Pests of Some Beans Recorded from Hinthada Environs

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Abstract

Hinthada Township which is located between 17˚ 20′ and 18˚ 31′ N, and 94˚ 48′ and 95˚ 47′ E was chosen to study the pests of some beans. The study period lasted from middle October 2009 to middle October 2011. In this study, three different kinds of beans: (*Phaseolus lunatus* L. var. (Pe-htaw-bat), *P. lunatus* L. var.1 (Pe-ne-bya) and *Dolichos lablab* L. (Pe-gyi) which were collected from Hinthada markets were used as pest hosts. Two species of pest weevil were observed. The ovi-positional responses to the respective beans conditions were studied. The mechanisms of the part of the seeds that inhabit the development of the immature to the adults were also detected. It was found that the female weevil decided to lay her eggs randomly rather than uniformly, where eggs were distributed in contagion manner specific gravity. It was also found that the kinds of beans influence the growth of the emerging adults. The physical properties, size, hardness, tissue of the beans were not concerned with the distribution of eggs and in the development of the larva. Physico-chemical analysis on the dried ripe seeds of contents has been undertaken. The chemical components of the beans seemed to inhibit the egg hatchability, duration of larval development and the survival of the immature stages.

Key words: pest hosts, pest weevil, beans, chemical components, Hinthada markets

Introduction

Being crops of traditional antiquity, food legumes (or grain legumes) form an importance component of Myanmar agricultural system. In addition to their importance in the economy and export trade of Myanmar, the food legumes are important from two other considerations as well. Firstly is their role as a cheap and efficient source of protein in the nation's nutrition. Secondly is their agricultural importance (Rajan, 1977).

The major feature of distribution of food legume area is the dominance of the "Upper" or "Central" Myanmar. Over 80% of the food legume area is located in "Upper" Myanmar, or the "dry zone", covered by the Sagaing, Mandalay and Magway Region.

The Ayeyarwady delta area contributes about 10% of the total area of these crops. There are seventeen cultivars belonging to eleven species involved in a major way in the food legume cultivation of Myanmar. Of the total of 723000 hectares under food legumes nearly 80% is accounted for by seven cultivars viz., Kalape (*Cicer arietinum*), Pe-htaw-bat (*Phaseolus lunatus*) Matpe (*Vigna mungo*), Pesingone (*Cajanus cajan*), Pegyi (*Lablab purpureus*), Sultapya (*P. lunatus*) and Pedisein (*V. radiata*) (Rajan,1977).

Of the 850 known species of Bruchid beetles about eight are responsible for serious damage to harvested peas and beans and a further 12 species cause losses by feeding on seeds in the ripening pods. Primary pests of leguminons crops, *Zabrotes subfasciatus*, and four species of the genus *Callosobruchus* have become adapted to breeding successive generations in stored seeds (Hall, 1970).

Family Bruchidae (= Laniidae): Over 1000 species are known and most pests are found boring in the seeds of leguminous plants and crops, both in the field and in storage. Many species are widely distributed as a result of being extensively transported with

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foodstuffs. In leguminosae many species are found in the fruits and seeds of Umbelliferae and Convolvulaceae (Hill, 1983).

In Myanmar, pulses are the second most important after paddy in terms of area, domestic consumption and foreign exchange earning (Pe Than Kyaw, 2007).

The pulse weevils in the *Callosobruchus* species destroy grains both in the fields and in storage area. Their distribution is cosmopolitan. Eggs are laid, stuck onto the outside of the pods, by the female beetles, each female laying up to 90 eggs (Southgate, 1978).

Bruchid weevil, *Zabrotes subfasciatus* (Boheman, 1833) (Coleopteran: Bruchidae) is one of the most important pests of stored beans worldwide (Abate and Ampofo, 1996). This species probably evolved in Central America and was used as original hosts the wild ancestors of the modern cultivated forms of the lima bean (*Phaseolus lunatus*, and the common bean, *P. vulgaris* (Fabaceae).

