ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 2 March 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Short communication

Afr. J. Food Agric. Nutr. Dev. 2021; 21(2): 17643-17655 https://doi.org/10.18697/ajfand.97.18520

A DOCUMENTATION OF PLANTS USED BY RURAL SMALL-SCALE FARMERS TO CONTROL MAIZE PESTS IN THE EASTERN CAPE PROVINCE OF SOUTH AFRICA

Skenjana NL[1, 2]* and AJ Afolayan[2]

Nolitha L Skenjana

*Corresponding author email: leo_mlanj@yahoo.com

[1]Plant and Crop Production Research Services Directorate, Döhne Agricultural Development Institute, Stutterheim, South Africa

[2]Medicinal Plants for Economic Development Research Centre, Botany Department, Faculty of Science and Agriculture, Fort Hare University, Alice, South Africa

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 2 March 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

ABSTRACT

Maize (*Zea mays L.*) small-scale farmers in the rural areas of the Eastern Cape Province of South Africa are generally under resourced, and as a result their crops are vulnerable to pest attacks. The farmers often cannot afford farming implements and inputs, and tend to improvise with what is freely available in their surroundings. Regarding pests, farmers tend not to follow the conventional use of chemical insecticides and rather use alternative methods of control such as plant-based methods. Plant-based methods that are founded on formulations and plant combinations, have been found to be eroding due to lack of documentation. This study sought to document the names of plants used in combinations and formulations and their preparation methods so that they can be further used to set a research agenda specific to affordable pest control methods for the Province. Surveys using the convenience and stratified purposive sampling techniques were conducted in selected rural areas of the Eastern Cape Province in order to investigate the plants, their combinations and formulations as used by these farmers to control insect pests of maize. A total of 217 farmers were interviewed. Study protocols adhered to ethical standards set by the Eastern Cape Department of Rural Development and Agrarian Reform. Data were analysed using descriptive statistics, whereas percentages were calculated using Microsoft Excel (2010). Findings revealed that most of the plants used were from families *Solanaceae* and *Asteraceae*. The most preferred plant was *Chenopodium ambrosioides*, a perennial herb from the family *Chenopodiceae*. Although, several arthropods were mentioned by farmers as pests of maize in their cultivation areas, the predominant targets of formulations and combinations were maize stalk borers. These insects were also cited as most troublesome. The common plant part used in combinations and formulations was the leaves. The findings raised the need for a continuous scientific validation and documentation of indigenous pest control methods to bridge the generational gap and increase the range of their use.

Key words: Insect pests, Small-scale farmers, Maize, Plants, South Africa

https://doi.org/10.18697/ajfand.97.18520

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 21 No. 2 March 2021
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

BACKGROUND

Information regarding the use of plant extracts in managing insect pests of maize (*Zea mays L*) in the Eastern Cape Province of South Africa is lacking. Findings from studies conducted by Odeyemi *et al*. [1] have revealed that some farmers are aware of this control method and are using it in managing pests on vegetables. The farmers are, however, old, and as a result the information is disappearing. Its dissemination depends on word of mouth, from one person to another. Documentation of this information would prevent erosion, and theft by opportunists who may seek to use it as their own without acknowledging the true custodians [2]. This study, therefore, aimed at identifying and documenting plants, formulations and their combinations as used by rural small-scale farmers to control field insect pests of maize in the Province.

METHODS

General description of the study site

A survey involving 217 farmers was carried out in five District Municipalities of the Eastern Cape Province, covering 14 towns namely, Butterworth, Centane, Stutterheim, Keiskammahoek, Mount Ayliff, Mount Frere, Mount Fletcher, Sterkspruit, Cala, Cofimvaba, Engcobo, Tsolo, Libode and Port St John's (Fig. 1).

