Agricultural Journal 2 (2): 242-247, 2007
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Current Post Harvest Practices to Avoid Insect Attacks on Stored Grains in Northern Cameroon

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Abstract: In northern Cameroon, small holders stored their crops for long period in permanent granaries. According to their architecture, these granaries could be grouped in 7 prototypes. During storage in these granaries, to prevent loss of harvested crops due to attacks of insect pests, farmers have a relish for industrial or natural insecticides. These tools are introduced in the granary at the same time they fill it with crops. In the studied area, 17 industrials insecticides are currently used. They are from 4 chemical families: chlorinated hydrocarbons 57%; organophosphates 30%, carbamates, 12% and pyrethrynoids 12%. In the other hand, farmers also introduce plants in their granaries. An amount of 27 plants were identified they belong to 13 botanical families. The 2 most important are Poaceae with 6 species and Lamiaceae with 5 species. The northern part of Cameroon where the storage is fairly conducted is characterised by 67% of farmers using plants as protectant of stored grains, they use mostly bottle-shape granary where the storage can last without significant losses for 48 months.

Key words: Storage, grains, cameroon, insecticide, botanicals, granary, insect pest

INTRODUCTION

From the farm where they are cultivated to their sold on markets or their consumption, grains are exposed to many losses due to several manipulations performed by producers during the post harvest process (Cruz and Troude, 1988; Bell *et al*., 1998; Keita, 1999). These losses affect the quality or the quantity of the stored grains. Main post harvest losses are due to the activities of insects and other pests (Cruz and Troude, 1988; Kodjo, 1989). The structure of the granary may also have an impact in the process (Keita, 1999; Metuge *et al*., 1977). In the northern Cameroon, the main cultivated crops are maize, *Zea mais*, millet, sorghum *Sorghum bicolor* and cowpea *Vigna unguiculata* (Seignobos, 1994). After the culture, the crops dry in fields or on dry tables near houses. Hence, dried products are introduced into granaries with protectant for long-period protection. In these regions where modern storage technologies have not yet been introduced, important damages in stored grains are expected. The most important factors determining storage losses are: The variety and the qualityof the stored grain; the type of store its maintenance and the duration of the storage; climatic factors dependaing on site and season; the possible infestation of grain from the fields and the spectrum of insects able to infest the stock (Stoll, 2000). The analysis of the storing habits with traditional granaries and of their management in order to reduce the post harvest losses of stored products has not been deeply investigate (Alzouma *et al*., 1994; Seignobos, 1982; De Groot, 1997). It is an important step in post harvest procedure for a better management of store products.

Some areas in inter tropical Africa are known as that of insufficiency because of their climate characterised by a long period of dry season lasting for 6 to 8 months and moreover having soils with a very low level of fertility. Many works in these areas were carry on the estimation of the post harvest losses dues to insects pests (Cruz and Troude, 1988; Alzouma *et al*., 1994; Kreiter, 1989). From these works many others were done to find out ways of reducing losses of stored foods and to avoid hunger and poverty. It now comes important to make an inventory of tools that are used in the post harvest process and to

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evaluate each one to finally promote the most efficient. This justify the present work which aims first to analyse the architecture of granaries, secondly to precise the diversity of plants and chemical insecticides currently used by producers and finally to point out the tool for a good management of the storage of grain.

MATERIALS AND METHODS

Presentation of the sampling site: The northern part of Cameroon (Africa) extends from 6° to 13° latitude North and from 11° to 15° longitude E, it coverts 3 administrative provinces belonging to 2 major biogeographical entities in the soudanian area. (1) The soudano guinean area dominated by the Adamawa Plateau (1100 to 1400 m) covered by humid savana. (2) The soudano sahelian area covering the Benoue basin in the North and the Mandaras hills and the Logon basin in the far north all characterised by a typical tropical climate with 2 seasons, a short 3-month humid season and 9 months of dry season (Laclavere, 1979). In northern Cameroon the mean annual temperature is 28±7.7°C.

Collection of information on post harvest process : In the studied region, 3 campaigns were carry out from November 2003 to January 2004, secondly from November 2004 till March 2005 and finally from November 2005 till March 2006. During these periods which correspond that of harvesting crops and filling of granaries, prospects made in rural areas concerned the diversity of the granaries used and the collection of information on the diversity of the chemical or botanical insecticides introduce in the granaries to protect stored grains.

