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TR1AL ON STORAGE OF MUNGBEAN SEED IN AIRTIGHT STORAGE

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ABSTRACT

The trials on preservation of mungbean seed in airtight storage (Volcani cube) were carried out at the Chinat Field Crop Research Center during April-September 1998 and April-July 1999. Mungbean seeds var. 'Chainat 36' were stored in 10-tonne capacity airtight storage cubes. In the first trial, the cube was placed indoors for 6 months. Results showed that no insect infestation or even any live insect were found in the airtight storage, whereas in normal storage, damaged seed reached 30.2% with 271 adults mungbean weevils, *Callosobruchus maculatus* F. collected in 100 grams of mungbean seeds. The germination of mungbean seed in the airtight storage decreased from 95.4 to 80%, while germination of mungbean seed in normal storage (control) decreased from 97 to 26%. At the end of storage, differences in seed moisture contents between airtight and normal storage were slight, (10.3-13.0% and 10.1-12.1% m.c. respectively). In the second trial, the airtight storage structure was placed outdoors for 3 months. The results showed that no live insect or damaged seed were found in the airtight or the normal storage indoors. The germination of mungbean seed under airtight storage decreased from 86.7 to 85.8%, whereas germination in normal storage decreased from 94.3 to 87%. Final seed moisture contents under airtight storage and normal storage were slightly different (10.3-13.0% and 10.1-12.1% m.c. respectively).

INTRODUCTION

Mungbean is an economically important leguminous field crop in Thailand. It is an excellent source of easily digestible protein in cereal-dominated diets of Asian countries. Moreover, mungbean has a very short growing span and rapidly reaches maturity so that it fits well into various cropping systems, thereby increasing small farmers' income and improving soil fertility. The area under mungbean cultivation in Thailand is about 320,000 hectares (2 million rai), almost all being grown in the northern and central regions of Thailand (Wattanasit *et al*. 1990).

Mungbean can be stored for long periods with a relatively minor reduction in germination. Damage to the stored beans is caused mostly by insect infestation, the southern cowpea weevil, *Callosobruchus maculatus* (F.) and the cowpea weevil,

Callosobruchus chinensis (L.) being the most destructive of the insect pests. These two species are similar in appearance both being small, oval brown weevils. *C. chinensis* is slightly smaller than *C. maculatus* (2.0-3.5 mm and 3.0-4.5 mm respectively). Also, the body of *C. maculatus* is oval-elongate, the antennae of both sexes being sub-serrate whereas the body of *C. chinensis* is broadly oval, antennae of the male are pectinate, and of the female, sub-serrate (Promsatit *et al.* 1985). Under normal storage conditions, when no protective measures are applied damaged caused by these insects can attain 80% after six months storage. Reduction in losses of mungbean in storage is achieved by applying insecticides after harvest, applying seed dressing before storage, or by fumigation. The present fumigation procedures for controlling stored-product pests using phosphine (PH_3) and methyl bromide (MB) carry with them all the problems inherent in the use of toxic chemicals including their effects on the products and the environment. To reduce such disadvantageous effects, new technologies for stored-product production are urgently required. Airtight storage is one such technology that is ecologically benign and can be used to protect stored-products from pest infestation, (Donahaye and Navarro 1990; Navarro *et al.* 1993: Navarro *et al.* 1994).

The first airtight storage trial in Thailand using the Volcani Cube® technology was carried out on the storage of corn seed during 1996-1997 for periods of 3 and 9 months. The results revealed that this airtight storage procedure could effectively preserve the germination levels of corn seed (Sukprakarn *et al.* 1999). The present studies were conducted following on from the favorable results of corn storage, to evaluate the storage of mungbean seed under airtight conditions in Thailand.

MATERIALS AND METHODS

Trial 1

Stack construction: Mungbean seeds, variety "Chainat 36" harvested in March-April 1998 and rice paddy seed of mixed varieties harvested in December 1997 were stored together in an airtight Volcani Cube, made from a white 0.8 mm PVC liner. The Dimensions of the Cube were 3.40 m (length), 2.95 m (width), and 1.50 m. (height) with a volume of 15 m^3 and a filling capacity of ~ 10 tonnes. The cube consists of two plastic sections, a bottom and top liner. The bottom section was placed on a concrete floor inside a warehouse and the seed bags were stacked inside the cube without pallets. Mungbean seed in 30 kg bags and paddy seed in 100 kg bags were used. Total quantity of mungbean seed was 7,050 kg (235 bags), and of paddy seed was 2,900 kg (29 bags). Paddy bags formed the first and second layer and these were used as ballast to enable the cube to be completely filled. (Results of paddy storage are not reported on here). Mungbean bags were stacked above these two layers to a height of 1.50 m. Then the upper section of the liner was placed over the stack and the two sections were zipped together using the zipping system particular to this technology. Storage duration in this cube was 6 months. Normal

atmospheric storage of mungbean and paddy stacked in the same warehouse served as control.

