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Farmers' knowledge, perceptions and control of pestiferous termites in Nakasongola district, Uganda

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Abstract

This study documented farmers' indigenous knowledge on termite damage and management practices in Nakasongola district, Uganda using a pre-tested questionnaire. The majority (84%) of 94 farmers interviewed were aware of the termite damage on vegetation in rangelands and croplands, and the damaging termite species. *Pseudacanthotermes militaris*, *Macrotermes subhyalinus*, *M. bellicosus*, *Nasutitermes arboreus* and *Eutermes arborum* were reported to cause severe damage to pasture grass, trees and/or crops. Farmers' knowledge of termite damage was significantly influenced by their age, sex and education. About half of the farmers had attempted to control termites, but with little success. Application of chemicals was the most commonly reported control method followed by queen removal. Farmers' efforts to control termites were mainly limited by high costs of chemicals and lack of knowledge on effective control methods. Implications of these findings on the development and promotion of integrated termite management strategies are discussed.

Key words: Indigenous knowledge, pest management, plant damage, rangelands, termites

Introduction

Plants in range and croplands are important sources of rural livelihoods in Africa. However, termite damage to trees, shrubs, crops and pastures is a major constraint to the productivity of these ecosystems (Cowie *et al.*, 1989; Logan *et al.*, 1990; Sekamatte *et al.*, 2000). Although the majority of termite species are beneficial because of their key ecological roles of nutrient recycling and provision of food and harborage for many other life forms, soil inhabiting termites are serious pests of rangelands, tropical forestry and tropical agriculture (Anonymous, 2005a). In Australia, for instance, termites degrade rangelands as consumers of arid vegetation in addition to overgrazing and bush fires and when trees and shrubs are lost from rangelands, the impact of termites can increase vegetation degradation (Anonymous, 2005b). In Africa, over 50% termite damage to maize has been reported in croplands in Nigeria, Ethiopia and Uganda (Wood *et al.*, 1980; Cowie and Wood, 1989; Sekamatte *et al.*, 2001) and *Armitermes evuncifer* has been reported as a pest of yams, groundnuts, sugarcane and some trees (Pearce *et al.*, 1995; Sands, 1998).

In Uganda, termites attack and damage several food crops, especially maize, cassava and groundnuts (Sekamatte *et al.*, 2001). Among trees, *Eucalyptus* species are widely attacked, and damages on other trees such as *Calliandra calothyrsus*, *Grevillea robusta*

and indigenous trees in rangelands has been reported (Sekamatte, 2001; Nyeko *et al*, 2004; Nyeko and Olubayo, 2005). In Nakasongola district, attack on agricultural crops, pasture grass, shrubs and trees in croplands and rangelands has been reported with the most damaging termite species being, *Macrotermes subhyalinus*, *M. bellicosus*, and other *Microtermes* species and *Pseudacanthotermes militaris* (Sekamatte, 2001, 2002).

Although there have been scientific advances to control termites using chemical, cultural and biological methods (Logan *et al.*, 1990; Su, 1994; Songa *et al.*, 2002; Nkunika, 2002; Sekamatte *et al.*, 2003), effective control of termites, and thus improvement on farmers' livelihoods, requires integrated efforts that take into account farmers' indigenous knowledge and management practices. Nyeko *et al.* (2002) pointed out that realistic evaluation of farmers' basic socio-economic characteristics, pest knowledge and perceptions, pest management practices and constraints, and decision-making processes is needed if new pest management technologies are to be adapted to local farmers' situations. Such information is important for the development of appropriate pest management strategies with high potential of adoption by farmers.

This study aimed at documenting farmers' indigenous knowledge about termites and their damage in range and croplands in Nakasongola district, Uganda in order to promote and improve integrated termite management by local communities. The specific objectives of the study were to document: farmers' knowledge and perceptions of termite damage; their termite control practices; and constraints they encountered.