Many granaries were snapped to have pictures or drawing of the main prototypes. Names and wrappers of the chemical insecticides used were noted or collect when possible to establish the list of the currently used industrial products with their correct name. Finally, herbaria of the plants cited were made when they were available. From a year to another and also out of the period of collection, other plants were collected and put in the referenced herbarium at the university of Ngaoundéré. The confirmation of the identification the plants collected was made in comparison with the collection of some local herbaria as that of 'Ecole des Faunes de Garoua', also that of 'Institut des Recherches Agricoles pour le Développement, station de Wakwa' that of the National Herbarium of the Republic of Cameroun at Yaoundé. Finally, the collection of the Herbarium du Jardin Botanique' at Mèze (Brussels) in Belgium was consulted.

RESULTS

During 3 campaigns, 447 elders were consulted in rural northern Cameroon. To conduct their post harvest procedure with success they store their grains in granaries. The insect pests attacks are avoided by the use of botanical, inert or chemical protective tools.

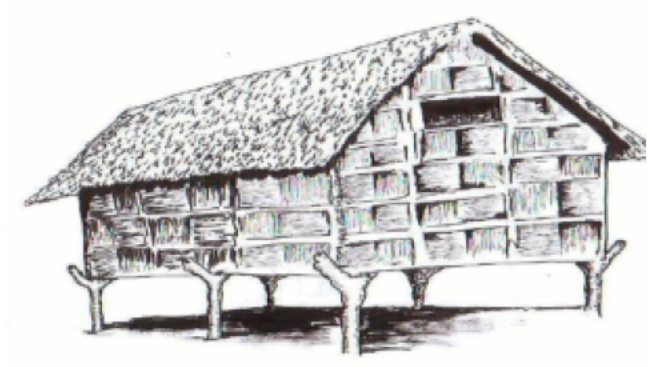
Diversity of the granaries currently used cameroon: Several prototypes of granaries are built by producers in northern Cameroon. They are in general made of leaves, woods or puddle alone or with other ingredients. These granaries vary by their out look, their shape, the type of material used in their construction and the crop stored in. For a same prototype, many variations are observable from a locality to another. Anyhow, for all prototypes observed and their alternatives, 3 principal parts constitute a traditional granary: the base, the body and the cap.

From this observation all the granaries frequently built in the northern Cameroon could be classified in 2 main groups: Granaries with body made of plant material and granary with body made of puddle.

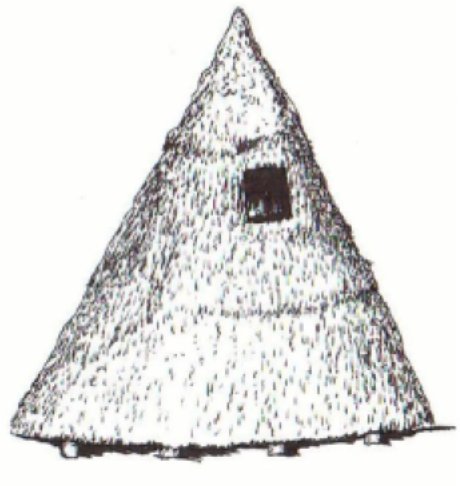
Granaries with body made of plant material: They are grouped in 5 prototypes. Granary with body made of leaves of raphia, *Raphia vinifera* (Arecaceae) having rectangular base built with bamboo (G1) ; granary made of stalk of Poaceae of the genus *Hyparrhenia* having a circular base at about 1.5 to 2 meters above the ground, fire is always made under this granary to warm stored crops (G2) (Fig. 1) ; granary on top of habitations cover with stalk of Paoceae which can in some case be intertwined. Stored crops are not warm by fire (G3); granary with body made of intertwined stalk of *Hyparrhenia* sp. Poaceae called '*secco*' and covered by a mixture of puddle and diverse plant and decaying material (G4) (Fig. 2). Finally underground granary with wall made of *secco* introduced in a 3 or 4 metres dept hole where crops are introduced. After filling this granary, the same types of *secco* are used to cover it (G5) (Fig. 3).

