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# Ethnobotanical survey of pesticidal plants used in South Uganda: Case study of Masaka district

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**Use of synthetic pesticides in developing countries is not only limited by their being expensive but also the small (uneconomic) fields whose limited production costs cannot offset costs of agricultural implements like agro-chemicals. Subsistence farmers, therefore, have no choice but to use local methods of controlling pests, one of which is the use of traditional and of late introduced pesticidal plants' extracts. In this study, whose main objective was to record all pesticidal plants used in Southern Uganda, Masaka district, it was established that thirty four species belonging to eighteen families are currently used in traditional plant production. Most useful species were *Azadirachta indica* and *Tagetes minuta* while the most frequently cited families were Meliaceae and Euphorbiaceae. It was noted that of the plant species recorded, some plants like *A. indica*, *Melia azedarach,* and *T. minuta* are already scientifically established pesticidal plants whereas others like *Euphorbia tirucalli, Bidens pilosa, Vernonia amygdalina* may be known for other uses but not for this purpose and hence the need for their efficacy evaluation. Some important pesticidal plants like *Abrus precatorius*, *Euphorbia candelabrum* and *Phoenix reclinata* were reportedly becoming increasingly rare and would need conservation. The need to carry out such surveys in order to obtain inventories was observed and recording this knowledge before it disappears with the aging farmers was seen as urgent.**

**Key words:** Indigenous knowledge, inventory, developing countries, conservation.

## INTRODUCTION

In most developing countries, use of modern synthetic pesticides is limited and sometimes non-existent (Scialabba, 2000). This is so not only because they are expensive but also because of the small fields cultivated by subsistence farmers making the use of such pesticides uneconomic. Yet, most of these countries lie in tropical and subtropical areas where pests and diseases are abundant throughout the year.

The implication to this is that in these areas, pests and diseases pose a major problem in agricultural production. According to Oerke and Dehne (2004), pests contribute 30-40% of crop loss worldwide while the loss in the tropics is reported to be even higher than 40% (FAO, 2003). These figures show that the battle against pests is a difficult one even with the advanced technology that exists today.

In developing countries, where technological advancement is still low and the use of modern methods is subjacent, the most credible alternative appears to be the use of traditional/cultural methodologies (Pei, 2001; Rates, 2001; Muhammad and Awaisu, 2008) - one of which is the use of traditionally-known pesticidal plants as a remedy for pest infestations.

The use of botanicals for pest control is as old as agriculture itself. Thacker (2002) reports the use of

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tobacco (*Nicotiana tabacum* L.) leaves for fumigation in stores as early as the late 1500s, the use of *Sabadilla officinale* A. Grey ex Benth. for crop protection in the mid 1500s, and application of *Quassia* spp extracts against aphids during the early 1600s among others.

While these botanicals were used as early as reported above, the discovery of synthetic pesticides in the early 1900s tended to overwhelm their use because of the many advantages synthetic pesticides appeared to have at that time. For example, DDT was reported to have a knockdown effect on most insects, high persistence in the environment, ease of application together with having a broad spectrum (DeLong, 1948; Walker, 2000) which advantages the botanicals appeared not to possess.

It was only after environmentalists like Carson (1962) started realizing that these advantages were in effect potential disadvantages that scientists started to question the future prospects of synthetic pesticides. Therefore, botanicals are not new on the pest management scene but have recently been re-discovered as a route through which to escape the many disadvantages of synthetic pesticides.

However, as Asman (2008) and Muhammad and Awaisu (2008) say, only a few are presently in commercial use. Therefore, there is need to explore, document and evaluate the use of more plants. Yet, Ankli et al. (1999) and Gradé (2008) note that knowledge of such herbs is usually in the hands of a small group of people who guard it jealously for their advantage. In many cases, it is passed on between generations by word of mouth or observing elders' activities and is often not documented. In many developing countries like Uganda, documentation and scientific evaluation of medicinal plants in general and botanicals for pest management in particular is still wanting. Available literature reveals that some ethnobotanical survey have been made in Uganda for traditional plants used in human medicine (Freiburghaus et al., 1996; Kamatenesi-Mugisha et al., 2007a; Katuura et al., 2007; Ssegawa and Kasenene, 2007; Waako et al., 2007), veterinary medicine (Tabuti et al., 2003; Bukenya-Ziraba and Kamoga, 2007; Gradé et al., 2007; Katuura et al., 2007), cultural values (Kakudidi, 2004a; Kakudidi, 2004b), but only limited amount of information concerning pesticidal/insecticidal plants used in this region is available (Mugisha-Kamatenesi et al., 2008). This is in stark contrast with the ideal requirements of the ongoing campaigns to 'go organic' that are slowly but steadily catching up in this region. Organic farming by principle discourages the use of synthetic agrochemicals and promotes the use of ecological techniques like use of plant-based pest remedies.