Materials and methods

Study area

The study was conducted in December 2002 in Nabiswera subcounty, Nakasongola district, Uganda where there is high termite infestation. Nakasongola district is located between 32° 00' – 33° 00' East and 0° 40' – 2° 00' North of Uganda and lies at an altitude of 1082 m – 1372 m above sea level. The rainfall pattern in the district is bimodal with peaks in March and May, and August and November. The mean annual rainfall in the district is 1230 mm while the mean annual maximum and minimum temperatures are 30°C and 21.5°C, respectively (Rwabwoogo, 1997). The soils in the district developed from laterised gneiss granite rich basement complex, old alluvial material and recent alluvial deposits (Nakasongola District Local Government, 2001). The natural vegetation cover in the district comprises moist thickets, moist *Combretum – Terminalia – Loudetia* savanna, *Combretum – Hyperrhenia* savanna, dry thickets, and plant communities on sites with impeded drainage and wetlands (Langdale-Brown *et al.*, 1964). About 97% of the population are subsistence farmers. The major food and cash crops cultivated in the district include cassava (*Manihot esculenta*), sweet potatoes (*Ipomoea batatas*), maize (*Zea mays*), groundnuts (*Arachis hypogaea*), beans (*Phaseolus vulgaris*), sorghum (*Sorghum bicolour*), bananas (*Musa* species), soyabeans (*Phaseolus* species), finger millet (*Eleusine coracana*), cotton (*Gossypium hirsutum*), coffee (*Coffee robusta*), cocoa (*Theobroma cacao*), fruits and vegetables respectively (Rwabwoogo, 1997). Sedentary pastoralism is also a major economic activity in the district. The commonly kept livestock are cattle, sheep and goats.

The survey

A total of 94 farmers were randomly selected from lists of farmers in three parishes (Kyangogolo, Nalukonge and Migeera)and interviewed using a pre-tested open ended questionnaire, to avoid limiting farmers' responses to set options. The questions focused on farmers' socio-economic background and farming systems, farmers' experience on major pests in their farming systems with emphasis on termites. Using the questionnaire farmers identified and

ranked (low. moderate, and high) the pestiferous termite species according to the levels and severity of damages they cause on trees, crops and pasture. They also indicated indigenous termite control practices with emphasis on methods used, mode of application, effectiveness and constraints to termite management. All interviews were conducted in vernacular (Luganda). A transect walk in the company of the farmers was conducted across crop fieldsand rangelands in order to collect samples of termites; assess the damages they cause; and verify the capacity of the farmers to distinguish the different damaging termite species encountered. The termite species that were collected were delivered for taxonomic classification at the Faculty of Agriculture, MakerereUniversity.

Data analysis

The raw data obtained were coded and entered into a spreadsheet in SPSS statistical package (version 10). Descriptive statistics were used to summarise farmers' responses into percentages that were based on either the total responses to a particular question or the total number of respondents for the study. Mean scores of the effectiveness of various control methods against different termite species, were determined by averaging the scores of each control method for each termite species. Chi-square test at 5% probability level was used to determine the influence of farmers' background on awareness of termite damage (Armstrong and Eperjesi, 2001; Nyeko *et al.*, 2002).

Results

Farmers' background

The majority (73%) of farmers interviewed in this study were males. Farmers' age averaged 43 years but varied widely between 15 and 75 years with only 21% of them being above 60 years old. The majority (51%) of respondents were cultivators while 34% of them were pastoralists and only 15% were both cultivators and pastoralists. All the farmers had attended formal education with 26% and 73% of them educated to primary level and at least secondary level, respectively.

Common pests in range and croplands

Most farmers (96%) reported observing various pests of plants and livestock on their rangelands and croplands. Termites were the most commonly reported pests in both rangelands and croplands, followed by potato weevils in croplands and ticks and tsetseflies on cattle in rangelands (Table 1). Antelope was the least mentioned pest in both rangelands and

Farmers' knowledge and perceptions of termite damage

Overall, 84% of the farmers interviewed were aware of termite damage. Farmers identified a total of nine termite species causing damage to plants in the rangelands and field crops (Table 2). The most commonly cited termite species was *Macrotermes subhyalinus* (23%) followed by *M. bellicosus* (17%) and *Pseudacanthotermes militaris* (14%). Two unidentified species locally called '*Ezomumpanga*' and '*Ezomumpita*' were each mentioned by only two farmers, suggesting that they were rare. Farmers' identification of termites was based on the general colour and size of the heads of soldiers.

