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Original Research Article

Study of the Cowpea (*Vigna unguiculata*) Conservation System in the Groundnut Basin (Commune of Niakhar)

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Abstract: Post-harvest food preservation remains a major constraint. However, producers in the area resort to the use of chemical or natural products to fight against pests. It is in this perspective that the present study is inserted, which aims to diagnose the cowpea conservation system in the commune of Niakhar. A survey was conducted in three villages, based on a questionnaire aimed at understanding farmers' perceptions of post-harvest cowpea conservation. The analysis focused on the incidence of insects and the estimation of losses, the conservation method and sanitary prophylaxis. The results showed that women were more involved in conservation activities than men, with 67% and 14% respectively. Indeed, the insects that cause more damage belong to the Bruchideae family, including *Callosobruchus maculatus*, which is the pest that causes serious damage to stored cowpeas, and *Bruchidius atrolineatus* respectively (80.5%) by *Callosobruchus maculatus* and (19.5%) by *Bruchidius atrolineatus*. These insects can cause losses of 15%, 30% and more than 75%, and even 100% of post-harvest losses. However, the conservation methods used are plastic barrels (19.4%), plastic bags (2.8%) and other methods are used by (72.2%). The conservation in seeds is done by (94%) of the producers and (6%) do it in pods.

Keywords: Cowpea, post-harvest storage, insect pests, chemical products, natural products.

1. INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) occupies an important place in the diet of many regions of the world (Diaw, 1999). It is the most important seed legume grown in tropical Africa because of its energy value and high protein content (Ndiaye, 1996). In addition to its nutritional qualities, it improves soil fertility through its ability to fix atmospheric nitrogen (Adeoti *et al*., 2002).

However, there is a problem of conservation by farmers because the grains suffer enormous damage caused by Bruchidae beetles. Among the Bruchidae species that depredate cowpea, Callosobruchus maculatus F. is the most damaging. The damage caused by this bruchid not only reduces the weight, nutritional and market value of the commodity but also results in a loss or reduction of the germination capacity of the grains (Illiassa., 2004; Demissie *et al*., 2008). In response to these post-harvest losses, various control methods have been developed. These include chemical control, biological control and the use of inert substances (fine sand). According to Isman (2006) and PAN Africa (2003), synthetic chemical insecticides are the most abused and misused in most African countries. These synthetic pesticides, although effective, not only cause resistance problems in insect pests and the destruction of beneficial organisms, but also lead to harmful effects on the environment and human health, availability and cost problems (Aïssata, 2009). In order to promote sustainable development and environmental protection, alternative control methods that are inexpensive, effective and easy to adopt for Third World producers are recommended. For this purpose, many natural additives such as certain local plants, minerals and oils seem to be effective in the control of insects present in stored commodities (De Groot, 2004).

The main objective of this work is to contribute to the reduction of losses due to the attack of the cowpea pest in storage by using less toxic substances.

2. MATERIAL AND METHODS

2.1 Presentation of the site

The commune of Niakhar is located in the west of the country, about 135km south-east of Dakar on the road linking Fatick and Bambey. It is located exactly to the south of the district of the same name in the region of Fatick. It covers an area of 186km2 and has a geographical coordinate of 14-29 North of altitude, 16-24 West of longitude and 6m of altitude.

2.2 Bio-physical setting

The commune of Niakhar is characterized by a flat relief in spite of the existence of some depressed areas in the South and East. The climate is of the Sahelian type with a rainy season or winter season that varies between three (03) and four (04) months (mid-June to mid-October) and a longer dry season that lasts eight (08) to nine (09) months (mid-October to mid-June) Thermal evolution is bimodal with two maxima in May and October, respectively 30.47°C and 29.72°C and two minima in January and September giving respectively 25.27°C and 28.60°C (Fatick regional metrology service 2006 -2015). The average thermal amplitude of the decade is equivalent to 14.9°C.

The soils found in the communal area are of four (04) types according to their characteristics. Tropical ferruginous soils with little leaching or Deck-Dior: These are transitional soils between Deck and Dior.

Leached tropical ferruginous soils or Dior: these are loose soils with a light structure that are easily carried away by erosive agents.

Non-leached tropical ferruginous soils or Deck: with a more compact structure, these soils have a high water retention capacity and better organic matter content.