Objectives of the Study

This present work is conducted with the following objectives;

- To investigate the infected pests on beans and
- To analyze the chemical composition of different beans.

Materials and Method

Study area and study period

The present study was conducted in Hinthada Township which is situated in Hinthada District, Ayeyarwady Region. It is located between 17° 20′ and 18° 31′ N, and 94° 48′ and 95° 47′ E (Figure 1). The study was conducted from November 2009 to October 2011.

Materials

Three kinds of pulses: *Phaseolus lunatus* L. var. (Pe-htaw-bat or Butter bean), *P. lunatus* L. var.1 (Pe-ne-bya) and *Dolichos lablab* L. (Pe-gyi) were used as pest host's resources (Plate I and II A- D).

Selection of the beans and specimen collection

All three kinds of healthy seeds were carefully selected, so as to have no significant difference between the sizes of all kinds of beans and within the sizes of the same bean. Containers (11.5 cm diameter x 2.5cm height Petri dishes) were used for bruchid culture. Seeds of each cultivar were put in each container. At least 20 or 30 seeds consist in 30 gram beans. The bruchid cultivars were kept in a room temperature. Incubation periods of eggs laid on different pulses were studied under laboratory conditions and kept at room temperature ranging from 28°C- 34°C and moisture range.

Physico-chemical analysis

The seeds were dried in sunlight from two to three days. Dried materials were ground to powder by using a blender machine and stored in an air-tight mark container. Then, the

samples were analyzed by energy dispersive X-ray fluorescence (EDXRF) method at the laboratory of University Research Centre (URC), University of Yangon.