Sampling methods: sampling was carried out by withdrawing 500 g samples of mungbean seed from the 4 corners and the center of the bottom, middle and the top mungbean layers of the stack. Also paddy seeds were withdrawn from 5 bags of the 4 corners and the center of the first layer. Sampling was done at the beginning and end of the trial to examine for insect damage, seed moisture content and germination, and results were compared to those of the control under normal seed storage conditions. During the storage period, 1 kg samples of mungbean seed were removed weekly from the airtight and normal storage stacks for examination through an upper screw-capped sampling port. The temperature and relative humidity inside the cube and outside were measured weekly.

Trial 2

Trial 2 was set up in a similar fashion to Trial 1 using the mungbean seed variety "Chainat 36" (harvested in March-April 1999). A total of 360, 30 kg bags were used, amounting to 10,800 kg in storage. The difference from Trial 1 was that the cube was placed outdoors for a three months storage duration, initial sampling was not carried out, and weekly temperature and humidity recordings were not carried out.

RESULTS

Trial 1

Temperature and humidity: The temperature and relative humidity readings recorded inside and outside the cube every week for 6 months, showed very slightly difference between recordings in the cube and in the warehouse (Fig. 1).

Insects and damage: There were no live or dead insects found in the mungbean seed sampled weekly. Neither were damaged seeds found, whereas an insect infestation in the control stack was revealed after 2 months and insect numbers increased from the 9th week until the end of storage (Fig. 2). Damaged seeds in the control stack reached 30.2%, and 271 adults of the mungbean weevil were recorded from 100 g mungbean seed at the end of 6 months (Table 1).

Seed moisture content: The moisture content (m.c.) of the mungbean seed at the beginning of the trial was 10.4% and after 6 months storage there was a slight increase to 11.0% (Table 1). The m.c.'s of mungbean seed recorded every week showed only slight slightly variations. The m.c. of seed in airtight storage was 10.3-13.0% and of the seed in normal storage was 10.1-12.1% (Fig. 2).

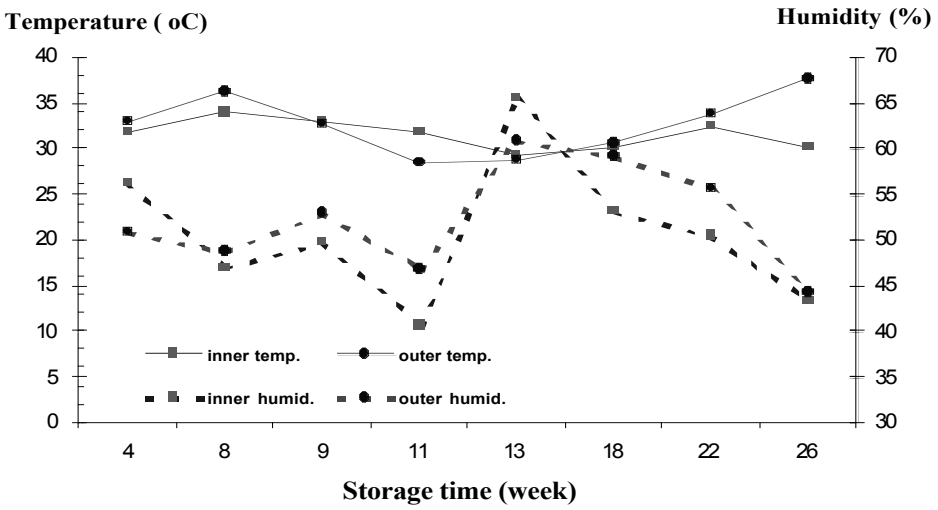

Fig. 1. Weekly recordings of temperature and relative humidity outside and inside the Volcani Cube set up indoors and containing mungbeans.