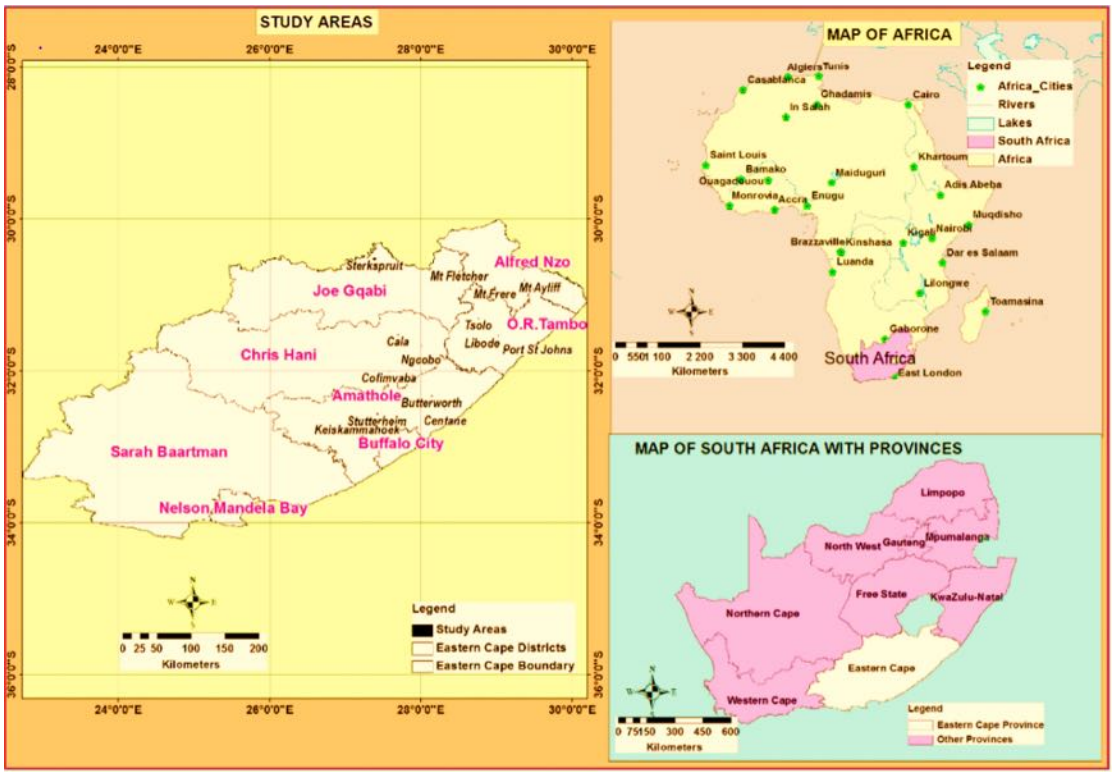

Figure 1: Geographic map of study cites (developed by the Department of Rural Development and Agrarian Reform GIS Unit)

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Survey methodology
Surveys were carried out using convenience and stratified purposive sampling techniques, and the proposal met all ethical compliance standards set by the Department of Rural Development and Agrarian Reform. All farmers had to give a verbal consent prior to participating in the study. The farmers were interviewed using detailed semi-structured questionnaires, which were adapted from Lwoga [3]. Pretesting of questionnaires was conducted at Nqampu Village, in Stutterheim, to identify and correct any interview items that may be misleading to participants.

Data collection and analysis
Data were collected on plants and plant parts used in controlling pests of maize, and preparation methods of extracts and combinations and their target pests. Plants used by respondents in pest control strategies were collected and identified at the Döhne Agricultural Development Institute (DADI) Herbarium in Stutterheim by Dr Theunis Morgenthal and Mr Azile Dumani. Voucher specimens are kept at the same herbarium. Insect specimens were either identified at DADI or sent for confirmation to Mr John Midgley at the Albany Museum in Grahamstown.

Analysis of data was done using descriptive statistics. Microsoft Excel (2010) was used to calculate frequencies and percentages. To calculate the frequency of citation percentage of plants used in maize pest control strategies, equation 1 was used:

$$\text{Frequency of citation: } \frac{Total\ number\ of\ citations\ per\ plant}{Total\ number\ of farmers\ using\ plant-based\ methods}\ X\ 100$$

RESULTS AND DISCUSSION

Plants used to control maize pests
Twenty-one (21) plants were mentioned and used by the farmers in the management of arthropod pests of maize in the field (Table 1). These plants are distributed in 18 genera and 11 families. Majority of plants used and cited by farmers were from the Solanaceae and Asteraceae families. Preference for the use of plants from these families could be attributed to their accessibility, since these plants are herbaceous and normally occur as common weeds in cultivated areas, and to their effectiveness in managing these pests [4]. The most cited plants were *Chenopodium ambrosioides* of the *Chenopodiceae* family (68%), *Tagetes minuta* (Asteraceae) (44 %) and *Nicotiana tabacum* (Solanaceae) (28 %).