The majority of farmers who reported *Pseudacanthotermes militaris, Nasutitermes arboreus* and *Eutermes arborum* rated these species as highly damaging while those who reported *Macrotermessubhyalinus* and *M. bellicosus* mostly rated them as moderately damaging (Table 3). In contrast, none of the farmers who observed '*Ezomumpita*' (Unidentified 2) rated it as highly damaging. *Pseudacanthotermes militaris*, *M. subhyalinus* and *M. bellicosus* were reported as causing severe damage to both living and dead plant materials. When asked to rate termite damage on different vegetation types, the majority of farmers perceived that termite damage was most severe on pasture grasses (41%) followed by cultivated crops (34%) and trees (25%). Up to 25% of the farmers rated *P.*

Table 1. The numbers and percentages of farmers that have experience with various crop and livestock pests in Nakasongola district

Pest	Responses*			
	Rangeland		Cropland	
	No.	%	No.	%
Termites (Enkuyegge)	81	36.7	67	28.4
Ticks (Enkwa)	36	16.5	13	5.7
Tsetse flies (Ebivvu)	34	15.3	11	4.7
Caterpillars (Ebisanyi)	31	14.7	32	13.4
Banana weevils (Kayovu)	13	6.0	22	9.4
Cassava mosaic virus (Kagengewala)	13	6.0	30	12.7
Centipedes (Amagongolo)	5	2.3	6	2.4
Antelopes (Engabi)	4	1.8	1	0.2
Bean weevils (Kawukumi)	2	0.7	17	7.4
Potato weevils (Kimonde)	2	0.7	37	15.7

*Responses do not add up because multiple responses were possible. Words in parentheses are local (Luganda) names of pests

Table 2. Termite species identified by farmers

Termite species		% of respondents
Local (Luganda) name	Scientific name	
Ensegere	*Macrotermes subhyalinus*	23.0
Empawu	*Macrotermes bellicosus*	17.0
Kaseregete	*Pseudacanthotermes militaris*	14.0
Enaka	*Nasutitermes arboreus*	13.8
Enkulukuku	*Eutermes arborum*	11.7
Ntunda/Entunddu	*Pseudacanthotermes* spp	9.0
Embaala	*Cubitermes* spp	5.3
Ezomumpanga	Unidentified. 1	3.1
Ezomumpita	Unidentified. 2	3.1

militaris as most damaging to pasture grasses. The farmers reported that this termite often wanders in the rangelands and croplands and extensively covers the grasses with faecal matter, eventually consuming the grasses completely within days. *Pseudacanthotermes militaris* and *M. bellicosus* were reported to cause high damage to grasses (26%) and trees (43%), respectively. However, most of the farmers considered *M. subhyalinus* most damaging to trees and crops. The farmers (39%) perceived this termite species as causing a wide range of damage to various plant species, and damaging all plant parts. The farmers reported that plants damaged by *M. subhyalinus* usually have parts covered

Table 3. Farmers' perceptions of levels of damage caused by different termite species

Termite spp	Perceived level of damage			Total responses*	
	Low	Moderate	High	No.	%
Pseudacanthotermes militaris	7	14	67	88	25.0
Macrotermes subhyalinus	12	43	18	73	20.7
Macrotermes bellicosus	13	27	19	59	16.8
Nasutitermes arboreus	0	7	42	49	13.9
Eutermesarborum	0	0	43	43	12.2
Pseudacanthotermes spp.	4	11	5	20	5.7
Unidentified 1	9	1	1	11	3.1
Unidentified 2	7	2	0	9	2.6
Total	52	105	195	352	100

* Responses do not add up because multiple responses were possible

with earth tubes, and are debarked often with tunnels in the stem that lead to death of the whole plant.