Therefore, this study was set up to contribute to documentation of pesticidal plants used in Uganda especially in the agricultural district of Masaka (south Uganda) where many farmers are converting to organic farming. The study objectives were: a) documentation of all known pesticidal plants in the area; b) establishment of pests on which these pesticidal plants are applied; and c) finding out their mode of application/formulation. Results will help to obtain a record of these plants from the farmers especially those who are elderly before they die/disappear with their knowledge and will stimulate further research on several aspects like conservation of the species and efficacy evaluation of plant substances against the pests they are claimed to control.

## MATERIALS AND METHODS

### Study area

The study was carried out in Masaka district located between 31º 12´ and 32º 06´E and 0º 48´ and 1º 20´S in South Uganda (Figure 1). Found on the shores of Lake Victoria, Masaka district is one of the most important agricultural areas in Uganda due to its favorable climatic conditions. The district has a bimodal type of rainfall with an annual average of 1200 mm and mild equatorial temperatures ranging between 22 and 26ºC. Following the bimodal type of rainfall, the district has two growing seasons, March to June and October to December that support the growing of crops the whole year around. Main crops grown include bananas (*Musa* spp), beans (*Phaseolus vulgaris* L.), cassava (*Manihot esculenta* Crantz.), maize (*Zea mays* L.), coffee (*Coffea* spp) and a range of other (tropical) vegetables, fruits and cereals (Tenywa et al., 1999).

### Data collection

The study was carried out with full knowledge and support of local councils (LCs) of the area that constitute the local administration at different levels of the district. Preparatory stages of the study involved holding meetings with local leaders who eventually introduced the research team to farmers. On the advice of district agricultural staff, it was found appropriate to include one agricultural field staff on the team to help with introduction and identification of 'right' respondents. Therefore, the survey team included an agricultural extension worker and a field officer recruited from the area, who also doubled as a translator where it was deemed necessary. The survey was conducted in the local language (Luganda) except for educated respondents who chose to use English.

During data collection, we opted for open-ended interviews in order to obtain quantitative data with a qualitative depth, devoid of researcher input. Mossholder et al. (1995) say that open-ended interviews offer a way of providing qualitative depth in a survey-based research and have an advantage of allowing respondents answer in their own frames of reference, implicitly reducing the prime influence of leading questions following researcher suggestions. We also used direct observation to record observable data on plant characteristics as recommended by Etkins (1993).

The survey was carried out between October 2007 and March 2008 and five sub-counties including Bigasa (0º 04´59´´S; 31º38´00´´E), Bukoto (0º 23´09´´S; 31º37´38´´E), Kitanda (0º 44´59´´S; 31º35´58´´E), Lwengo (0° 24´ 58´´ S; 31° 24´ 29´´ E) and Buwunga (0° 22´ 22´´ S; 31° 47´ 35´´ E) were assessed (GPS coordinates taken are for farms of lead farmers in the sub-county). These sub-counties were chosen on advice of Masaka agricultural staff and using the criterion that they were among the leading areas in organic farming adoption; which implies extensive use of botanicals for pest management.

In each sub-county, twenty-five farmers, (about 1/3 of all farmers in a sub/county) and one extension staff were interviewed making a