Preparation methods
Farmers identified 28 preparation methods (Table 2). These were further classified into 4 main extraction practices, namely, soaking, boiling, burning, and mixing of ingredients. Mainly, formulations were prepared using the mixing preparation method. A variety of plants parts were used in their preparation and the main plant part used was the leaves. The predominant use of leaves in the extracts could be based on their effectiveness, compared to other plant parts since they contain more secondary plant metabolites. In addition, leaves are easier to pick and to work with compared to other plant parts, and possibly were a convenient choice for older farmers who were the majority users of botanical insecticides in this study.

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

The extracts were applied on various parts of the maize plants including whorls, whole plant and leaves, with the main target insect pests being stalk borers. The choice of maize plant part where the formulations were applied was largely influenced by pest type. Although famers had mentioned eight arthropod pests, namely, stalk borers, cutworms, spotted maize beetles, black maize beetles, earwigs, snails, African bollworm, and grasshoppers as problematic in their cultivation areas, only stalk bores, cutworms and beetles were the target of the prepared plat extracts. In fact, it is in only three formulations where stalk borers were not cited as target pests. Generally, for stalk borers, the mixtures were applied on the whole plant, whorl, and leaves while for cutworms they were applied on the whole plant and soil, and soil around the plant. This means that the respondents were aware of feeding, oviposition, and general biology of these insects

Demography of farmers

Out of the 217 farmers interviewed, only 25 (12 %) were using plant-based methods to control arthropod pests of maize (Table 3). None of the farmers 36 years or younger were using this method of control. This could be attributed to lack of or no access to information.

CONCLUSION

From the results of the present study, it can be concluded that the use of plant extracts in insect pest control still exists in the Eastern Cape Province. However, the information on the names of plants used, formulation and/ combination preparation methods reside with fewer older farmers. It is, therefore, recommended that further documentation be done so that more information can be preserved for future use. Scientific assessment and validation of farmers' methods should also be conducted continuously so that these methods can be included in Integrated Pest Management Strategies and education curricular.

DECLARATIONS

Ethics Approval and Consent to participate

The study was conducted following a thorough review of protocols by researchers in the ethnobotanical field of study from the Medicinal Plants and Economic Development Research Centre at the University of Fort Hare in Alice, South Africa. Moreover, the proposal was granted an Ethical Compliance Certificate by the Department of Rural Development and Agrarian Reform.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Authors' contributions
This study formed part of an MSc project, whereby Prof AJA was the supervisor and NLS a student. NLS developed the study design and procedures, collected the data, conducted the statistical analysis, and prepared the draft manuscript. AJA was involved in the study design and protocol development, provided consistent comments during the analysis and write-up of the manuscript, and thoroughly reviewed it. Both authors have read the manuscript, approved its contents, and agreed on its submission.

Funding
The Eastern Cape Department of Rural Development and Agrarian Reform funded the study.

Availability of data and materials
Data generated or analyzed during this study are included in this article.

ACKNOWLEDGEMENTS
The authors extend their deepest appreciation to all the farmers who participated in this study.

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 1: Plants used by famers, scientific name, local name, plant type, growth form and citation frequency of plants by farmers

Voucher Number	Family, Genera & species names	Local names	Plant type	Habitat	Frequency % (N =25)
EntNS 001	Solanaceae, *Solanum aculeastrum* Dun.	Umthuma	Shrub	Wild	8
EntNS 002	Solanaceae, *Solanum giganteum* Jacq.	Icuba lasendle	Shrub	Wild	8
EntNS 003	Solanaceae, *Nicotiana tabacum* L.	Icuba	Perennial herb	Wild/Cultivated	28
EntNS 004	Solanaceae, *Nicotiana glauca* Graham	Icuba lesixhosa elide	Shrub	Wild	4
EntNS 005	Solanaceae, *Capiscum annuum* L.	Upele-pele	Perennial herb	Cultivated	8
EntNS 006	Asteraceae, *Artemisia afra* Jacq.	Umhlonyane	Herbaceous shrub	Wild/Cultivated	8
EntNS 007	Asteraceae, *Tagetes minuta* L.	Untsangu-ntsangu/ Unukayo	Annual herb	Cultivated Ground	44
EntNS 008	Asteraceae, *Bidens pilosa* L.	Umhlabangubo	Annual herb	Cultivated Ground	8
EntNS 009	Asteraceae, *Eriocephalus punculutus* DC.	Isirhalarhala	Shrub	Wild	24
EntNS 010	Asteraceae, *Sonchus oleraceus* L.	Ihlaba	Annual herb	Wild/Cultivated	4
EntNS 011	Alliaceae, *Tulbhagia violacea* Harv.	Isuvumba mpunzi/ utswelana	Perennial herb	Wild/Cultivated	4