Halomorphic soils (tans): These are soils affected by the phenomenon of salinization. They are located to the east and south-east of the locality.

2.3 Population

The population of Niakhar is estimated at 37265 inhabitants, with a distribution of 18155 men and 19110 women (SRSD Fatick, 2013). It is composed of a majority of Serer (98%), Pulaar (1%), Wolof (0.5%) and other minority ethnicities (0.5%).

3. MATERIAL

A variety of materials were used to conduct our study. These included:

- A survey questionnaire designed beforehand in relation to our objectives,
- A cell phone to communicate and take pictures,
- A computer for data entry,
- A motorcycle to travel to the different villages,
- A motorcycle to travel to the different villages, A small equipment (pencil, eraser, sharpener, papers).

4. METHODS

For the realization of this work, the methodology adopted is articulated around these three phases:

(a) Phase of elaboration of questionnaire of survey

The questionnaire relates to the households with its producers including also the training center of the cowpea sector. Interviews with people involved in the sector, such as the president of the cowpea training center and the GPF (Groupement de promotion féminine), and the former president of the CLCOP (Cadre local de concertation des organisations de production) were conducted during this phase.

(b) Sampling and selection of villages

The study was carried out in three (3) villages, namely Sassar, Yénguélé and Ndianéme, whose populations use the developed perimeter, at a rate of twelve (12) farms per village, divided into groups of four (4) farmers in three (3) different neighborhoods of the village, which allowed us to have a number of thirty-six (36) family farms.

(c) Data collection tools

The study is based on the collection of data from the baseline surveys using a participatory approach. These data were collected using a questionnaire designed beforehand in relation to the objectives set at the outset and addressed specifically to the head of the farm.

5. RESULTS AND DISCUSSION

5.1. Gender

The analysis by gender of the respondents on cowpea conservation in our study area shows a clear dominance of women who represent 67% of the sample against 14% for men (Figure 1).

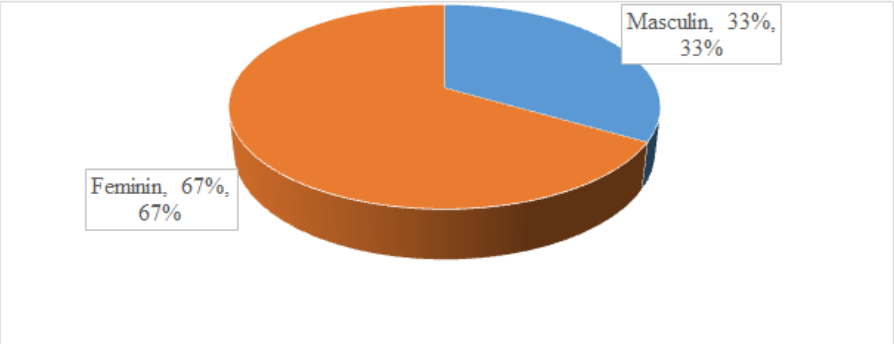

Fig-1: Distribution of producers by gender

Age

The compilation of data shows that the 21-40 age group is the most represented with 56%, followed by the 41-60 age group with 31%, the 61+ age group with 8% and finally the 0-20 age group which has the lowest representation with 6% of respondents (Figure 2).

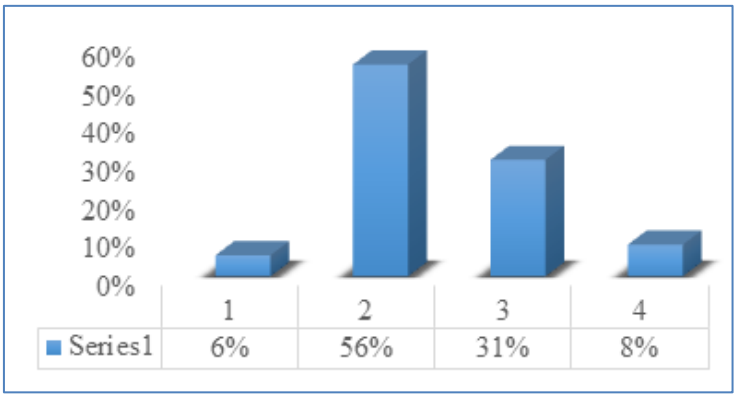

Fig-2: distribution of respondents by age group

5.3. Insect impact and loss estimates

Periods of infestation, Table 1 shows that twenty-two (22) producers noted infestation at the storage level, thirteen (13) at the field level, and one (1) immediately after harvest.