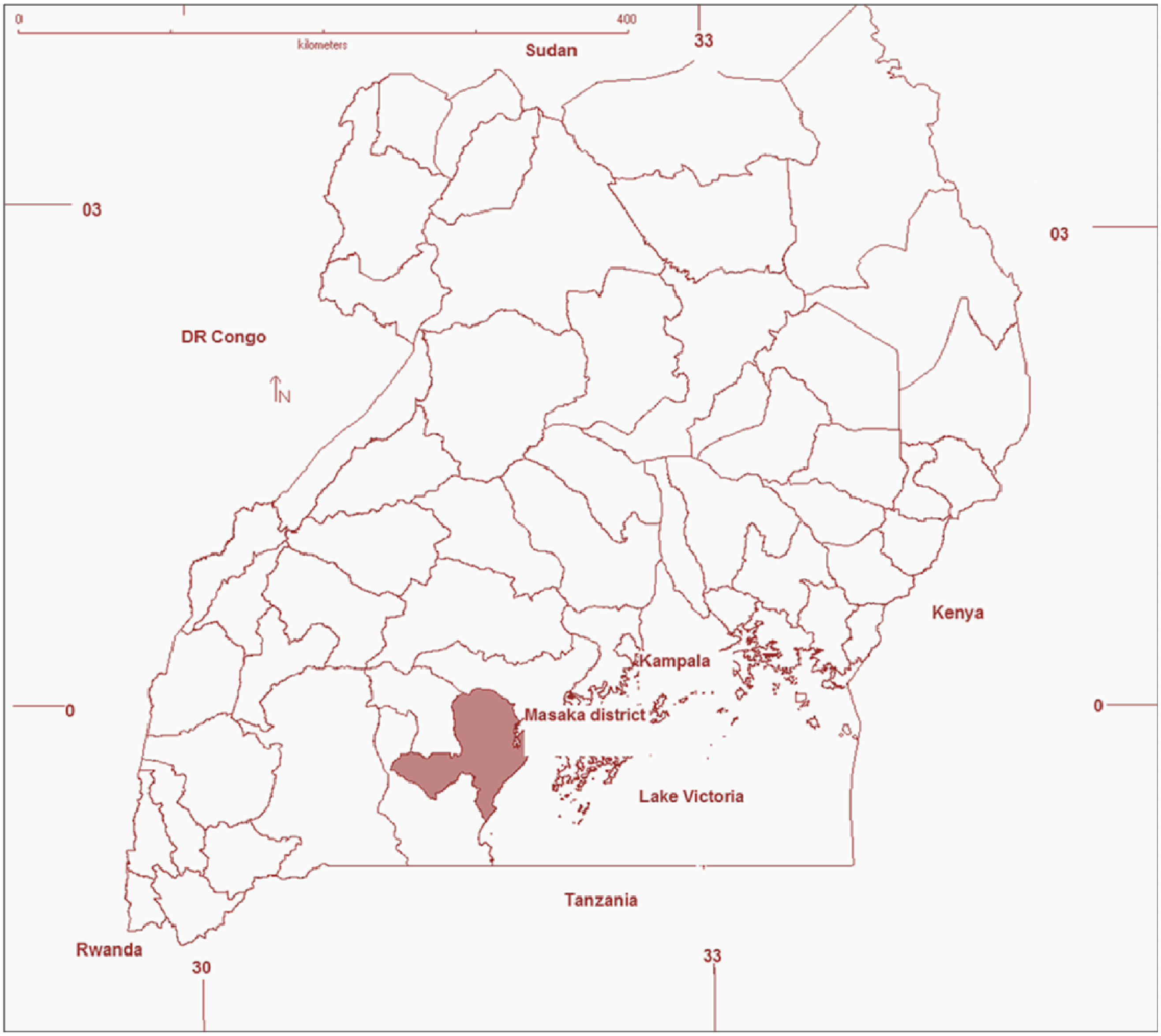


**Figure 1.** Map of Uganda districts showing the study area (Masaka district). Adapted from Google maps.

total number of 130 respondents in the whole district. All respondents were adults (70 males and 60 females) between ages of 19 and 70 of African descent that is, about 90% were baganda, 6% were banyankole, 5% were of Rwandese origin and 1% were of luo origin.

During the survey, each respondent was requested to give information pertaining to the plants' local name, plant part used, method of formulation/application mode of part used and pest(s) which the latter was used against. Finally, voucher specimens (JM 1-34) were prepared from each plant mentioned and deposited at the herbarium of Makerere University. Plants were identified by comparison with authentic herbarium specimens and sometimes with assistance from experts at Makerere University herbarium.

### Data analysis

All data was recorded in previously designed data sheets to reflect different objectives. For analysis, species and families recorded were assessed for User Value (UV) (Aburjai et al., 2007; Heinrich et al., 1998) - a quantitative method that demonstrates the relative importance of species locally UV = $\frac{\sum U}{n}$,

where UV is the user value, *U* is the number of user citations and *n* is the number of respondents.