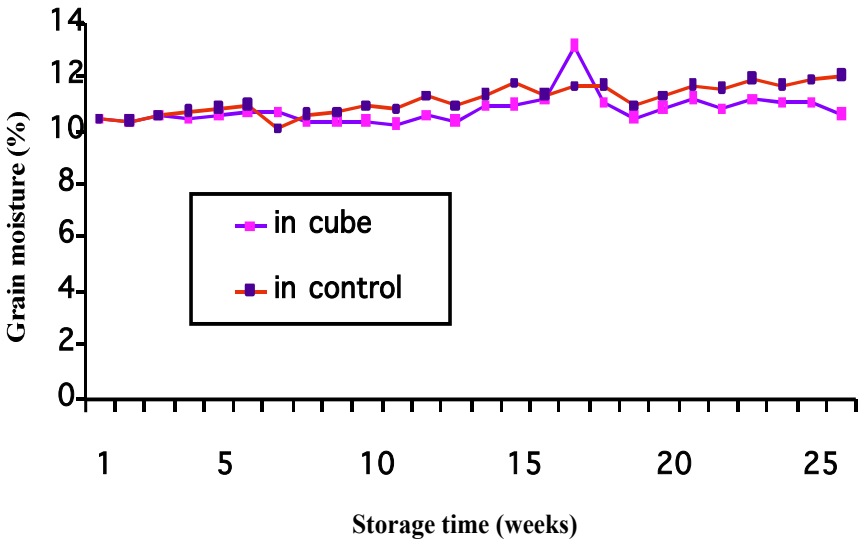

Fig. 2. Changes in moisture content of mungbeans stored in a Volcani Cube and in a control stack over a 26 week storage period.

TABLE 1
Quality parameters of mungbean seed before and after 6 months storage in a 10 tonne capacity airtight Volcani Cube placed indoors at the Chainat Field Crop Research Center during April–October 1998 (Trial 1)

Sack No.	Moisture content (%)		Germination (%)		Damaged seed (%)		No. of insects (before)*		No. of insects (after)*	
	Before	After	Before	After	Before	After	Alive	dead	Alive	Dead
1	10.4	10.9	89	76	0	0	0	0	0	0
2	10.4	10.8	98	77	0	0	0	0	0	0
3	10.4	11.1	99	82	0	0	0	0	0	0
4	10.4	11.0	87	86	0	0	0	0	0	0
5	10.4	10.9	99	75	0	0	0	0	0	0
6	10.4	10.9	99	80	0	0	0	0	0	0
7	10.4	10.9	97	70	0	0	0	0	0	0
8	10.4	11.0	98	71	0	0	0	0	0	0
9	10.4	10.8	99	84	0	0	0	0	0	0
10	10.4	11.8	98	86	0	0	0	0	0	0
11	10.4	11.0	84	86	0	0	0	0	0	0
12	10.4	11.1	89	82	0	0	0	0	0	0
13	10.4	10.7	88	79	0	0	0	0	0	0
14	10.4	11.0	98	89	0	0	0	0	0	0
15	10.4	11.0	99	78	0	0	0	0	0	0
Mean	10.4	11.0	94.7	80	0	0	0	0	0	0
Control	10.4	11.6	97	26	0	30.2	0	0	271	0

*No. of insects per 100 g of sample

Germination: The germination of mungbean seed before storage was 94.7%. After storage, in the sealed cube germination reached 80% at the end of trial. This was in sharp contrast to germination under normal storage conditions (control), which decreased from 97% to 26% (Fig. 3). The germination of both seed from airtight storage and normal storage showed no difference over the first 3 months, but from then on, differences in germination were significant.. There was no recorded instance of reduction of seed germination caused by insect infestation until the 10th week.

Trial 2

In this trial no insect infestation was found in seeds stored both in airtight and normal storage. Slight differences were recorded in mungbean m.c. between the two storage methods: in airtight storage, seed m.c.'s at the beginning and end of storage were 11.0% and 10.8%, respectively, whereas the seed m.c.'s under normal storage were 11.7% and 11.6%, respectively. Because there was no insect infestation the seed germination under both storage conditions remained good. From Table 2 it can be seen that germination in airtight storage was 86.7% at the beginning, and 85.8% after 3 months, whereas germination under normal storage started at 93% and ended at 87.5%. Although there was no insect infestation, and germination for both storage

methods remained high, there was a difference in reduction in germination between the two, with a 0.9% reduction in the sealed outdoor storage and 5.5% for the normal warehouse storage.