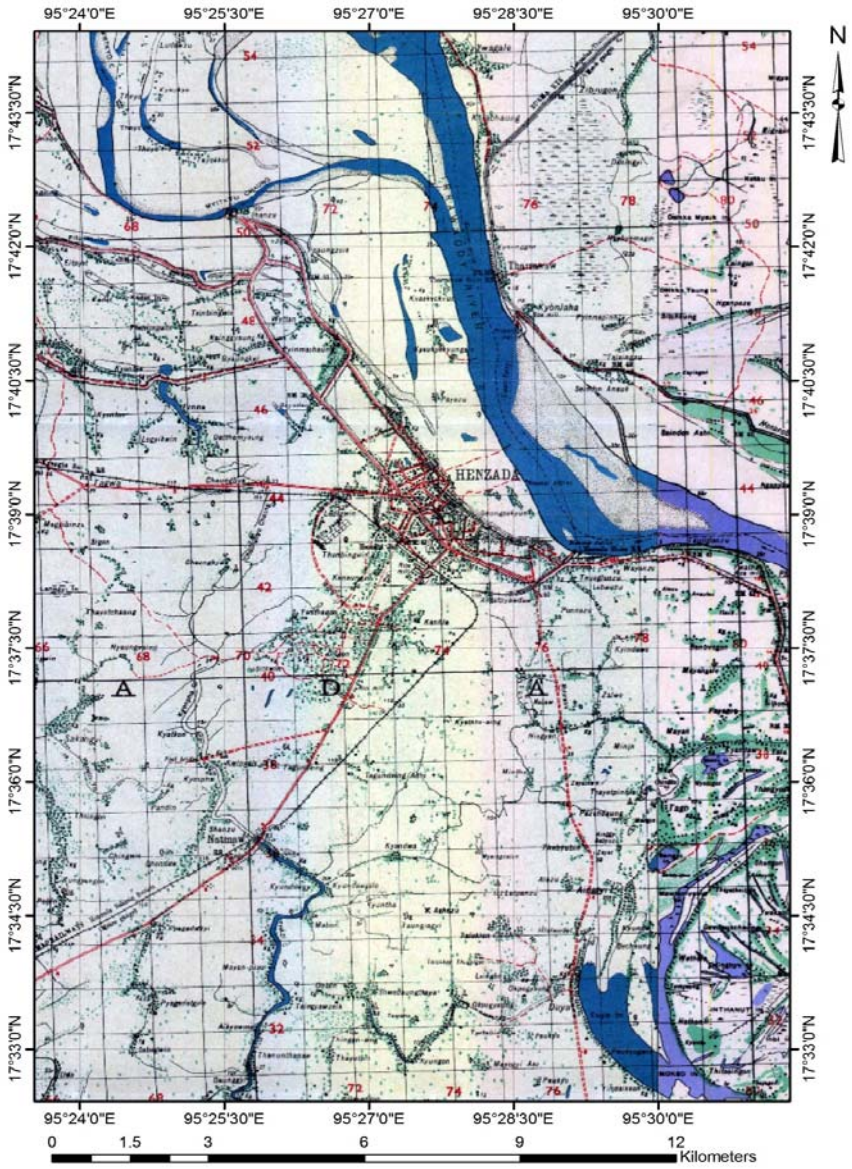


Figure 1 Map of the study area (Source: Geography Department, University of Yangon)

Varieties of pulses

Pe-gyi

Pe-htaw-bat

Pe-ne-bya

Plate I Studied pulses (as pest host's) of Hinthada markets

Identification of species

Insect specimens found in each sample were preserved and identified. These two species were identified by the British museum (National History) London and the species, *Callosobruchus phaseoli* which was also identified by the Zoological Survey of India. Systematic position followed after Kingsolver (2002).

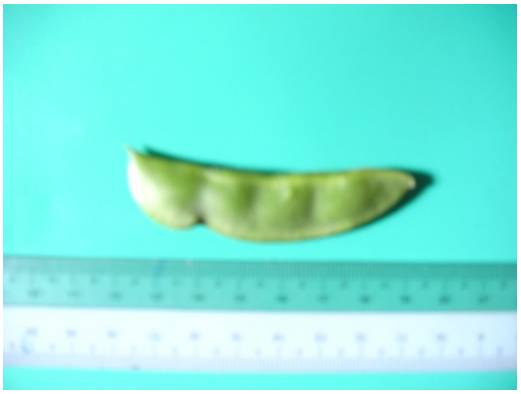
Results

The bruchid beetle or weevil is an important primary pest of several pulses but is particularly associated with the many varieties of common beans. In this study, several kinds of beans; Dolichos lablab, Lablab bean (Pe-gyi), *Phaseolus lunatus* ; Butter bean or Lima bean (Pe-htaw-bat), *Pisum sativum* L. (Pe-leik-pya), *P. mungo*, Black gram; *P*. spp., Pe-sarau, *P. lunatus* L. var.1, Red bean (Pe-ne-bya); *Vigna* spp., Pe- ze-quet, Pe-gya, Apyogyi pe, Apyolay pe, Sultani and Sultapya were recorded from Hinthada markets.

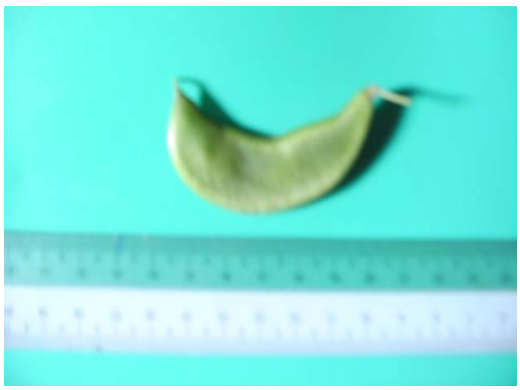
Among them, three kinds of beans; (Pe-gyi, Pe-htaw-bat and Pe-ne-bya) were used as hosts. Two pulse beetles *Callosobruchus phaseoli* and *Zabrotes subfasciatus* emerged from two different kinds of beans: *Dolichos lablab* (Pe-gyi) and *P. lunatus* (Pe-htaw-bat). Out of three legumes, the development of *C. phaseoli* was completed in Pe-gyi and Pe-ne-bya. There was no larval development although eggs were found on Pe-htaw-bat. However, the Pe-htaw--bat was liable to damage by *Z. subfasciatus* (Plate III and V.A and B).