Informant consensus ICF (Aburjai et al., 2007; Ankli et al., 1999) was calculated to indicate information homogeneity. According to the latter authors, ICF will be lower (closer to 0), if there is a large variation in plant use or when users do not exchange information about plant uses. High values (close to 1) reflect well-defined plant use or information exchange between respondents. All calculations and graphic presentations were carried out in Microsoft office Excel 2007. UV and ICF values are reflected in Tables 1 and 3.

**Table 1.** Record of species, their families, plant parts used and Use Values (UVs).

| Species name and Voucher no. | Local name | Family | Part used | Times mentioned | UV |
|---|---|---|---|---|---|
| *Abrus precatorius* L. JM-001 | Lusiiti | Fabaceae | L, S | 23 | 0.176 |
| *Allium sativum* L. JM-002 | Katungulucumu | Alliaceae | L | 56 | 0.430 |
| *Annona senegalensis* L. JM-003 | Kisitaferi | Annonaceae | L,B | 55 | 0.423 |
| *Artemisia annua* L. LM-004 | Artemisia | Asteraceae | L,Fl | 67 | 0.515 |
| *Asparagus africanus* Lam. JM-005 | Kadaali | Asparagaceae | L(spines) | 45 | 0.346 |
| *Azadirachta indica* A.Juss JM-006 | Neem | Meliaceae | L,B R,F | 125 | 0.961 |
| *Bidens pilosa* L. JM-007 | Ssere | Asteraceae | L | 36 | 0.276 |
| *Cannabis sativa* L. JM-008 | Njagga | Cannabaceae | L, S, F | 52 | 0.400 |
| *Capsicum frutescens* L. JM-009 | Kamulari | Solanaceae | F | 87 | 0.669 |
| *Carica papaya* L. JM-010 | Mupaapali | Caricaceae | R,B | 32 | 0.246 |
| *Chrysanthemum coccineum* Willd. JM-011 | Pyrethrum | Asteraceae | L, Fl | 23 | 0.176 |
| *Citrus aurantifolia* Swingle JM-012 | Nimawa | Rutaceae | F,L | 32 | 0.246 |
| *Cupressus lusitanica* L. JM-013 | Kapripusi | Cupressaceae | L,B | 54 | 0.415 |
| *Cupressus sempervirens* L. JM-014 | Ssedero | Cupressaceae | S,L | 60 | 0.461 |
| *Cymbopogon nardus* L.(Rendle) JM-015 | Mutete | Poaceae | L | 45 | 0.346 |
| *Datura stramonium* L. JM-016 | Ruziringa | Solanaceae | L | 68 | 0.523 |
| *Eucalyptus globulus* Labill. JM-017 | Kalitunsi | Myrtaceae | L,B | 60 | 0.461 |
| *Eucalyptus grandis* W.Hill.ex Maid JM-018 | Kalitunsi | Myrtaceae | L,B | 56 | 0.430 |
| *Euphorbia candelabrum* Tremaut. ex Kotschy JM-019 | Nkukuulu | Euphorbiaceae | Latex, B, R | 49 | 0.376 |
| *Euphorbia tirucalli* L. JM-020 | Nkoni | Euphorbiaceae | Latex, B, ash | 46 | 0.353 |
| *Jatropha curcas* L. JM-021 | Kiryowa | Euphorbiaceae | Sap, F,S, B | 103 | 0.792 |
| *Lantana camara* L. JM-022 | Kayukiyuki | Verbenaceae | L | 69 | 0.530 |
| *Melia azedarach* L. JM-023 | Lira | Meliaceae | L, R,B | 110 | 0.846 |
| *Mucuna pruriens* Bak. JM-024 | Mucuna | Fabaceae | L,R | 32 | 0.246 |
| *Nicotiana tabacum* L. JM-025 | Taaba | Solanaceae | L | 98 | 0.753 |
| *Phoenix reclinata* Jacq. JM-026 | Mukindo | Arecaceae | Sap, ash | 15 | 0.115 |
| *Phytolacca dodecandra* L'Herit JM-027 | Luwoko | Phytolacceae | L, F | 43 | 0.331 |
| Plant ash N/A | Evuu | N/A | Ash | 101 | 0.777 |
| *Ricinus communis* L. JM-028 | Nsogasoga | Euphorbiaceae | S | 87 | 0.669 |
| *Schinus molle* L. JM-029 | Kishenda | Anacardiaceae | L, F | 65 | 0.500 |
| *Solanum lycopersicum* L. JM-030 | Enyaanya | Solanaceae | F | 24 | 0.184 |
| *Tagetes minuta* L. JM-031 | Kawunyira | Asteraceae | L | 118 | 0.907 |
| *Tephrosia vogelii* Hook.f. JM-032 | Muluku | Fabaceae | L | 88 | 0.676 |
| *Tithonia diversifolia* (Hehsl.) A. Gray JM-033 | Ekimyula | Asteraceae | F,L | 75 | 0.577 |
| *Vernonia amygdalina* Del. JM-034 | Omululuza | Asteraceae | L | 35 | 0.269 |

