CONTROL OF STORAGE PESTS IN THE TROPICS USING SEALED STORAGE

G. C. Sabio[1]*, S. Navarro[2], E. Donahaye[2], F.M. Caliboso[1], M. Rindner[2] and R. Dias[2]

[1]Bureau of Postharvest for Research and Extension
CLSU Compound, Nueva Ecija, Philippines

[2]Department of Stored Products. Agricultural Research Organization
The Volcani Center, P.O. Box 6, Bet Dagan 50250, Israel
e-mail: vtshlo@netvision.net.il

Abstract

The feasibility of the sealed storage technology for storing bagged corn grains with up to 14% moisture content outdoor, was investigated in the Philippines. The essential advantage of this storage technique lies in the generation of an oxygen-depleted and carbon dioxide enriched intergranular atmosphere storage ecosystem that arrests insect development. The structures used were weld-mesh walled plastic silos with a capacity of 40 tonnes and frameless flexible envelopes (Volcani Cubes, also known as Cocoons™) of 20 tonnes. A total of 11 trials consisting of 9 gastight sealed storage and 2 conventional storage as control, were conducted for periods of up to 6 months. Results showed no significant increase in population density of insects in the gastight sealed corn stacks whereas in the control, insect population increased considerably. Insect density in sealed storage was maintained below the threshold of economic damage without the use of pesticides. Comparative average weight loss due to insect activity after about 3 months of storage was 0.3% in sealed stacks and 5.3% in the control.

INTRODUCTION

Corn is the second largely grown cereal crop next to rice in the Philippines. The white corn is the second staple food while the yellow corn is used as livestock food ingredient. Storage of corn is mainly by the private traders/millers and the government through the National Food Authority (NFA). This is because adequate storage facilities are lacking at the farm level. Many farmers immediately sell their produce immediately after harvest instead even if prices are very low during this time. Some farmers keep their bagged grains stacked in barns, under the eaves of their residences or in the open just covered with tarpaulin or flat plastic sheet while waiting for better prices. But as prices may start to pick up only in about 3 months, the grains would be left exposed to insect infestation and subsequent losses. The farmers, therefore, need a safe temporary storage structure. A potential solution, is the sealed storage technology or hermetic storage. The application of this storage technique as an outdoor storage option was evaluated under tropical condition. Important criteria used in the evaluation were its effectiveness in controlling pest infestation and grain quality deterioration. The effects on insect pest infestation will be the main topic of this paper.

MATERIALS AND METHODS

Experimental stocks and storage structures: Bagged yellow corn grains of 50 kg each, with a moisture content of up to 14% was used in the trials. The storage structures which were made of flexible polyvinyl chloride (PVC) were a weld-mesh walled plastic silo, 0.83mm thick, 40 tonne capacity and frameless flexible envelopes (Volcani Cubes), 0.83mm thick, 20 tonne capacity. Both structures consisted of a lower and upper sections that are zipped together.

Construction of gastight sealed storage and control stacks: The gastight storage structures were set-up on a selected level of ground. After the stack had been built to the required height, the stack was insulated to reduce temperature gradient within the grain mass. For the cubes, the top layer was insulated with 2-3 layers of sacks containing rice hull. For the silo, the cone shaped top surface was covered with plastic sheet to catch water and prevent the grain from getting wet. then 1-2 layers of bagged rice hull were placed above the plastic sheet. When the stack was insulated, this was covered with the top section of the storage structure then zipped together with the lower section. Control stacks were also constructed in the open on pallets with ordinary tarpaulin cover for protection. Samples were collected at the start and at the end of storage to determine changes in insect population density and other quality parameters.

RESULTS AND DISCUSSION

Trials were conducted on 8 gastight cubes, 1 gastight silo and 2 control stacks for storage periods of up to 184 days (Table 1). The insects found in corn were: *Sitophilus zeamais*, *Rhyzopertha dominica*, *Oryzaephilus surinamensis, Latheticus oryzae, Lophocateres pusillus, Carpophilus spp., Tribolium castaneum, Cryptolestes spp., Typhaea stercorea*, species of ants, crickets and cockroaches. Changes in density of insect populations in the corn stocks from the start to the end of storage are shown in Table 2. No significant increase in population density of insects was noted in 8 out of 9 gastight stored corn stocks. The live initial insect population in the 8 stacks was suppressed. The observed increase in insect density in one sealed stack (IV-2) was suspected to be due to air infiltration through a leak in the zipper caused unintentionally. But in the control stacks, insect population increased considerably. Based on insect infestation and in comparison with the control stacks, gastight sealed or hermetic storage was considered successful. Comparative weight loss due to insect activity is shown in Table 3. Average weight loss after about 3 months of storage was 0.3% in sealed stacks and 5.3% in the control stacks. Results indicate that weight loss was effectively reduced through sealed storage. The average weight loss of 0.3% was considered within the permissible experimental weighing error related to the accuracy of the balance. Our previous experience with biological losses with sealed storages was found much lower or even negligible. The control stacks suffered severe kernel discoloration, whereas no significant changes were observed in sealed storage. Attack from rodents and birds were noted in control stacks but not in the sealed ones.

Table 1. Profile of corn trials conducted.

Trial No.	Structure	Treatment		Capacity (tonnes)	Duration of storage (days)
		Gastight	Control		
I-1	Cube	x		15.02	93
I-2	Cube		x	4.75	93
II-1	Cube	x		17.00	97
II-2	Cube		x	4.58	97
III-1	Cube	x		19.25	112
III-2	Cube	x		19.22	112
IV-1	Cube	x		16.88	183
IV-2	Cube	x		16.99	183
V-1	Silo	x		38.73	184
VI-1	Cube	x		16.77	148
VI-2	Cube	x		16.77	148

Table 2. Density of live insects per kg of corn samples collected during the trials.

Trial No.	Treatment	Initial	Final
I-1	Gastight Cube	0.00	0.00
I-2	Control	1.71	68.66
II-1	Gastight Cube	1.33	1.0
II-2	Control	0.30	17.33
III-1	Gastight Cube	2.00	0.33
III-2	Gastight Cube	3.00	0.33
IV-1	Gastight Cube	2.33	1.00
IV-2	Gastight Cube	0.67	3.30
V-1	Gastight Silo	3.00	0.67
V-1	Gastight Cube	2.33	1.00
VI-2	Gastight Cube	3.30	0.67

Table 3. Change in actual weight (kg) in corn stored under gastight structures and in control stacks.

Trial No.	Treatment	Initial weight	Final weight	% weight loss
I-1	Gastight Cube	15020	14963	0.379
I-2	Control	4750	4509	5.073
II-1	Gastight Cube	17000	16961	0.229
II-2	Control	4580	4323	5.611
III-1	Gastight Cube	19200	19152	0.250
III-2	Gastight Cube	19220	19158	0.320
IV-1	Gastight Cube	18430	18227	1.100
IV-2	Gastight Cube	18430	18347	0.450
V-1	Gastight Silo	38730	38587	0.370
V-1	Gastight Cube	16770	16695	0.450
VI-2	Gastight Cube	16770	16690	0.400