A. Pe-htaw-bat cultivated land

B. Pe-gyi cultivated land

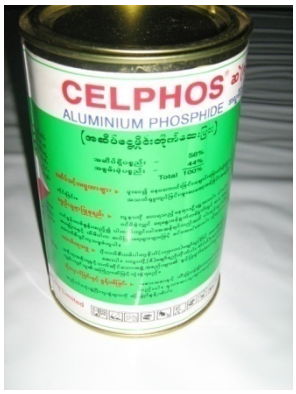


C .Pod of Pe-htaw-bat



D. Pod of Pe-ne-bya

E. Cases of celphos' tablets



F. Box

Plate. II Studied pulses' fields, pods and used chemical fumigant

Systematic position of two recorded weevils

Phylum	-	Arthropoda
Class	-	Insecta
Order	-	Coleoptera
Suborder	-	Polyphaga
Superfamily	-	Chrysomeloidea
Family	-	Bruchidae
Subfamily	-	Bruchinae

Genus	-	*Callosobruchus* (Pic, 1902)
Species	-	*C. phaseoli* (Gyllenhal, 1833)
Common name	-	Bruchid weevil
Genus	-	*Zabrotes* (Horn, 1885)
Species	-	*Z. subfasciatus* (Boheman, 1833)
Common name	-	Bruchid weevil

General morphological characters of *C. phaseoli*

This species is grey-green in color and about 3-5 mm long. They have a 'tear drop' like body shape and are covered in short hairs. The wing cases are short and mottled brown with the antennae being grey and reddish. The femur of the hind leg has three tooth-like spines. They are usually found in dried kidney and haricot beans. The grub, or larva, is whitish and hairy. The eggs are whitish and ellipsoidal (Plate. V B).

Egg: Females' *C. phaseoli* laid their eggs on the seed coat of pulse grain. The eggs are cemented firmly to the outside of the grain and seen as clusters. The larva hatches through the floor of the egg straight into the grain. After the larva has hatched the egg case is clearly visible as a small creamiest-white spot on the surface of the infected grain. Incubation period of *C. phaseoli* takes about 6 days. Eggs were laid about 7 days during lifetime. The eggs distribution on single seed by single female was recorded 1-10 egg per seed. On the sixth day after oviposition, the whole egg turned to white colour.

Larva: The hatching larvae immediately bore inside and spend their entire life feeding within the seed. The larvae which are responsible for the major damage are small white, C-shaped worms with darker heads.

Prepupa: The prepupa is white color and chewing mouthparts were reduced. In this stage, the body segments were clearly seen and no- active. This stage takes about 2 days as *C. chinensis*.

Pupa: Pupa stage is not active, does not feed and change to adult form slowly. Eventually forming a pupation chamber just under seed coat, at which stage the infestation becomes evident as a circular 'window' on the surface of the grain. This stage takes about 2 days.

Adult: The adult which emerges from the pupal chamber is short-lived and does not feed and the female lays its eggs rapidly. *C. phaseoli* stay in 2 days in adult stage before emerged out. A developmental period takes about 21 days. The life cycle was completed inside the seed and adults emerged through circular holes (Plate III, V and VI).

General morphological characters of *Z. subfasciatus*

It is particularly common in central South America but is also found in several other tropical or sub-tropical regions.

Smallish bruchids (2-2.5 mm long) with long, filiform antennae, black with basal segments reddish yellow. The dorsal surface of adults usually variegated dark and brown while the base of the pronotum has a large patch of whitish hairs also exist as a broad transverse patch on the elytra. The head is deep brown. There is a pair of broad compound eyes one of each side of the head. At emergence the beetle is black in colour (its original colour). In the female beetle; there are white spots in the middle of the dorsal side of the thorax and the two wings. The male beetle occupies dry brown colour. There are no white

spots on the thorax and wings are compared with female. The female beetle lays her eggs singly on the pulse seed (Plate IV).

Mostly the eggs glutted onto the surface of the seed and seen as oval in shape but some of them are round. Under laboratory condition the incubation period was 4-14 days on the average of 10. 4 days. Each female beetle can be lay about 7-62 eggs and an average of 31eggs.