Key: L , Leaf; B, Bark; F, Fruit; S, Seed; R, Root.

## RESULTS

### Record of species

Table 1 shows the inventory of all species recorded from the survey. Thirty-four species belonging to 18 families were recorded. The most important pesticidal species were *Azadirachta indica*, *Tagetes minuta, Melia* 0.85 and from 0.7 to 0.12 with *Phoenix reclinata* (0.12), *Abrus precatorius* (0.18) and *Chrysanthemum coccineum* (0.18) scoring the least (Table 1).

The most used families were Meliaceae, Euphorbiaceae, Solanaceae and Verbenaceae with UVs of 0.90, 0.55, 0.53 and 0.53, respectively while Arecaceae 0.79, respectively. Other species scored UVs ranging*azedarach* and *Jatropha carcus* with UVs of 0.96, 0.91, (0.12) and Rutaceae (0.25) were indicated as the least useful (Table 3). Only two families namely Poaceae

**Table 2.** Record of pesticide mode of formulation and pests they control.

| Species name | Mode of formulation | [1]Pest/ disease/deficiency treated |
|---|---|---|
| *Abrus precatorius* | Water extract | Worms |
| *Allium sativum* | Trap crop, water extract | Field pests, storage pests |
| *Annona senegalensis* | Water extract | Fungicidal properties, insects |
| *Artemisia annua* | Water extract | Mosquitoes, flies |
| *Asparagus africanus* | Physical trap/thorns | Birds, moths, bats |
| *Azadirachta indica* | Water extract/crashed seeds | Most insects, mosquitoes |
| *Bidens pilosa* | Water extract | Aphids |
| *Cannabis sativa* | Water extract, smoke, trap crop | Storage pests, insect pests, coccidiosis, anti-biotic |
| *Capsicum frutescens* | Water extract, crashed seeds | Cut worms, ants, snails, storage pests |
| *Carica papaya* | Leaf water extract, crashed seeds | Blight, animal worms |
| *Chrysanthemum coccineum* | Oil extract , water extract | Most pests |
| *Citrus aurantifolia* | Water extract, trap crop | Insect pests |
| *Cupressus lusitanica, Sempervirens* | Physical admixture, water extract | Storage pests, houseflies |
| *Cymbopogon nardus* | Trap crop, oil extract | Lepidoptera pests, beetles, aphids |
| *Datura stramonium* | Water extract | Insects |
| *Eucalyptus globulus* | Water extract, physical admixture, oil extract | Storage pests, repellent |
| *Eucalyptus grandis* | Water extract, physical admixture, oil extract | Storage pests, repellent |
| *Euphorbia candelabrum* | Latex spray, water extract | Termites, cutworms |
| *Euphorbia tirucalli* | Latex spray, ash dusting, physical admixture | Aphids, safari ants, cutworms |
| *Jatropha curcas* | Latex spray, water extract(seeds)/ oil | Insect pests, animal worms |
| *Lantana camara* | Water extract, physical mixture | Insect pests, storage pests |
| *Melia azedarach* | Water extract | Most insects, worms |
| *Mucuna pruriens* | Water extract, intercrop | Nitrogen deficiency |
| *Nicotiana tabacum* | Water extract, smoke, physical admixture | Storage pests, soil pests ,domestic pests, repels snakes |
| *Phoenix reclinata* | Ash/dusting | Storage pests |
| *Phytolacca dodecandra* | Water extract | Snails, insect pests ,fungi |
| Plant ash | Dusting, water mixture | Cut worms, banana weevil, storage pests, fungi |
| *Ricinus communis* | Water extract, crushed seed /oil | Storage pests, domestic pests, animal worms |
| *Schinus molle* | Water extract, crushed seeds | Worms, storage pests |
| *Solanum lycopersicum* | Water extract, repellent crop | Aphids, thrips, weevils |
| *Tagetes minuta* | Water extract, repellent crop | Most insects, nematodes |
| *Tephrosia vogelii* | Water extract | Insect pests, ticks, fungi, mites, moles |
| *Tithonia rotundifolia* | Trap crop | Nematode trap plant |
| *Vernonia amygdalina* | Water extract | Insect pests, malaria parasites, worms |

[1]Pests/diseases controlled were grouped into four broad uses: field pests, storage pests, domestic pests, veterinary pests and others/unclassified for calculation of ICF whose values were above 0.9 in all categories.

and Arecaceae belong to monocotyledonous subdivision while the rest are dicotyledonous.