https://doi.org/10.18697/ajfand.97.18520

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

EntNS 012	Alliaceae, *Allium savitum* L.	Igaliki	Perennial herb	Cultivated	8
EntNS 013	Alliceae, *Allium cepa* L.	Itswele	Perennial herb	Cultivated	8
EntNS 014	Lamiaceae, *Leonitis ocymfolia* (Burm. f.) lwarsson.	Isihlungu	Perennial herb	Wild/Cultivated	8
EntNS 015	Apiaceae, *Alepidea amatymbica* Eckl & Zeyh	Iqwili	Perennial herb	Wild	16
EntNS 016	Pittosporacae, *Pittosporum viridiflorum* Sims.	Umkhwenkwe	Tree	Wild	12
EntNS 017	Chenopodiceae, *Chenopodium ambrosioides* L.	Unakani/Unukayo	Perennial herb	Wild	68
EntNS 018	Cyperaceae, *Cyperus rotundus* Linn.	Ingca/Imisi/Imizi	Perennial shrub	Wild/Cultivated Ground	4
EntNS 019	Polygonaceae, *Rumex obstusfolius* L.	Idolo lenkonyane	Perennial herb	Cultivated round	8
EntNS 020	Asphodelaceae, *Aloe ferox* Mills	Ikhala	Succulent Tree	Wild/C	32
EntNS 021	Poaceae, *Tristachya leucothrix* Nees.	Inkwenkwe yolusa amathole		W	4

https://doi.org/10.18697/ajfand.97.18520

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 2: **Preparation methods, mode of application, where applied, intervals between applications and insect pest controlled**

Extraction method	Plant part(s) used and preparation methods	Where applied	Intervals between applications	Insect controlled
Boiled	*S. aculeastrum*, *B. pilosa* and *C. rotundus* **whole plants** are boiled in water and allowed to cool	Whole plant	3 day	Stalk borer
Burnt	*S. aculeastrum*, *B. pilosa* and *C. rotundus* **whole plants** are burnt in the infested field and ash is used	Whole plant	Once	Stalk borer
Soaked	*S. geganteum* and *A. afra* **whole plants** are soaked in water for 3 days	Whorl + whole plant for stalk borer/ Soil for cutworms	Once	Stalk borer/ Cutworms
Soaked	One handful of *N. tabacum* **leaves** is soaked in 20L of water for few hours	Leaves	14 days	Stalk borer
Mixed	*N. tabacum* **leaves** are crushed and mixed with 5L of water	Whole plant	3 or 5 days	Stalk borer
Mixed	*N. tabacum*, *S. aleraceus* and *N. glauca* **whole plants** are crushed and mixed with water	Whole plant	7 or 14 days	Stalk borer
Mixed	*C. annum* **pods** cut into small pieces, crushed *A. savitum* **cloves** and 1 tablespoon of	Whole plant	14 days	Stalk borer

https://doi.org/10.18697/ajfand.97.18520

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

	sunlight dishwashing liquid are mixed together in 2 L of water			
Soaked	*T.minuta* and *A.cepa* **whole plants** are soaked in 20L of water for 3 days	Whorl	7 or 14 days	Stalk borer
Soaked	*T. minuta* **leaves** and **stalk** are soaked in water for 7 days	Whole plant	14 days	Stalk borer
Soaked	*T. minuta* and *T. violacia* **leaves** are soaked in 20 L of water for few hours	Whole plant	Once	Stalk borer
Soaked	*E. punculutus* **leaves** and **stalk** are soaked in 20 L of water for 5 days	Leaves	Once	Stalk borer
Soaked	*E. punculutus* **leaves** and rock hyrax urine are soaked in water overnight	Whole plant	Once	Stalk borer
Boiled	**Leaves** of *E. punculutus* and *A. ferox* are boiled in water with copper sulphide	Whole plant	Once	Stalk borer
Mixed	*A. cepa* l**eaves** and **bulbs** are cut into small pieces, mixed with hot water and Madubula	Whole plant	7 days	Stalk borer
Mixed	Dried and crushed **leave**s and **stalk** of *A. amatymbica*, **leaves** and **bark** of *L. ocymofilia* and *P. viridiflorum* are mixed together	Whorl	Once	Stalk borer