Control of bruchids

Cultural control can be effective in growing vulnerable crops at least half a mile from farm crop stores which were the primary source of infestation.

Chemical composition

Chemical compositions of studied beans were varied. Altogether twelve components were detected (Table. 1).

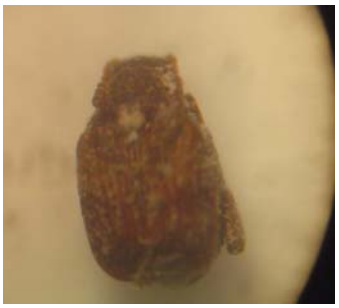
Among three beans, only five components (K, S, Zn, Rb and Cu) were found in Pe-gyi, nine (K, Fe, S, Ca, Zn, Rb, Mn, Cu and Si) in Pe-htaw-bat and 11components in Pe-ne-bya. Only Silica was not found in Pe-ne-bya.

A. Adult weevil Dorsal view

B. Ventral view

Plate III *Callosobruchus phaseoli*

A. Female adult weevil (Dorsal view)

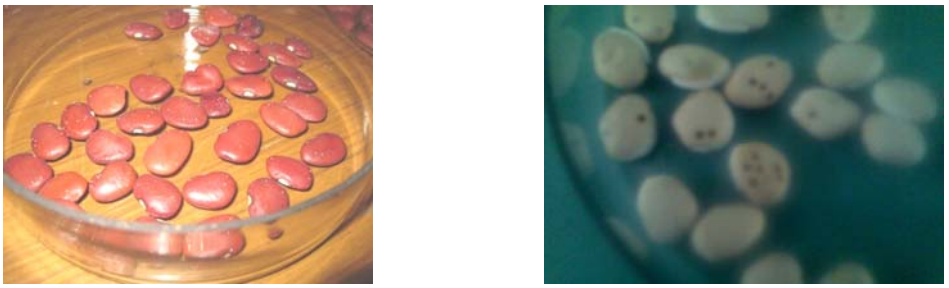


B .Male adult weevil (Dorsal view)

Plate IV *Zabrotes subfasciatus*

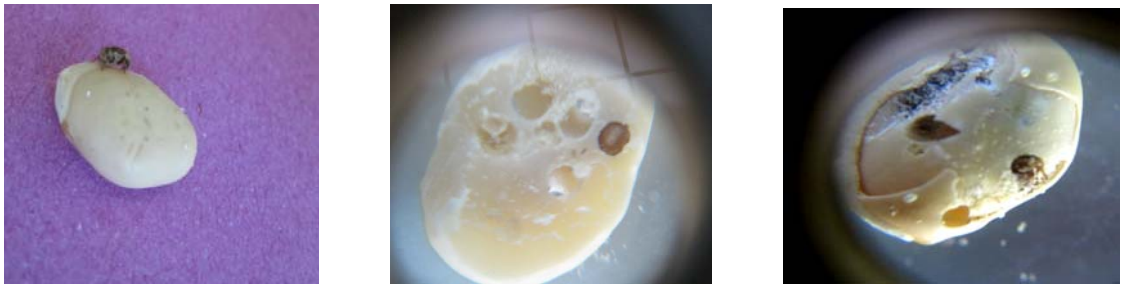
Table. 1 Chemical composition contents of three selected legume cultivars

Chemical components (%)	Pe -ne -bya	Butter bean (Pe- htaw-bat)	Pe -gyi
K (Potassium)	43.29	23.89	71.29
P (Phosphorus)	25.36	-	-
Fe (Ferrous)	11.35	0.69	-
S (Sulphur)	9.11	9.12	12.69
Ca (Calcium)	5.03	2.21	-
Zn (Zinc)	1.44	0.21	1.92
Ti (Titanium)	1.28	-	-
Rb (Rubidium)	0.96	0.26	1.79
Mn (Manganese)	0.94	0.23	-
Cu (Copper)	0.79	0.22	1.87
Cr (Chromium)	0.44	-	-
Si (Silica)	-	63.18	-