Table-1: Cowpea infestation periods

Cowpea infestation periods	don't know	0
	immediately after the harvest	1
	in the field	13
	during storage	22
	other (please specify)	0

5.4. Estimation of losses due to insects during storage

According to figure 3, the losses that are less than or equal to 5% are 3, then those that are less than or equal to 15% are 11. The losses inferior or equal to 30% are 7, those inferior or equal to 50% are 6. The losses inferior or equal to 75% are 1 and at the end for those are more than 75% are 8 (figure 3).

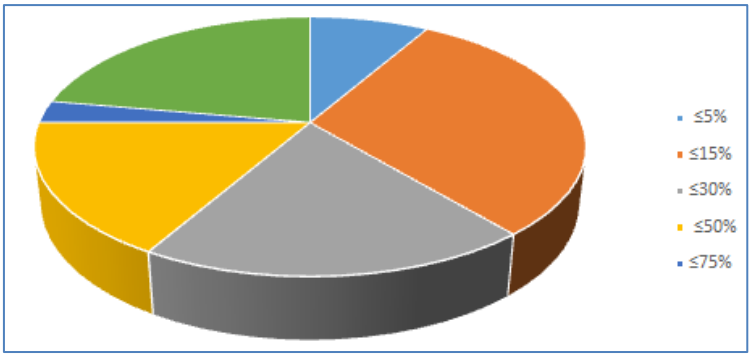

Fig-3: Estimation of losses due to insects during storage

5.5. Methods of storage of cowpea

The survey revealed that 72.2% of the respondents use other modes of conservation than those indicated in Table 3, conservation in plastic barrels is used by 19.4% of the respondents, then 5.6% use bags treated with pesticides, a minority number of 2.4% use bags in sacks and finally metal barrels, jerry cans and conservation in bulk are not used (Table 2).

Table-2 : Conservation methods for cowpeas

How to store cowpeas	bags treated with pesticides	5,6 %
	bags in sacks	2,8%
	plastic drums	19,4%
	metal drums	0%
	jerry cans	0%
	in bulk	0%
	Other	72,2%

5.6. Natural products

These results show that among our respondents 17 producers use sand for conservation, 2 producers use neem leaves and finally 2 others use chili powder (Figure 4).

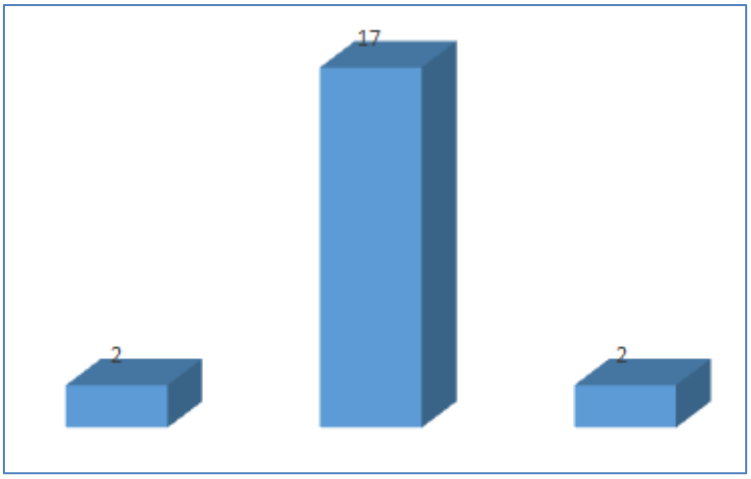

Fig-4: The natural products used

5.7. The products used at the time of the presence of bruche or other insects on the cowpea

The results thus obtained revealed that the treatment with the chemical products is more used of which 18 producers among the investigated ones, 7 producers also use the natural products and finally 11 use other products (figure5).