## Plant parts used as source of pesticide

Leaves were named as plant parts most-used in formulation of pesticides. They were reported for 26 species out of the total 34 cited in the survey. They were followed by seeds/fruits and the bark with 11 and 10 species, respectively.

Ash made by burning wood and flowers were the least with 2 species each (Figure 3). However, ash was generally mentioned as a constituent of many concoctions. Several intersections were observed where some plants were named for more than one part. A. indica, *M. azedarach*, Cannabis sativa and *J. carcus* were named for using almost all parts while others were

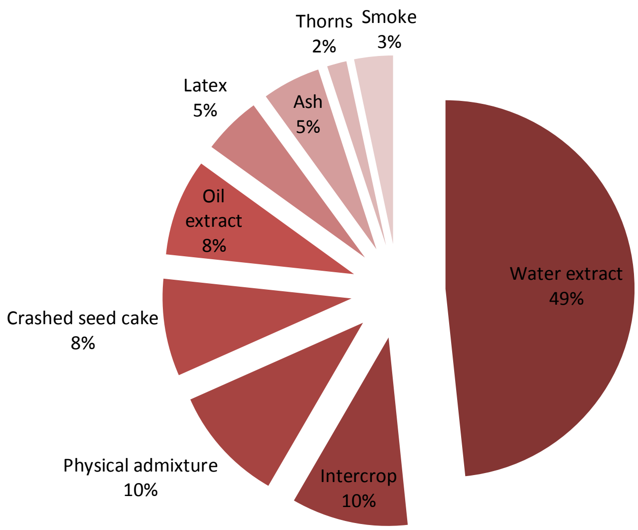


**Figure 2.** Mode of formulation of pesticides among species recorded.

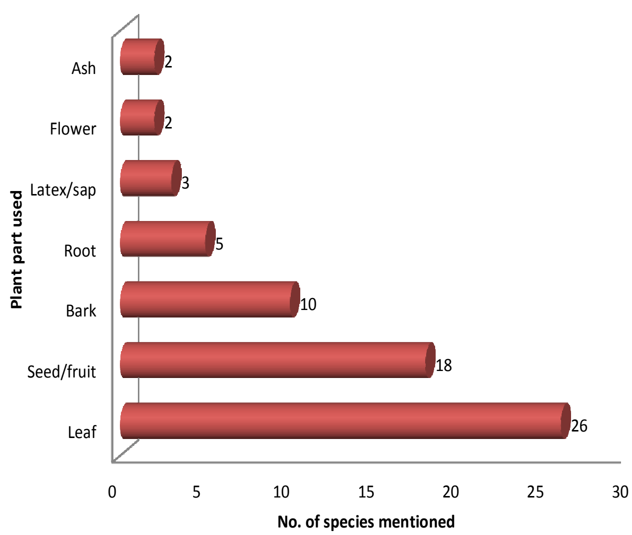


**Figure 3.** Plant parts used as source of pesticide.

named for one or two parts (Table 1).

## Formulation/mode of utilization of plant parts

Water extract was the most commonly named mode of formulation accounting for nearly half (49%) of all formulations. Others included use of the whole plant as an intercrop that is, trap crop/repellant (10%), physical admixture of plant part with produce (10%), use of crushed seed cake (8%), application of plant oil extract (8%), latex spray (5%), ash admixture (5%) use of thorns as deterrents (2%), and use of smoke from burning plant parts (3%) (Figure 2).

Most plants were reported to have several ways in which pesticides could be formulated from them. For example *J. curcas*, *E. tirucalli, Eucalyptus* spp, *Nicotiana tabacum* and *C. sativa* were named for three ways, while the majority was reported for two ways and a few others for only one (Table 2).