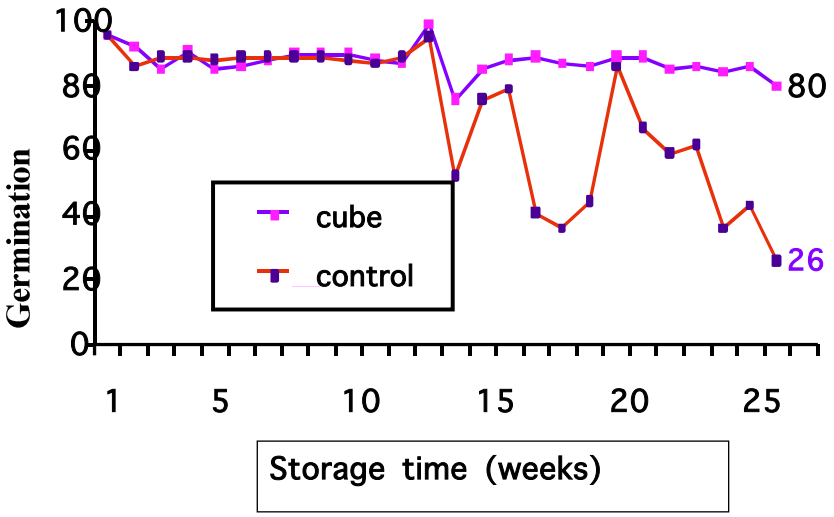

Fig. 3. Changes in germination of mungbean seeds stored in the Volcani Cube and in the control stack over a 26 week period.

DISCUSSION AND CONCLUSION

The trial on storage of mungbean seed in indoor airtight storage for 6 months resulted in complete prevention of insect infestation. Damaged mungbean seed and live insect were not observed at the end of storage. There was only a slight change in seed moisture content. Furthermore, germination trials revealed that the mungbean seed was still in good condition. Temperature and humidity conditions inside the airtight storage remained stable, and were not different from ambient conditions in the warehouse.

The outdoor trial on storage of mungbean seed in airtight storage for 3 months showed similar results as in Trial 1. There was no insect infestation and seed germination was still high at the end of 3 months. Unfortunately this trial had to be terminated prematurely due to a lack of available seed for planting.

These results indicate that airtight storage in the Volcani Cube provided advantages for the storage of mungbean seed in order to maintain good germination quality and freedom from insect infestation. If this system of seed storage were to be adopted, it would also the reduce need for insecticidal and fumigant application in the warehouses. Further research is planned to investigate storage of mungbean

seeds for 9 to 12 months and examine mungbean seeds stored in Volcani Cubes outdoors.

TABLE 2
Quality parameters of mungbean seed before and after 3 months storage in a 10 tonne capacity airtight Volcani Cube placed outdoors at the Chainat Field Crop Research Center during March-April 1999 (Trial 2)

Sack No	Moisture content (%)		Germination (%)		Damaged seed (%)		No. of insects (before)*		No. of insects (after)*	
	Before	After	Before	After	Before	After	Alive	Dead	Alive	Dead
1	10.9	10.8	90.5	91.5	0	0	0	0	0	0
2	10.8	10.8	78.0	85.5	0	0	0	0	0	0
3	11.0	10.4	87.0	85.5	0	0	0	0	0	0
4	11.2	10.6	84.5	82.0	0	0	0	0	0	0
5	10.7	10.6	91.5	86.5	0	0	0	0	0	0
6	11.0	10.8	87.5	87.5	0	0	0	0	0	0
7	10.4	10.4	88.0	85.5	0	0	0	0	0	0
8	11.4	10.9	86.0	85.5	0	0	0	0	0	0
9	11.3	11.1	87.5	90.5	0	0	0	0	0	0
10	11.0	10.8	88.5	85.0	0	0	0	0	0	0
11	10.7	10.8	83.0	84.0	0	0	0	0	0	0
12	11.0	10.8	87.5	81.5	0	0	0	0	0	0
13	10.8	10.7	90.5	82.5	0	0	0	0	0	0
14	11.1	11.0	83.0	85.5	0	0	0	0	0	0
15	11.0	11.1	88.0	89.0	0	0	0	0	0	0
Mean	11.0	10.8	86.7	85.8	0	0	0	0	0	0
Control	11.7	11.6	93.0	87.5	0	0	0	0	1	0

*No. of insects per 100 g of sample

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