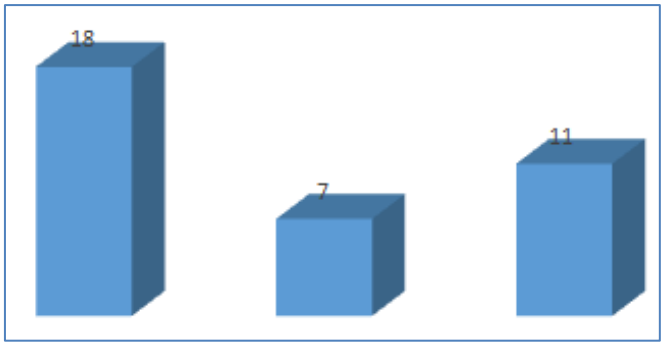

Fig-5: Products used for preservation

5.8. Names of chemical and natural products used

This result shows that the chemical products are used much more among which we have Diasphox which is the most known in the zone ; it is used by 17 producers among our respondents and for the natural products we have the nem leaves for 2 producers, the sand for 12 producers and finally the chilli powder for 2 producers in our sample.

Table-3: The names of the products used

The names of the chemical or natural products us		17
	Neem leaf	2
	Sand	12
	Chilli powder	2

5.9. Drying places before threshing

According to figure 6, among our respondents, 30 producers adopt the drying platform in the yard of the house and 5 others who do the drying near the houses and with the exception of one producer who practices another method.

Fig-6: Drying structures

5.9.1 The importance of drying before threshing

28 producers of our sample do drying before threshing to facilitate the release of the pods, only 5 think about the preservation of physical damage on the pods at the end the 3 tell us about the improvement of the cleanliness of the pods (Table 4).

Table-4*:* The importance of drying before threshing

	Facilitate the release of the pods	**28**
The importance of drying before threshing	Improve pod cleanliness	3
	Prevent physical damage to pods	5
	Other	0

5.9. Duration of storage

Most of our respondents, i.e., 14 producers, store for 8 months, 5 for 7 months, 2 for 6 months, 3 for 5 months, 1 for 4 months, and 1 for 2 months. In addition, 11 producers have other types of stock use (Figure.7).

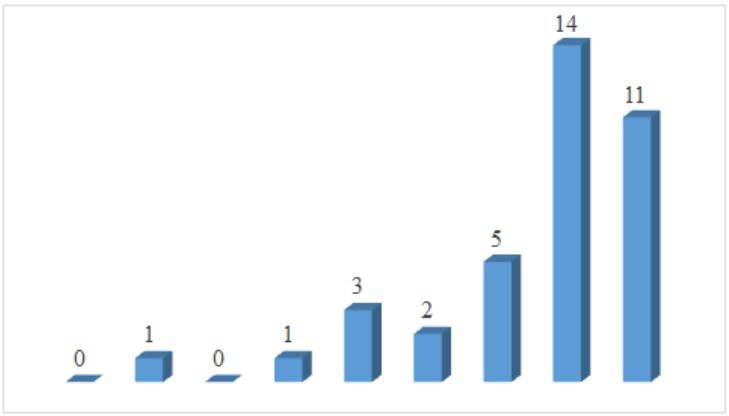

Fig-7: The duration of the stocks

5.9.2. Forms of cowpea storage

We note that 94% of the producers surveyed store their cowpeas as seeds and only 6% store them as pods (Figure 8).

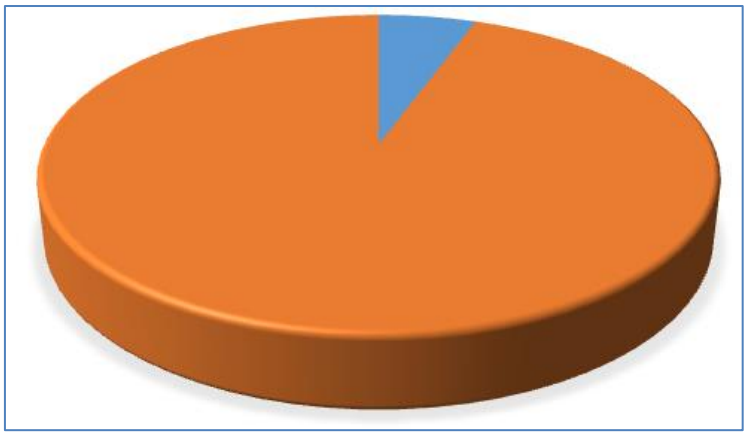

Fig-8: Forms of storage of cowpea

5.9.4 Cowpea storage methods

In our study area, 32 of the producers surveyed store their cowpeas in rooms, and 4 have other methods of storage (Figure 9).