These 4 first prototypes are frequently built in the Adamawa Plateau, in the soudano guinean region except the G5, underground granary which is observed in the Logon basin, in sahelian zone.

Granaries with body made of puddle (Fig. 4): In sahelian region where the level of degradation of the vegetation is very high, granaries are mainly made of puddle alone or associate with dry grasses. The base of the granary can be made of piece of rock or of woods. The body of the

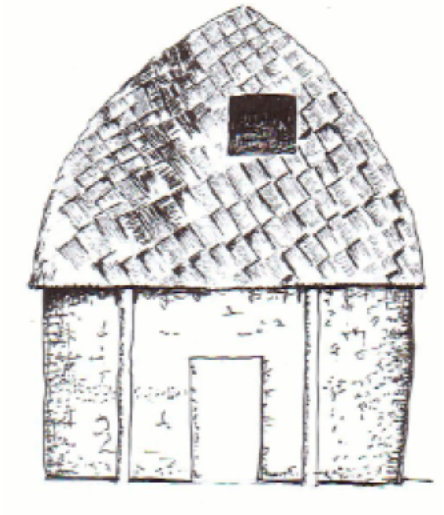


G1: Granary with rectangular base

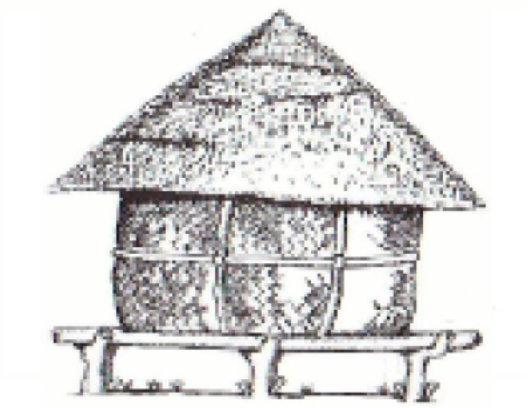


G2: Conice-shaped granary

Fig. 1: Granaries with body made of plant material



G3: Granary on top of house



G4: Granary with secco

Fig. 2: Granaries with body made of twisted plant material

granary is in most of the case divided in 3 or 4 rooms. The granary is filled through a mouth, which is summital (G6) or frontal (G7).

The bottle-shape granary (G6) always have its mouth in summital position. This mouth in some case is sustained by a collar prominence. After the filling period, this mouth is cover by a conical cap made of *secco*. The granary G7 has its mouth in frontal position, in addition to its body divided in rooms it can itself be separated in stairs each one having its mouth.

A former description of the main types of granaries from the northern Cameroon distinguished 3 prototypes named by the ethnic group using them more (Mbon, 1979). The *Tupuri*, *Mundang* and *Fulbe* granaries are the prototypes described. They are all different forms of the bottle-shaped granary (G6). It is difficult to associate granary with a particular ethnic group since in Northern Cameroon (Metuge *et al*., 1977) migrations of populations affected the organisation of the towns and village deeply. With the success of using a particular granary, other

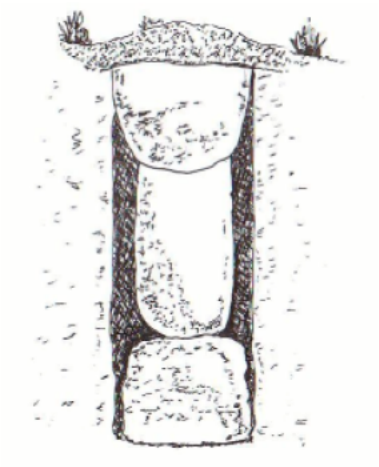
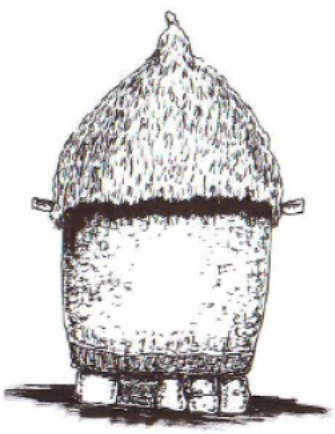
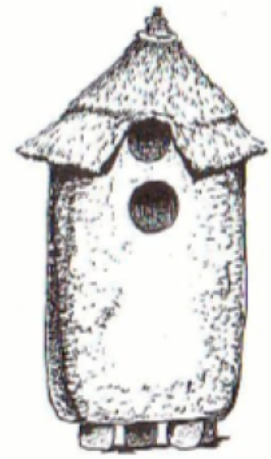


Fig. 3: G5 underground granary



G6: Gottle-shaped granary



G7: Granary with forntal mouth

Fig. 4: Granaries with body in puddle

persons formerly non user adopt easily the new strategy. The granary with lateral mouth also has cap made of conical shape *secco*.

