon (1993) reported that the use of pesticides has increased pest immunity and greater infestation.

The plants used for pest control varied considerably. Generally most farmers consistently used the similar plant parts from particular species such as leaves, roots, fruits, husks, etc. The main difference was in the mixtures applied by each individual farmer.

It was realised that some plants were preferred; such plants were more commonly used as compared to others depending mostly on their perceived efficacy, availability and ease of use. In reference to this, it was established that mixtures consisting of *C. frutescens, T. erecta, T. minuta, A. indica, N. tabacum, T. vogelii*, and *C. lusitanica* were widely used as compared to other plant species. Farmers were asked to assess the control strategies they preferred to use. In addition, from the beginning of the research, efficacy was recognised as one of the factors that farmers considered when choosing a method of pest control and hence influenced their choice of pest control options. Some of the reported plants are documented to be used in Kenya such as *Lantana camara, T. vogelii, Ocimum* species (Ogendo et al., 2003a,b). Many farmers preferred to use botanical products for field pest.

**Table 4.** Major field pests and the crops affected in the study areas.

| Pests | Scientific names | Number of respondents | Crop Enterprises |
|---|---|---|---|
| Ants | | 1 | bananas |
| Birds | | 18 | Sorghum, maize, groundnuts, finger millet, beans |
| Grass hoppers | | 1 | horticulture/vegetables |
| Man | | 1 | sweet potatoes |
| Millipedes | | 9 | sweet potatoes, groundnuts, maize, horticulture/vegetables |
| Rodents | | 22 | Groundnuts, beans, maize, sweet potatoes, cassava |
| spotted cricket | | 1 | beans |
| Wildlife | | 11 | Maize, cassava, sweet potatoes, groundnuts |
| Moths | *Agrius convolvuli* (sweet potato) | 22 | sweet potatoes, beans, maize, horticulture/vegetables |
| Cutworm | *Agrotis* spp | 13 | beans, maize, cassava, horticulture/vegetables |
| Shootfly | *Atherigona soccata* | 1 | horticulture/vegetables |
| Whitefly | *Bemsia tabaci* | 1 | horticulture/vegetables |
| Stem borer | *Busseola fusca*, *Chilo partellus* | 30 | maize |
| Banana Weevil | *Cosmopolites sordidus* | 67 | bananas |
| Sweet weevil | *Cylas* spp | 10 | Sweet potatoes |
| Leaf Miner | *Liriomyza* spp | 1 | horticulture/vegetables |
| Termites | M*icrotermes* spp | 19 | Maize, rice, beans, groundnuts |
| Bean fly | *Ophimyia phaseoli* | 49 | soya beans, beans |
| Aphids | *Rhopalosiphum maidis* (maize) *Aphis craccivora* (gnuts) *Aphis fabae* (beans) | 18 | Groundnuts, maize, beans, horticulture/vegetables |
| Lesser Grain Borer | *Rhyzopertha dominica* | 1 | maize |
| Grain moth | *Sitotroga cerealella* | 24 | Maize |
| Army worms | *Spodoptera* spp | 6 | Maize, beans, groundnuts, bananas |
| Pod borers | *Varuca Vitrata* (pod borers) *Nezara viridula* (green stinks bugs) | 29 | beans, soya beans, |

pests. Their availability, safety, and effectiveness might have contributed towards the use of botanical pesticides among subsistence farmers in the study area. However, many farmers reported that some botanical formulations take a lot of time to prepare and are not easily applied especially on a big scale. The number of times botanical pesticides were used in the field varied considerably depending on the seasons.

Samples of the plant pesticides documented were collected and their identity confirmed. This was extremely important because sometimes several local language names could refer to the same plant species and some of the plants are not identified as yet (Table 5). However, individual farmers knowledge about different plants and how best to use them varied considerably. The research to date has been able to identify the list of plants that are commonly used in pesticide formulation of botanical pesticides.

In all the study areas, maize and beans were found to be important for food and cash crops besides bananas that were ranked highest for cash, food and traditional purposes. Bananas are a staple food for most of the people in Masaka, Mukono and Rakai districts. Among other crops grown that were recorded but lumped together are the horticultural crops.

The most common pests were banana weevil, stem borers, grain moth, beanfly, pod feeders, aphids, grain moths (*Sitotroga cerealella*.). Other pests included rodents, wildlife, lesser grain beetles, termites and birds. These pests cut across all the study sites. The field pests were reported to attack crops at any stage mainly during the dry season and also during the vegetative or the reproductive stages of the crops.

From the gender perspective, women were the majority of the respondents. Women particularly those living in the rural areas of third world countries, play a major role in