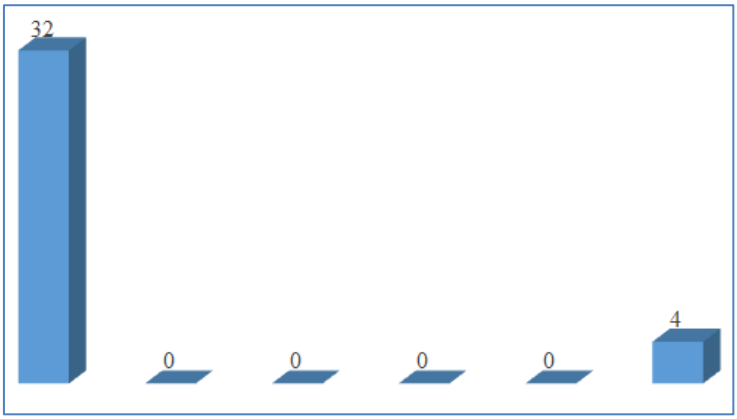

Fig-9: Cowpea storage methods

5.9.5. Products used for stock treatment or structure before storage

For this part, most producers use other products for the treatment of stocks and storage premises (Table5).

Table-5: Products for stocks

The products used	Smoke	0
	Biocidal plants	0
	Insecticides	1
	Others	6

5.9.6. The use or not of pesticides during storage

94% of producers use chemicals during storage and only 6% do not (Figure.10).

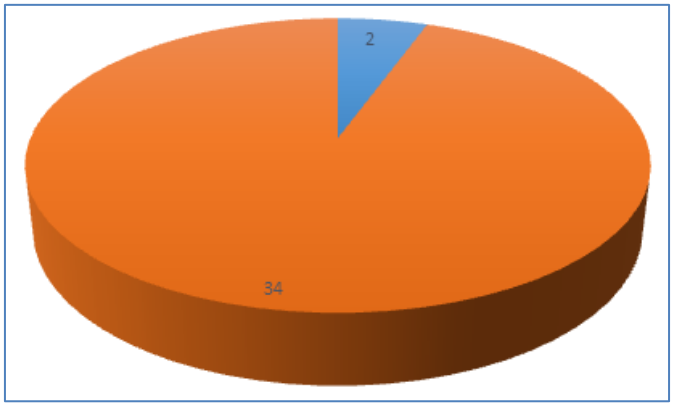

Fig-10: The use or not of pesticides during storage

DISCUSSION

The analysis of the results shows that cowpea conservation seems to be a predominantly female activity in the study area. Indeed, 67% of the users surveyed were female. Only 14% of the men were included in the study. This is justified by the fact that during the rainy season most women do not have fields to grow a cash crop, and they either combine in groundnut fields or help their husbands with maintenance and storage. Even though the majority of applicators are between 21 and 40 years of age (56%), there are users between 41 and 60 years of age (31%), those over 60 years of age (8%), and at the end of the 0-20 years of age there are only (6%) (fig. 2). This could be justified by the fact that young people engage more in the activity of conservation at the expense of other activities. This confirms the work of Toe (2010) who stated that age can also be a factor accentuating the use of pesticides of a rather aging workforce for an activity as vigorous as agriculture. According to the respondents, infestation periods occur largely at the storage level but also at the field level. This is because harvested pods carry larvae with them, and if they are not well preserved, they develop into juveniles that will infest the seed; in addition, at the field level a large number of insects attack cowpea crops. This confirms the work of (Glitho, 1990; Ouédraogo *et al*., 1996; Sanon *et al*., 2006), who asserted that pod infestations by insects take place in the crop but the development of larvae in the cotyledons of the seeds continues in the stocks.This work also allowed us to note that insects are responsible for most of the post-harvest losses. The most accentuated losses are between 15%, 30% and more than 75%. This result shows a variation in the periods of stock losses according to the different stages of development of the insects. There are also losses related to the decline in germinative capacity. This confirms the work of Singh and Singh (1992); Odah (1995), who stated that insects cause not only a reduction in dry weight, but also a decrease in seed quality and seed viability, compromising their consumption and sowing. The methods of conservation practiced in the study area reveal that (72.2%) of the producers practice other methods of conservation (19.4%) conserve in plastic drums and (2.8%) only do so in plastic bags. In the study area, most producers use other methods of conservation such as: conservation in plastic drums with sand, plastic drums under the sun and in bags with sand. There are also those who preserve in plastic drums and bags in sachets plastique. In the opinion of these producers, the hermetic devices asphyxiate the insects in the storage structures through the reduction of oxygen. This confirms the work of (Murdock *et al*., 2012) who stated that when there is a lack of oxygen in the environment, glucose is no longer degraded, which will result in the organism not being supplied with water and energy. The traditional methods consist in mixing the seeds, either with inert material (fine sand), or with fresh leaves of insect repellent plants. These results corroborate those of Thouillot and Maharetse (2010). According to these authors, in many African countries, farmers use different natural products (sand, ash, stems and crushed leaves of certain plants) that they apply to their food in storage. Conservation requires the use of chemical or natural products. Exposure to the sun is also one of the means used in the conservation of cowpeas. Given the extent of the damage caused by insects and the ineffectiveness of traditional methods to protect cowpea stocks in an efficient and sustainable manner, farmers often resort to chemical control, which consists of using synthetic chemical substances with insecticidal properties to protect