The granary mouth is used to fill and to remove crops. While closed just by a cap made of *secco*, the infestation of crops by pest is not totally avoided. In granary G7, the mouth is firmely closed with a plate, a basin or other large ustensil. Pests can not easily infest crops stored there.

EXPECTED DURATION OF STORAGE

According to tools used to protect their grains during storage producers from year to year make successful storage. A storage is said to be successful if no significant loss in quantity nor in quality is observed during the whole storage. The duration of the storage depends on the needs of the family, the type of the crops and the quantity harvested. Cowpea is the crop that the storage is the shortest. The maximal duration observed is 18 months in soudano sahelian zone, in the guinean zone this maximal period is 12 months. The mean storage duration is 4 months (Table 1). Millet and maize are the 2 crops that are well stored, in Adamawa, they are stored during 8 months and in the sahelian area during 13 months. In this last area, the maximal duration of storage is 4 years.

Use of chemical tools for the protection of the stored grains: In northern Cameroon, producers have a relish on industrial insecticides, 75.84% of the prospected persons in the sahelian region and 57.22% in the Adamawa plateau frequently use insecticides to protect their crops (Table 2). This is the consequence of the liberalisation of pesticides market.

The 16 chemicals used are from 4 classes (Table 3). The chlorinated hydrocarbons (56.25%) with 9 commercials products are the most important. Many banned products still in circulation as dieldrin, lindane,

Table 1: Duration of storage (in month) of stored grains in northern Cameroon

	Guinean zone (n = 169)			Sahelian zone (n = 149)		
	Minimum	Mean	Maximum	Minimum	Mean	Maximum
Cowpea	3	4±0.8	12	3	9.0±7;5	18
Millet	2	8.8±3.7	12	3	13.0±9.6	48
Maize	2	8.3±3	12	2	13;8±9.9	48

Table 2: Users of insecticides to protect grains during storage in northern Cameroon

Zones	Person consulted	Users of industrial insecticides
Guinean	173	57.22% (99/173)
Sahelian	149	75.84% (113/149)

Table 3: Chemicals used for the protection of stored grains in northern Cameroon

Insecticidal classes	Commercial speciality	Rate (%)
Chlorinated hydrocarbons	9	56.25
Organophosphates	3	18.75
Pyrethrinoids	2	12.5
Carbamates.	2	12.5

Table 4: Users of plant as protective tool for stored grains in northern Cameroon

Zones	Users of plants
Guinean zone (n = 173)	14.45% (25/173)
Sahelian zone (n = 149)	66.44% (99/149)

Table 5 Diversity and importance of plants used in northern Cameroon for the protection of stored grains from attacks of insect pests

Botanic family	Amount of plant species per family	Rate (%)
Annonaceae	2	7.4
Acanthaceae	1	3.7
Asteraceae	3	11.10
Bruseraceae	1	3.7
Combretaceae	1	3.7
Convolvulaceae	1	3.7
Cucurbitaceae	1	3.7
Fabaceae	2	7.4
Lamiaceae	5	18.5
Moraceae	1	3.7
Poaceae	6	22.2
Rutaceae	2	7.4
Verbenaceae	1	3.7
Total	27	

DDT and relatives. Other products are from the family of Organophosphates (18.75%), carbamates (12.5%) and pyrethrinoids (12.5%).

Use of plants to protect grains during storage: In the Adamawa plateau, the use of plant to protect is not as usual as the vegetation is diverse. Only 14.45% of the producers have a relish on plant to protect their stored grains (Table 4). In the soudano sahelian area, the use of the plant is more frequent 66.44% of the producers introduce plant in the granary to protect grains during storage.