A. Weevil eggs on Pe-ne-bya seeds B. Seed windowed and holed (Pe-gyi)

Plate V. Infested seeds



A. *C. phaseolus* on lablab bean B. Larval stage C. Larva and Prepupa stage

D. Pupa stage E. Newly hatch adult F. Inside of damaged seed

Plate VI Life cycle of *C. phaseoli*

Discussion and Conclusion

The most dangerous attacks of the legumes of pulses are insect pests called Bruchid beetles. They are important pests of pulse crops in Africa and Asia both on field crops and in stores. Two pulse beetles *Callosobruchus phaseoli* and *Zabrotes subfasciatus* emerged from different kinds of beans; Pe-gyi , Pe-ne-bya and Pe- htaw- bat.

Balachowsky (1962) mentioned that *Z. subfasciatus* prefer beans (*P. vulgaris* L.) and all its varieties which are grown in tropical regions (*P. multiflorous* L., *P. mungo* L., *P. lunatus*, L., etc.).

Ghosh (1940) observed that almost all beans belonging to the botanical species *P. lunatus* are practically immune. These are (Pe-htaw-bat) and (Pe-ne-bya).They remain free if properly dried at harvesting time and occasionally taken out, dried and cleaned during storage. Even if a few pulse beetles *C. phaseoli* should occur no appreciable damage is done.

According to the number of pulse beetles emerged from two varieties of beans *P. lunatus* L. var.1, (Pe-ni-bya) and Pe-gyi, no larval development although eggs were found on Pe- htaw- bat it could be assumed that Pe- htaw- bat could resist and immune to the pulse beetle *Callosobruchus phaseoli* attack. But Pe-gyi was liable to heavy damage by *C. phaseoli* if the temperature and relative humidity are suitable for its development. However, the Pe-htaw- bat was liable to damage by *Z. subfasciatus.* These findings agreed with the statements of the authors mentioned above. It was also found that the kinds of beans influenced the growth of the emerging adults.

The results showed that the female weevil laid her eggs randomly, regardless of the shape and surface texture of the beans. This showed that the weevils do not avoid the beans already conditioned by the eggs. The female do not prevent too many eggs being placed on any one bean.

Southgate (1978) stated that *Z. subfasciatus* became a pest when it established itself as a continuous breeder in stored seeds and spread too many pests of the tropics and subtropical areas of the world through trade in bean seeds.

It is universally known that carbohydrates and proteins are present in legumes. Thandar Oo (2006) mentioned that the protein content was found to be the highest in *Dolichos lablab* L. 22.89%; 22.05% in *Phaseolus lunatus* L. var. and in *P. lunatus* L.var.1 contain 19.19% .Total ash content was above 9% in all the studied species. The highest percentage was found in *Dolichos lablab* L.(Pe-gyi) which was about 10.74% and lowest one was found in *P. lunatus* L.var.1(Pe-ni-bya). From these result it is showed that proteins, fat and the total ash contents in the *D. lablab* L. were found the highest amongst the three types of seeds. It could be assumed that Pe-gyi was liable to heavy damage by attack of the pulse beetle *Callosobruchus phaseoli.*

Although, in this study showed that heavy metal compositions were lowest in Pe-gyi and highest in Pe-ne-bya. These chemical compounds together might hinder the development of the immature larvae. The moisture content was above 5% in all the studied species. The highest percentage was found in *P. lunatus* L.var.1 (18.75%) lowest in *P. lunatus* L.var. 7.18%. From these results it could be suggested that the hardness, specific gravity and tissue of beans did not influence the development of the larvae.

Based on these findings the writers' final conclusion on the infestation of pulse beetles was that all of the pulse beetles infestation concerned before the seeds were harvested. It can be assumed that not all but some of the pulses were attacked in the field. On the other hand, the clean seeds are infested on in the godowns and stores where the greatest damage is

really done. However, heavy damage was not found in these areas maybe of fumigation with Celphos (Aluminium phosphide) tablets was widely used and very effective (Plate II E).

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