https://doi.org/10.18697/ajfand.97.18520

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Mixed	Dried and crushed **leaves** and **stalk** of *A. amatymbica* are mixed with **leaves** and **bark** of *L. ocymofilia* in water	Whorl	Once	Stalk borer
Mixed	Dried and crushed leaves and stalk of *A. amatymbica*, **leaves** and **bark** of *P. viridiflorum* are mixed together.	Whorl	Once	Stalk borer
Mixed	Dried and crushed leaves and stalk of *A. amatymbica*, **leaves** and **bark** of *P. viridiflorum* are mixed together	Whorl	Once	Stalk borer
Boiled	**Leaves** of *C. ambrosioides* are boiled in 20L of water and soaked overnight	Whole plant and soil around it	Once	Stalk borer
Mixed	**Whole plants** of *C. ambrosioides* are mixed with 5L of water	Whorl	Once	Stalk borer/ Black maize beetle
Soaked	A sack filled with *C. ambrosioides* **leaves** and kraal manure is soaked in water for few days	Whole plant	14 days	Stalk borer
Soaked	Ten or more *C. ambrosioides* **whole plants** are soaked in water for 4 days	Whole plant	7 days	Stalk borer

https://doi.org/10.18697/ajfand.97.18520

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Soaked	**Leaves** of *C. ambrosioides* are soaked in water mixed with kraal manure for few days	Whole plant	7 days	Stalk borer
Soaked	**Leaves** of *C. ambrosioides* are soaked in water in a closed container for 3 weeks	Whole plant	Once	Stalk borer
Mixed	*R. obstusfolius* **leaves** are mixed sunlight bar soap in boiled water	Whole plant	Once	Stalk borer
Mixed	Crushed *A. ferox* **leaves** are mixed with water	Whole plant	3 or 5 day	Stalk borer
Mixed	Crushed *A. ferox* **leaves** are mixed with Bulalazonke and water	Whole plant	Once	Stalk borer /Cut worm
Burnt	*T. leucothrix* **whole plants** are burnt in the infested field	Smoke and smell repels insects	Once	Stalk borer

https://doi.org/10.18697/ajfand.97.18520

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 21 No. 2 March 2021 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

Table 3: **Demography of farmers using plant materials to control maize pests**

Data	Alfred Nzo	O.R Tambo	Amathole	Joe Gqabi	Chris Hani	Total
Plant users	8 (23 %)	3 (6 %)	3 (6.4 %)	3 (9.4 %)	8 (15.1 %)	25 (12 %)
Mean Age	65	58	63	64	78	66
Female : Male ratio	5 (62.5 %): 3 (37.5 %)	3 (100 %): 0 (0 %)	3 (100 %): 0 (0 %)	2 (66.7 %): 1 (33.3 %)	3 (37.5 %): 5 (62.5 %)	9 (36 %): 16 (64 %)
Total No. of Farmers	35 (16.1%)	50 (23%)	47 (21.7%)	32 (14.8%)	53 (24.4%)	217

Education Level			
None	**Primary School**	**High School**	**Tertiary Education**
2 (8 %)	11 (44 %)	11 (44 %)	1 (4 %)

Occupation			
Pensioner	**Unemployed**	**Employed**	**Self-employed**
16 (64 %)	8 (32 %)	0	1 (4 %)

https://doi.org/10.18697/ajfand.97.18520

REFERENCES

1. **Odeyemi OO, Masika P and AJ Afolayan** Farmers' knowledge and experience of indigenous insect pest control in the Eastern Cape Province of South Africa. *Indilinga: Afr. J. Indig. Knowl. Syst*. 2006; **5** (**2**): 174 -176.

2. **Sithole J** The challenges faced by African libraries and information centres in documenting and preserving indigenous knowledge. *IFLA Journal*. 2007; **33**(**2**): 117–123.

3. **Lwoga ET** Application of knowledge management approaches and information and communication technologies to manage indigenous knowledge in the agricultural sector in selected districts of Tanzania. PhD thesis. University of KwaZulu-Natal, Pietermaritzburg, South Africa. 2009.

4. **Gazzaneo L, de Lucena R and U de Albuquerque** Knowledge and use of medicinal plants by local specialists in a region of Atlantic Forest in the state of Pernambuco (North-eastern Brazil). *J. Ethnobiol. Ethnomed*. 2005; **1**: 1-9 https://doi.org/10.1186/1746-4269-1-9