When asked to name plant species most damaged by termites, the majority of farmers cited grasses (24%) followed by cassava (14%), *Eucalyptus* species (Kalitunsi) (12%) and *Grewiamollis* (Mukomo) (11%) (Table 5). In contrast, less than 1% of them mentioned termite attack on *Combretummolle*. *Eucalyptus* species (49%) and *Grewiamollis* (36%) were reported to be most susceptible to *M. bellicosus*. The crop most commonly reported to be damaged by termites was cassava (14%) and maize (10%). Sugarcane and groundnuts were least reported to be damaged by termites (Table 4). Most of the farmers (66%) emphasised that termite damage was highest on dead trees than the living ones and that termites damage pasture grasses faster than trees. Farmers' knowledge of termite damage was influenced significantly ($P < 0.05$) by their sex, age and education level (Table 5).

Farmers' termites control practices

Overall, 51% of the respondents interviewed had attempted to control termites. More farmers (59%) had attempted to control termites on croplands than in rangelands (41%). The farmers claimed to have used a wide range of control practices against termites (Table 6). The majority of farmers, who had attempted to control termites used chemicals including acaricides and insecticides. Among the farmers who used chemicals, 23 % (all of whom were pastoralists) applied cattle sprays such as supona (chlorfenvinphos)and gamatox (lindane BP) to control termites because they desperately wanted to eradicate damaging termites. The insecticides farmers used included Ambush (permethrin) and Furadan (carbofuran). Other commonly reported termite control practices were the traditional queen removal from termite mounds (19%) and firing/smoking of the mounds (13%). Farmers used these methods to control *Macrotermes subhyalinus* (31%), *Pseudacanthotermes militaris* (29%) and *Macrotermes bellicosus* (13%). Few farmers reportedly attempted to control the unidentified *Pseudacanthotermes* species (6), Ezomumpanga (1) and Ezomumpita (5) apparently because of the low damage these termites were reported to cause. A few farmers (5%) had attempted using predatory ants which they had observed being tested in the study area by the Nalukonge Community Initiative Association (NACIA) (Table 6).

Marked variability was reported in the effectiveness of various methods used by farmers (Table 7). The majority (65%) of farmers

Table 4. Farmers' perceptions of the susceptibility of different plants to termite attack

Termite species	Plants damaged												Total
	No. of responses												
	Trees				Grasses	Crops							
	Acacia hockii	*Grewia mollis*	*Eucalyptus* spp	*Combretum molle*	Grasses	Maize	Millet	Sorghum	Cassava	Potatoes	Sugar cane	ground nuts	
P. militaris	3	9	9	2	19	5	11	6	17	3	4	0	88
M. subhyalinus	4	2	5	3	16	8	5	4	11	7	2	6	73
M. bellicosus	0	14	20	0	16	0	0	0	9	0	0	0	59
N. arboreus	4	5	0	2	14	7	2	0	4	11	0	0	49
E. arborum	2	8	17	0	3	8	0	2	0	1	1	1	43
Pseudacanthotermes spp	0	1	0	0	3	2	1	0	5	0	0	0	12
Unidentified 1	0	0	0	0	2	4	2	1	1	1	0	0	11
Unidentified 2	0	0	0	0	5	2	1	0	1	0	0	0	9
Total	13	39	41	7	84	36	24	13	48	23	7	7	352

*Responses do not add up because of multiple responses

Table 5. Influence of farmers' background on their knowledge on termite damage

Farmers' background	Knowledge of termite damage			X^2	P*-value
	Unaware	Aware	Total		
Sex					
Female	15	10	25	0.689	0.000
Male	1	68	69		
Total	16	78	94		
Education level					
Primary	7	19	26	0.215	0.036
Secondary and above	8	60	68		
Total	15	79	94		
Age					
15 - 45 years	14	42	56	0.219	0.033
46 and above years old	6	32	38		
Total	20	74	94		

* P-value significantly different at 5% level of significance

who had attempted to control termites reported very little success using the various methods attempted (Table 6). On average queen removal was reported to be the most effective method for controlling *M. subhyalinus*, but not *E. arborum* (Table 7). Mound firing/ smoking method was reported to be relatively more effective against *M. bellicosus*, *N. arboreus* and *E. arborum* than any other methods attempted. The effectiveness of the chemicals applied was generally rated as low in controlling several termite species (Table 7). Similarly the effectiveness of crushed dry cells, grease or oil, human urine, rainwater, hot water, ash and predatory ants against termites were generally rated as low (Table 7). However, predatory ants were rated as moderately effective against *P. militaris*. The farmers (49%) who did not attempt any termite control methods cited a number of reasons for doing so, including (i) high costs of termite control (40%) (ii) not aware of any effective chemicals against termites (12%) and waiting for results of control methods being piloted tested by NACIA (2%).