their crops. The fumigation insecticide used at the site is Diasphox, which is used for both cowpea and groundnut conservation. There are also those who use PICS bags. This method consists of pouring the grains into the deepest of the three bags and tying it tightly. Then, tie the middle bag and at the end the outermost one. The three tightly tied bags will allow any insects inside the grain to die by asphyxiation. The survey revealed that the products used when bruchid or other insects are present on cowpeas are chemical products, natural products and other methods. In our study area, most farmers use chemical products to stop the development of the attack, while others use natural products such as chilli powder, which has a strong repellent power. Producers also make a slurry of the attacked stock to scare away the bruchids by the heat, but these seeds are only used for food because the germinative power is no longé there. Drying differs among producers, with drying platforms in the yard being more common among (30) producers surveyed and drying near the house. The producers dry the pods on a clean surface such as a mat, a plastic sheet, a tarp or a raised platform. The threshing of dried pods is done at home according to the interviewees. The good women use mortars and pestles to help separate the pods from the seeds during winnowing. After threshing, the seeds will be stored in different places according to the producers. The length of storage varies depending on the product with which the stock was treated. In our sample, most of our producers have a duration of (8 months), others can have up to (12 months). In our study area (94%) of the surveys save cowpea seeds only (6%) do so with pods. These results indicate that treated seeds are easier to store and do not take up much space in the storage area. The preserved pods are exposed to à high risk of infestation but also lack of cleanliness. The surveys showed that 32 producers among our respondents store their cowpeas in rooms. These different means were considered closed storage systems by Ravololonandrianina and Rabeatoandro (1996).

This is because farmers prefer to secure their crops by storing them close to their homes. The proximity of the crops helps to avoid theft and to better monitor pest attacks. Only 2 producers use other methods such as exposing the cans to the sun in the yard of the house. For the storage place the surveys reveal precautions for storage. Among our respondents, six use other methods, such as fresh neem leaves on wooden pallets or on stone supports. Only one producer mentioned insecticides (sprinkling) at the storage sites. The surveys showed that 94% of the respondents do not use chemicals at the storage area, only 6% use it.

CONCLUSION

This study was carried out in the commune of Niakhar in three (3) villages in order to identify and describe the modes of conservation of cowpea. It allowed us to understand the technical itinerary of conservation. The results showed that the majority of people practicing this activity are young people between the ages of 21 and 40, followed by those between 41 and 60. The different methods of conservation used by the producers with the use of chemical or natural products with modes of storage and the appropriate sanitary prophylaxis for the treatment.

The choice of the (natural) insecticide should be based primarily on the major insect to be controlled. It has been shown that the response to the intensity of the toxicity of a product depends in many cases specifically on the pest and for a given pest on the stage considered.

Furthermore, the efficacy of biocides is partly associated with soil and climatic conditions. The promotion of resistant varieties, techniques such as solarization as well as the direct application of plants with an inhibitory, antiappetizing function are to be taken with more consideration, given their simplicity of implementation.

Some empirical practices still used in the conservation of crops should be evaluated in order to scientifically establish their real effectiveness and their harmlessness on the health of the populations, taking into account the storage conditions.

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