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Grain storage and insect pests of stored grain in rural Niger

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ABSTRACT

We surveyed 1293 farmers and traders in southern Niger to learn about their grain storage practices and their views on the storage pest problem. We identified the insect species found in samples obtained from 40 localities in three regions of the country. We stored 371 grain samples collected from respondents in the laboratory for seven months to allow populations of the insects present to develop and emerge and the resultant grain weight loss to be determined. The commodities most commonly stored in Niger were millet and sorghum, kept in storage on average for about 6 months by 53% and 80% of respondents respectively. When millet samples from respondents were kept in the laboratory for seven months, two pests were found, the rice moth Corcyra cephalonica Stainton, and Tribolium spp. This millet experienced a weight loss of 17.1% during seven months storage. *Tribolium castaneum* Herbst, *Sitophilus granarius* L., Cryptolestes spp, *Sitotroga cerealella* Oliver, *Trogoderma granarium* Everts, *Rhyzopertha dominica* F. and *C. cephalonica* were found in stored sorghum, which lost 10.1% weight after seven months. Eleven other grains or foods were stored by 2.9–24.4% of respondents. Recorded weight losses were 15.9% for groundnuts, 12.6% for paddy rice, 7.6% for sesame and 7.4% for maize. Seeds of *Hibiscus sabdariffa* L. and Bambara groundnut were essentially destroyed by bruchids during storage, mean weight losses being 83.9% and of 61.8% respectively. Most respondents took no measures to control insect pests in their stored grains. Food security and quality in Niger would be greatly improved if Africa-manufactured technology that is safe, low-cost, insecticide free, and widely available could be implemented for post-harvest storage of food grains.

1. Introduction

The West African nation of Niger, located in the Sahel, has more than 80% of its population living on farms and relying on agriculture for livelihoods (Fig. 1). Average national grain production over the past 5 years is estimated to be about 5.9 million tons (MAG, 2012). Millet (*Pennisetum glaucum* (L.) R. Br.) and sorghum (*Sorghum bicolor* (L.) Moench) account for 70% of agricultural production. Cowpea *Vigna unguiculata* Walp is next in importance with 1.33 million tons, accounting for 22.5% of annual total production. Groundnut, *Arachis hypogea* L., with an average annual production of about 300,000 tons, contributes about 5.1% of available food. While rice and maize are important foods in urban areas of Niger, they account for less than 0.5% of total annual agricultural production. More than 270,000 tons of these two grains are imported annually (MAG, 2009; SIMA-Niger, 2011). Several crops are cultivated primarily by women, including sesame, *Sesamum indicum* L., Tiger nut *Cyperus esculentus* L., Bambara groundnut, *Vigna subterranea* (L.) Verdc, sorrel *Hibiscus sabdariffa* (L.) and fonio, *Digitaria exilis* (Kippist) Stapf. These contribute an average of roughly 2% of national food production.

Most food produced in Niger is harvested at the end the rainy season that starts in June and lasts into October. Stores kept by the producers themselves, by cooperatives and community grain banks, and by retailers and charities, provide food for the people over the course of the year. Depending on the product, storage may last only a month or so or as long as twelve months or more. During storage it is exposed to pests and is subject to losses they cause.

As a result of the country-wide diffusion of a simple, low-cost hermetic technology (Baributsa et al., 2010), in the form of PICS (Purdue Improved Crop Storage) triple-layer bags, losses of cowpea grain to bruchids in Niger have been substantially reduced. PICS bags are now available in many rural markets not only in Niger but