Discussion

Farmers' knowledge of termite diversity and damage

The majority of the farmers interviewed during this study had observed various pests on their rangelands and croplands with termites being the most commonly reported. In particular, *Pseudacanthotermes militaris*, *Macrotermes subhyalinus*, *M. bellicosus*, *Nasutitermes arboreus* and *Eutermes arborum* were cited as causing severe damage to various vegetation types. This finding corroborates earlier reports that termite damage is a serious and widespread problem in the district (Sekamatte, 2002). Similar termite problems have been reported by farmers in agricultural systems in other districts of Uganda (Nyeko *et al.*, 2004; Nyeko and Olubayo, 2005), and in other tropical countries (Logan *et al.*, 1990;

Table 6. The number of and percentage of farmers using various methods of control for different termite species in Nakasongola district of Uganda

Control method	Farmers' responses								Total	
	Termite species									
	M. subhyalinus	*M. bellicosus*	*P. militaris*	*N. arboreus*	*E. arborum*	Unidentified 2 Ezomumpita	Unidentified1 Ezomumpanga	*Pseudacan-thotermes* spp	No.	%
Queen removal	19	0	11	0	1	0	0	0	31	18.6
Chemicals	17	15	25	7	5	0	0	0	69	41.3
Ash	6	2	5	2	0	0	0	3	18	10.8
Hot water	4	0	0	0	0	0	0	0	4	2.4
Smoking	4	2	1	4	6	1	1	2	21	12.6
Human urine	1	1	1	0	0	0	0	0	3	1.8
Ants	1	1	2	1	1	3	0	0	9	5.4
Grease or oil	0	0	2	0	0	0	0	0	2	1.2
Dry cells	0	0	0	3	0	1	0	1	5	2.9
Rain water	0	0	2	1	0	0	0	0	3	1.8
Trenching	0	1	0	1	0	0	0	0	2	1.2
Total	52	22	49	19	13	5	1	6	167	100.0

Table 7. Farmers' rating of the effectiveness of different control methods they attempted against different termite species

Control method	Effectiveness against termites (mean scores)								No. of responses	%
	Termite species									
	M. subhyalinus	*M. bellicosus*	*P. militaris*	*N. arboreus*	*E. arborum*	Unidentified 2 Ezomumpita	Unidentified1 Ezomumpanga	*Pseudacanthotermes* spp		
Queen removal	2.32	-	0.91	-	0.00	-	-	-	31	18.6
Ash	2.00	0.00	0.80	1.00	-	-	-	1.00	18	10.8
Chemicals	1.64	1.00	1.28	1.43	0.80	-	-	-	69	41.3
Smoking	1.25	2.50	1.00	2.50	2.67	0.00	1.00	1.00	21	12.6
Human urine	1.00	0.00	0.00	-	-	-	-	-	3	1.8
Ants	1.00	1.00	2.00	0.00	1.00	0.67	-	-	9	5.4
Hot water	0.75	-	-	-	-	-	-	-	4	2.4
Grease or oil	-	-	1.00	-	-	-	-	-	2	1.2
Dry cells	-	-	-	0.67	-	0.00	-	1.00	5	2.9
Rain water	-	-	1.00	0.00	-	-	-	-	3	1.8
Trenching	-	0.00	-	1.00	-	-	-	-	2	1.2

*Effectiveness of control methods were scored as follows: 0 = not effective, 1 = low effectiveness, 2 = moderately effective, 3 = high effectiveness

Nkunika, 2002). Such pests require immediate attention if national poverty eradication action plans through the improvement of agricultural production is to succeed.

Information about indigenous taxonomy of termites is scarce in the literature, indicating the need for documenting such valuable information from a wide range of ethnic groups. In this study, farmers consistently identified termite species based on the colour and size of the heads of soldiers. In eastern Uganda, Nyeko and Olubayo (2005) reported that farmers use a wider range of such simple features including, mound building character, mound morphology, timing of alate flights, and size, colour and/or odour of workers, soldiers and alates to consistently identify termite species. Such indigenous taxonomic skills could be vital for communication between researchers, extension agents, educators and farmers for effective communication and development of management programmes for different termite species.