## Pests the plants are used against

Numerous pests were mentioned during the survey but it was apparent that farmers were neither familiar with formal classification nor names of pests and diseases. Most farmers gave broad answers such as weevils, storage pests, caterpillars, insects, moths or field pests. It was therefore difficult to obtain meaningful data for comparison.

During interviews, respondents also pointed out, the difficulty of naming particular pests managed by certain plants because extracts are used when there is infestation in the field without establishing particular pests being controlled. After all, many plants are used in combination with others. Therefore, plants were reported to be used against a range of pests. For analysis, pest data collected were organized in broad groups namely: field pests, storage pests, veterinary pests, domestic pests and others which could not be classified. All groups include the corresponding diseases. Table 3 shows that the most-cited pests were field pests named for 29 plant species in 1,270 user reports, while veterinary pests scored least with 5 species in 326 reports. However, all groups returned a high ICF that is, above 0.9 indicative of the fact that there is a high user consensus among the farmers and a likelihood of sharing ideas about use of botanicals.

## DISCUSSION

Ethnobotanical surveys are made for different reasons. Some of these include assessment of functions of plants, for example identification of medicinal species (Jouad et al., 2001; Kamatenesi-Mugisha et al., 2007b; Katuura et al., 2007) and analysis of species diversity in a given area (Oryemoriga et al., 1995). Other reasons include determination of species conservation status (Schemske et al., 1994; van Jaarsveld et al., 1998) or when trying to identify new plant species in an area that is not yet extensively studied (Oryemoriga et al., 1995).

This study was meant to establish a record of pesticidal plant species used in Masaka district, South Uganda and how they are utilized.

It was found out that 34 species distributed in 18 families are being used in Masaka district as pesticidal plants (Table 1). Some of these species are already established /confirmed pesticidal plants such as *A. indica*, *M. azedarach*, *J. curcas, Tagetes. minuta, Tithonia rotundifolia, Chrysanthemum* spp (Isman, 2006) but there

**Table 3.** Family use values.

| Family | No. of species | % of all species | Use citations | % use citations | UV |
|---|---|---|---|---|---|
| Asteraceae | 6 | 17 | 354 | 17.41 | 0.453 |
| Solanaceae | 4 | 12 | 277 | 13.62 | 0.532 |
| Euphorbiaceae | 4 | 12 | 285 | 14.01 | 0.548 |
| Fabaceae | 3 | 9 | 143 | 7.03 | 0.366 |
| Cupressaceae | 2 | 6 | 114 | 5.60 | 0.438 |
| Meliaceae | 2 | 6 | 235 | 11.55 | 0.903 |
| Myrtaceae | 2 | 6 | 116 | 5.70 | 0.446 |
| Alliaceae | 1 | 2.9 | 56 | 2.75 | 0.430 |
| Anacardiaceae | 1 | 2.9 | 65 | 3.19 | 0.500 |
| Annonaceae | 1 | 2.9 | 55 | 2.75 | 0.423 |
| Arecaceae | 1 | 2.9 | 15 | 0.73 | 0.115 |
| Asparagaceae | 1 | 2.9 | 45 | 2.21 | 0.346 |
| Cannabaceae | 1 | 2.9 | 52 | 2.55 | 0.400 |
| Caricaceae | 1 | 2.9 | 32 | 1.57 | 0.246 |
| Phytolacceae | 1 | 2.9 | 43 | 2.11 | 0.330 |
| Poaceae | 1 | 2.9 | 45 | 2.21 | 0.346 |
| Rutaceae | 1 | 2.9 | 32 | 1.57 | 0.246 |
| Verbenaceae | 1 | 2.9 | 69 | 3.39 | 0.530 |

are some species like *E. tirucalli, Euphorbia candelabrum, Bidens pilosa and Vernonia amygdalina* that would require efficacy evaluation and publication/popularization for use as pesticidal plants. Therefore, there is a need to substantiate findings of this study by carrying out efficacy studies and other related work that may lead to confirmation and recommendation of such plants for more extensive use.

Meliaceae and Euphorbiaceae were reported to be the most useful families in this area for having a good number of species with pesticidal features. This means that they are good families to start from when looking for species of pesticidal importance.