The low dependence of the population of Adamawa on this use of plant for the protection of grain could be explained by the fact that, this land was that of cattle rearing or ranches. It is the 50 past years, the region is becoming progressively an agricultural zone. In the sahelian zone where the degradation of vegetation is high, people has for long time practice agriculture and storage.

In northern Cameroon, 27 plants are currently introduced into granaries to protect grains from the attacks of insect pests. They are from 13 botanical Families (Table 5). Lamiaceae and Poaceae are the most used families representing respectively 22.2 and 18.5% of the whole.

The introduction of plants into granaries aims to kill insects already present or to keep away all other insect wanting to infest the stored grains (Boeke *et al*., 2004). These plants are mostly aromatic plant producing flavours that have anti insect properties. They can kill or repel insects from the granary. Many insecticidal plants are useful to control insect grain pests. The use of plants was used in the pas and it is nowadays being neglected in favour of the industrial insecticides which are easier to access.

The active plants used in the past potential to be insect bio inhibitor. They are toxic to insect at all stages of their development, They can also reduce the egg-laying, the moulting of larvae and finally enhance the phagodeterrence of insects.

ACKNOWLEDGMENTS

The present study was funded by the Belgian Cooperation through the convention Storeprotect, PIC-2003 Cameroon. Authors are also grateful to Dr. Christian Seignobos (Geographer, IRD, Montpellier) for its comments and also the artist Bero, who draw the prototypes of granaries.

REFERENCES

Alzouma, I., J. Huignard and A. Lenga, 1994. Les coléoptères Bruchidae et les autres insectes ravageurs des légumineuses alimentaires en zone tropicale. In Post-Récolte, principes et application en zone tropicale. ESTEM/AUPELF Verstraeten *et al*., (Eds.), pp: 79-103.

Bell, A., O. Muckh and H. Schneider, 1998. La protection intégrée des denrées stockées est une affaire rentable! GTZ, Eschborn, Germany, pp: 42.

Boeke, S.J., I.R. Baumgart, J.J.A. van Loon, A. van Huis, M. Dickea and D.K. Kossou, 2004. Toxicity and repellence of African plants traditionally used for the protection of stored cowpea against *Callosobruchus maculates*. J. Stored Prod. Res., 40: 423-438.

Cruz, J.F. and F. Troude, 1988. Conservation des grains en régions chaudes. Collection du Ministère français de la coopération et du développement, Techniques rurales en Afrique, CEEMAT/CIRAD, Montpellier, pp: 548.

De Groot, I., 1997. Protection des céréales et des légumineuses stockées. CTA. Agrodoc n°18.

Kodjo, O., 1989. Structures paysannes de stockage. In *Céréales en régions chaudes*, AUPELF-UREF, John Libbey Eurotext, Paris, 19: 25.

Kreiter, J., 1989. Les déprédateurs des denrées entreposées. Document de travail, École Nationale Supérieure d'Agronomie de Montpellier, Cahier d'Écologie animale et de Zoologie Agricole, Inédit, pp: 52.

Keita, A., 1999. Guide pratique des banques de céréales au Mali. CTA and Jamana (Eds.), pp: 125.

Laclavère, G., 1979. Atlas de la République Unie du Cameroun. Editions J. A., Paris, pp: 72.

Metuge, K., B. Heyler and J. Gould, 1977. Traditional storage methods in Cameroon. Bloc-Notes du Mode Rural Publication de la commission pour le développement de la FEMEC, pp: 31.

Mbon, R., 1979. Les unités de stockage des céréales au Cameroun. In, La conservation des denrées alimentaires cultivées en climat chaud et humide. Premier CIT/Culture Technologique, Yaoundé, novembre 1979. AUPELF, Montréal, Paris, Dakar, pp: 377-386.

Seignobos, C., 1994. Notes sur les méthodes traditionnelles de protection des cultures dans l'extrême Nord du Cameroun. Actes de la réunion phytosanitaire de coordination. Cultures annuelles en Afrique Centrale, Maroua, CIRAD *et al.*, pp: 218-221.

Stoll, G., 200. Natural Crop Protection in the Tropics. Margraf Verlag (Eds.), Agrecol/CTA, pp: 376.

Seignobos, C., 1982. Montagnes et hautes terres du Nord Cameroun. Roquevaire: (Ed.) Parenthèses, Coll. Architectures Traditionnelles, pp: 188.