**Table 5.** Plants used in field and storage pest Management in Uganda

| Family | Scientific Name | Local Names/Common Names | Parts used | No of Farmers |
|---|---|---|---|---|
| | | Jazimuganda (GA) | Whole plant | 1 |
| Alliaceae | *Allium cepa* L. | Akatungulu (GA,SO) (Onion (ENG) | Bulb, leaves | 1 |
| Alliaceae | *Allium sativa* L. | Garlic (ENG)<br>Katungulusimu (GA,SO) | Bulb, leaves | 1 |
| Aloeaceae | *Aloe vera* L. | Aloe, Kigaji (GA) | leaves | 3 |
| Asteraceae | *Aspilia africana* (Pers.) C.D.Adams | Makaayi (GA) | leaves | 1 |
| Asteraceae | *Bidens pilosa* L. | Blackjack (ENG) | leaves | 1 |
| Asteraceae | *Tagetes erecta* L. and *Tagetes minuta* L. | Kawunyira (GA) | leaves and Whole plant | 26 |
| Asteraceae | *Tithonia diversifolia* A. Gray | Tithonia | leaves | 6 |
| Asteraceae | *Vernonia amygdalina* Del. | Mululuza (GA, SO) | leaves | 3 |
| Cannabaceae | *Cannabis sativa* L. | Cannabis (ENG), Njayi (GA,SO) | leaves | 2 |
| Cannaceae | *Canna indica* L. | Canalilly (ENG) | Whole plant | 1 |
| Caricaceae | *Carica papaya* L. | Pawpaw (ENG), Papali (GA) | leaves | 2 |
| Chenopodiaceae | *Chenopodium opulifolium* DC. | Kavumbavumba (GA) | Whole plant | 1 |
| Commelinaceae | *Commelina benghalensis* L. | Comellina, Teija (GA, SO) | Whole plant | 1 |
| Cupressaceae | *Cupressus lusitanica* Mill. | christmas tree (ENG) | leaves | 25 |
| Euphorbiaceae | *Jatropha* spp. | Kirowa (GA, SO) | leaves | 1 |
| Fabaceae | *Lablab purpureus* (L.) Sweet | Lablab | leaves | 1 |
| Fabaceae | *Phaseolus vulgaris* L. | bean husks (ENG)<br>Ebidandali (SO)<br>Ebijanjalo (GA) | husks | 7 |
| Fabaceae | *Sesbania sesban* (L.) Merr. | sesbania | Leaves | 1 |
| Fabaceae | *Tephrosia vogelii* Hook.f. | Muluku (GA,SO) | leaves | 22 |
| Lamiaceae | *Ocimum* Spp. | Ocimum<br>Mujaja (GA,SO) | leaves | 2 |
| Meliaceae | *Azadirachta indica* A.Juss | Neem , Niimu (GA,SO) | leaves | 19 |
| Moringaceae | *Moringa oleifera* Lam. | Moringa (GA,SO) | leaves | 7 |
| Musaceae | *Musa* spp | Banana (ENG)<br>Matoke (GA,SO) | Fruit juice | 14 |
| Myrtaceae | *Eucalyptus* spp. | Eucalyptus (ENG)<br>Kalitunsi (GA,SO,NY) | leaves | 3 |
| Phytolaccaceae | *Phytolacca dodecandra* L'Hér. | Luwoko (GA,SO) | leaves | 4 |
| Poaceae | *Elusine coracana* (L.) Gaertner. | Finger millet (ENG)<br>Obulo (GA,SO) | husks | 1 |
| Rubiaceae | *Coffea* spp. | Coffee (ENG), Mwani (GA,SO) | husks | 2 |
| Rutaceae | *Citrus sinensis* Pers. | Oranges (ENG)<br>Micungwa (NY,GA,SO) | leaves | 1 |
| Solanaceae | *Capsicum frutescens* L. | Pepper, pilipili (ENG) Kamulali (GA,SO) | fruits | 99 |
| Solanaceae | *Lycopersicon esculentum* Mill. | Tomato (ENG), Nyanya (GA,SO) | leaves | 1 |
| Solanaceae | *Nicotiana tabacum* L. | Tobacco (ENG)<br>Taaba (GA,SO) | leaves | 24 |
| Theaceae | *Thea sinensis* L. | Tea (ENG), Majani (GA,SO) | leaves | 1 |
| Verbenaceae | *Lantana camara* L. | Omuhukye (NY)<br>Kayukiyuki (GA)<br>Kapanga (SO) | leaves | 4 |

**Key:** Language dialect: ENG (English); GA (Luganda); SO (Lusoga); NY (Runyankore),

the managing of natural resources that are linked to agriculture as well as in the household make them the daily managers of the living environment. They have profound knowledge of the plants and animals and ecological processes around them (Dankelman and Davidson, 1994). Reardon (1993) asserted that women have a rich fund of knowledge that is slowly or progressively being lost. Furthermore, the age bracket of 31-50 years that is represented by over 53% which tallies with the critical reproductive age and most critical productive age group is line with the national projections (UBOS, 2002).

## Conclusions and Recommendations

The research established that farmers use botanical pesticides and that they are perceived to be as effective as the synthetic counterparts. It was also noted that the subsistence farmers preferred using botanical pesticides rather than conventional ones mainly because of cost and availability. It was established that the common crops grown in the area of the research were bananas, maize beans, groundnuts, sweet potatoes and cassava. Traditional pest control methods, especially the use of indigenous pesticide plants if improved, offer a safer, low cost and more dependable method of field crops protection. However, it should not be assumed that because the botanical pesticides are naturally derived that they are safe to use and can be consumed by humans. This research team intends to carry out a biosafety assessments of the pesticide plants used in order to establish their mammalian and environmental safety. The plants that will be found to have proven effectiveness and safety will be studied further to find out how best they can be used to protect the environment from the increasing degradation. Then, issues of propagation and cultivation as on-farm crop for pest control as well as conservation will be looked at closely in order to enhance crop productivity and food security.

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