Plants produce a variety of secondary metabolites to protect themselves against pathogens and herbivores and/or to influence the growth of neighboring plants (Fraenkel, 1969; Swain, 1977; Edwards, 1992; Sirikantaramas et al., 2008). The same authors go on to say that some of these metabolites are toxic to the producing cells when their target sites are present in the producing organisms and must therefore be demobilized. Such substances include alkaloids (Dethier, 1980), tannins (Bernays, 1981), phenols (Palo, 1984), terpins (Schutte, 1984), and according to Gatehouse (2002), these are the substances man can exploit to make pesticides of botanical origin for pest control.

Our results are indicative of the fact that leaves constitute a large portion of the said secondary substances. This conclusion was reached at by considering our results (Figure 3) which show that most-exploited tissues of pesticidal plants are leaves (76%) followed by fruits and seeds (53%) and then the bark with 29%. These findings could be attributed to the positioning of plant parts on a plant. Plant defense theories suggest that chemical or structural defences should be maximized when and where browsing is most likely to occur (Massei et al., 2000). Leaves are exposed and conspicuous, which makes them easy targets for herbivore attack. It is not surprising, therefore, that plants tend to deposit and localize secondary substances in exposed parts such as leaves and fruit/flowers to act as deterrents to herbivores. Plants without conspicuous leaves like *Euphorbia* spp. utilize their green stems/latex for such a purpose.

Similar findings have been reported by Kamatenesi-Mugisha et al. (2007a), Maregesi et al. (2007), Ssegawa and Kasenene (2007) giving a clue to researchers on the cardinal parts to assess when in search of pesticides from plants.

Crops in tropical countries are heavily attacked by a variety of pests and diseases which are active throughout the whole year, probably due to tropical conditions (Kamatenesi-Mugisha et al., 2007a). Farmers, therefore have to fight these pests in order to obtain tangible outputs from fields. However, during the present study, farmers could not point out exactly the particular pests managed by the mentioned pesticidal plants which could be a limitation for pest management. They reported pests generally as storage pests, insects, weevils, field pests and others (Table 2). Such type of identification is incoherent and groups pests in categories that cannot help to draw scientific conclusions. While this could be attributed to low literacy rates of the farmers in this region (Dent, 2007), it could also be due to the fact that a remedial concoction is often composed of a number of plant species and targets several pest species in the field or in storage (Kamoga per.comm). The need for research to elucidate chemical composition of the medicinal species and evaluate specific pests managed by particular plants species through efficacy studies was observed.

During our analysis, it was found appropriate to categorize the mentioned pests in broad groups namely field pests, domestic pests, veterinary pests and storage pests in order to give a broad view of pests managed by these plants. According to this categorization, field pests were the most-cited with 1270 user reports on 29 species, followed by storage pests (661 user reports on 16 species) indicative of the dominant type of occupation in the area studied. Masaka district is dominated by arable farming with little emphasis on pastoralism (Tenywa et al., 1999). It is likely that different results would have been obtained in a predominantly pastoral region (Gradé, 2008).

During interviews with extension staff, it was revealed that certain medicinal plants are no longer available in the area studied and farmers have to travel long distances to harvest them. Species named include: *Abrus precatorius, Phoenix reclinata,* and *E. candulubrum*, which are mainly woodland species. Without substantiation, farmers also reported that some plants are completely unavailable and cannot be found anywhere, which could have implications of extinction. Most of South Uganda and Masaka district in particular was originally a woodland area where these trees were once abundant (Hamilton, 1974). However, most of them have long been cut down for timber and while opening up agricultural land as the population increased. This is not surprising because over the years, an increasing number of plants have been red-listed as threatened species by IUCN in Uganda. For example, in 1997, IUCN had a red-list of 15 plants in Uganda (Walter and Gillet, 1999), which increased to 33 in 2002 (Earthtrends, 2003) and to 38 in 2008 (IUCN, 2009). This confirms our and other people's fears e.g. Hedberg (1993), Cox (2000) that unless these plants and the traditional knowledge thereof are documented now, they will soon face extinction. Therefore, due considerations to conserve these species (for example by domestication) should be made as quickly as possible before they disappear completely.

## Conclusion

This study has shown that numerous plant species are used in this region for purposes of pest management. Notable ones such as *A. indica*, *M. azedarach*, and *T. minuta* dominate the application scene but a few 'new ones' like *B. pilosa and E. tirucalli* were also documented (for this purpose) for the first time in this region.

Therefore, there is need to establish their efficacy and identify the pests against which their extracts are most active. Also, the need for conservation of such species of pesticidal importance was noted. The earlier it is done, the better for pest management and biodiversity.

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