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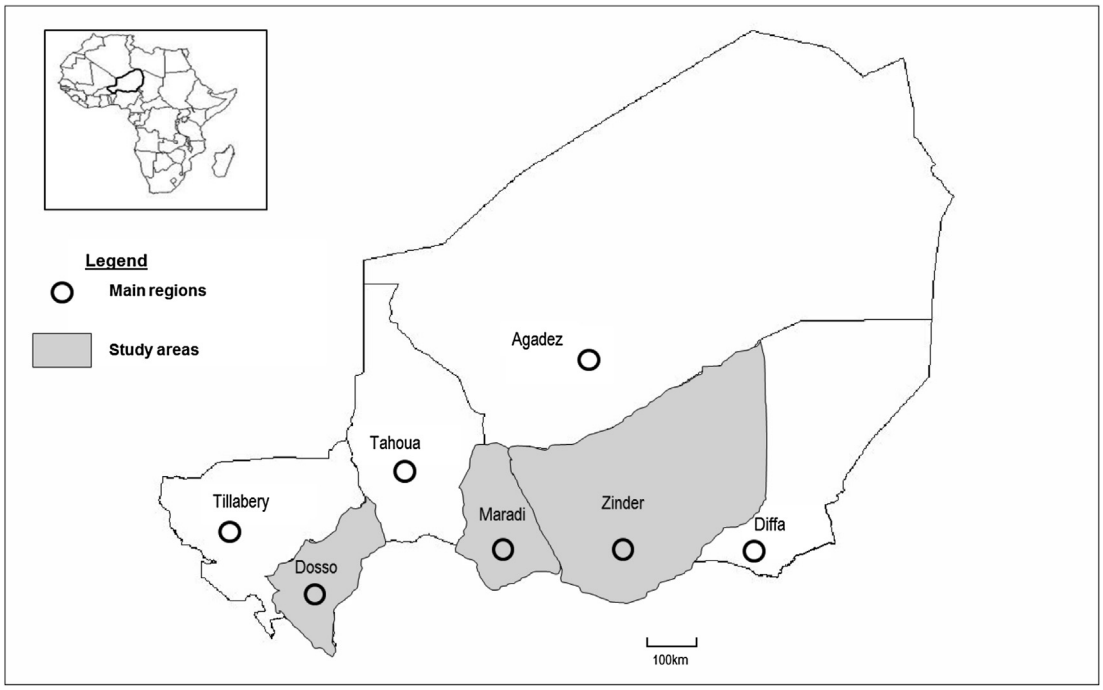

Fig. 1. Location of the West African nation of Niger, with positions of the three study regions of Dosso, Maradi and Zinder.

throughout West Africa. This technology arrests bruchid population growth and allows safe storage of cowpea for up to several years (Murdock et al., 2012; Baoua et al., 2012).

The research described here was undertaken to: (i) assess how food commodities other than cowpea are stored in Niger; (ii) determine the extent to which farmers are aware of storage insect pests in a variety of crops, and; (iii) ascertain their main control methods, if any. In addition, we sought (iv) to determine the insect species attacking stored grain and (v) to estimate the degree of associated mass loss. This assessment was carried out to learn if there was reason to promote the extension of PICS storage bags for use with other food commodities in the Sahel.

1.1. Methodology

We conducted the survey and sample collection components of our study during the early part of the annual storage season, specifically, from the 2nd to the 8th of December 2012. The work was carried out in the regions of Dosso (13° 2′49.49″N; 3°12′14.08″E), Maradi (13°28′60.00″N; 7° 5′60.00″E) and Zinder (13°48′19.00″N; 8°59′18.00″E). All three regions are located in the southern agricultural belt of Niger (Fig. 1). We focused primarily on people storing agricultural products in 40 localities selected randomly; these encompassed eleven rural and urban markets. We used a questionnaire to document the quantity of food stored and the duration of storage. We solicited respondents' opinions of the degree to which the different commodities are subject to insect pest attacks using a 4-point scale: 0 – no response, 1 – minor problem, 2 – moderate damage and 3 – major damage. We asked each interviewee to describe any control methods he or she used to protect each stored product. Data were entered into an Excel template, noting the average quantities stored and the length of the storage period.

During the baseline survey we collected grain samples from respondents. Initial weights were determined by weighing three samples of 100 seeds separately. Beginning January 15, 2012, all individual samples were stored in the laboratory in open 1000 ml bottles, their mouths covered with Muslin cloth to allow air exchange but to keep insects from entering or escaping. The bottles were kept in a concrete cabinet into which was also placed on a lower shelf a metal bucket filled with water to keep the relative humidity inside the cupboard elevated. The cabinet also contained a data logger (Model EL-USB-2. Lascar, Wiltshire, Great Britain) to record the temperature and humidity. Monthly inspections of each sample documented the insect pest species emerging and its numbers. Analyses were terminated on July 15 after 7 months of storage. The 100 seed weights were again determined, as described above. Weight loss for each sample was calculated using the formula:

$$\text{percentage weight loss} = \left(\frac{\text{initial weight} - \text{weight after 7 months}}{\text{initial weight}}\right)*100$$

2. Results and discussion

The field survey interviewed 1293 individuals, of whom 66.3% were farmers and 33.7% were traders; 11.8% of respondents were women. We collected 371 grain samples; these were taken to the