This study showed that gender, age and education level are important in their understanding of termite problems. The farmers between 15 and 45 years old were more aware of termite damage than those between 46 and 75 years old, apparently because the former were more active cultivators and pastoralists and, therefore, frequently encountered termites damaging vegetation. Males were more aware of termite damage than females. This is contrary to the commonly held view that women are more active in farming and play a predominant role in pest management than men (Malena, 1994). It could be attributed to the fact that men in Nakasongola district were more exposed to meetings and sensitisation programmes about termite damage than the females.

Farmers who had attained secondary education were more aware of termite damage than those who stopped in primary schools probably due to basic concepts on termite biology and ecology taught in secondary schools. Gender, age and educational backgrounds may not only influence pest awareness but also adoption of new pest management strategies. For example, Alston and Reding (1998) reported that younger farmers with higher education levels were more likely to recognise harmful environmental effects of pests and are likely to be more willing to adopt new technologies in organic pest management.

Termite control methods

Although the majority of farmers interviewed in this study considered termites as a major production constraint in rangelands and croplands, only about half of them had attempted to control the insect. This suggests inadequate flow of termite management information among farmers. Community based organisations such as NACIA should therefore intensify their dissemination programmes on termite management with the aim of making farmers less dependent on chemical inputs, which a number of them considered to be prohibitively costly.

The farmers who had attempted to control termites cited several control methods that they had used, ranging from chemical, cultural to biological control strategies. The application of such control methods by farmers is commonly reported in the literature (Wardell, 1987; Logan *et al.*, 1990; Nkunika, 2002; Nyeko and Olubayo, 2005). However, the application of acaricides reported in this study is lacking in the literature, and apparently suggests misuse of the pesticides.

Misuse of chemicals by farmers is common in the literature. For example, Propper *et al.* (1996) reported that in rural Guatemala insecticides were mentioned more often by coffee farmers for combating fungi than were fungicides. Nyeko *et al.* (2002) found that some farmers in Kabale district, Uganda advised others to use Dithane for combating aphids. This means that the pesticides would be wasted, resulting in unnecessary and potentially harmful health and environmental impacts. There is a need to train farmers on the use of pesticides in termite management.

Trutmann *et al.* (1996) pointed out that education about pesticides, to which farmers are exposed, would promote more selective,

less dependent use and safer handling of such products and provide farmers with a more objective basis for decisions about pesticide use in local systems.

That some farmers interviewed in this study had attempted using predatory ants to control termites is encouraging. Several authors (e.g. Cowie *et al.*, 1989; Sekamatte *et al.*, 2001) have suggested the need to integrate such natural enemies as part of termite management strategies. There is, however, a need for sensitisation of more farmers about the importance of such biological control agents. Knowledge of natural enemies may be increased among farmers by simple experiments such as putting a predatory ant and termites pest in a jar or exhibiting to them sporulating entomo pathogenic fungi such as *Metarhiziumanisopliae* on termites attacked and killed by the fungus. Such simple techniques teach farmers to appreciate the role of natural enemies (Van Huis and Meerman, 1997; Nyeko *et al.*, 2002).

Although the farmers reported attempting several termite control strategies in this study, they considered most of the methods not highly effective. Nonetheless, such methods need to be documented, tested, adapted and promoted to farmers with other integrated pest management strategies. With new and traditional knowledge, farmers themselves would then be able to develop suitable pest management technologies and make better decisions as to which technologies to accept and demand (Nyeko and Olubayo, 2005).

Conclusions

Overall, farmers demonstrated good understanding of the termite species and their particular damage to plants. Also the limited efforts by farmers to control pestiferous termites in Nakasongola district provides a basis for building adequate capacity for integrated termites management that utilises the body of knowledge already existing among the farmers. Farmers' capacity in termite diagnosis and use of effective termite management strategies need adequate attention. Studies to improve the efficiency of the termite control methods documented during this study could be vital in overcoming the termite problem.

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