OCCURRENCE OF STORED GRAIN INSECT PESTS IN STORED CEREALS AND PULSES IN MEIKTILA

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ABSTRACT

During the study period from September, 2013 to February, 2015 insect samples were taken at monthly intervals from stored cereals and pulses in bags kept in two storage study sites of Meiktila amounted to a total of eighteen insect pest species. These included fifteen Coleopterans, two Lepidopterans and a single Psocopteran species. Among the collected species, Psocid (booklice) was the most abundant, followed by maize weevil and cowpea weevil. The highest number of species composition was found in order Coleoptera (83%), followed by Lepidoptera (11%) and Psocoptera (6%).

Key word: Occurrence, Stored grain insect pests, Stored cereals and pulses

Introduction

Several species of insects may infest grain in storage. The principle pests that cause damages are adult and larval stages of beetles and weevils; and the larval stages of moths (Sallam, 1997).

Stored-grain insects are known as "internal feeders" if they feed within the kernels, otherwise they are referred to as "external feeders." External feeders feed on grain dusts, cracked kernels, and grain debris without entering the kernel (Mason and Obermeyer, 2010).

Meiktila is situated in Mandalay Region in dry zone of Myanmar. Various cereal and pulse crops are grown and produced in Meiktila Township. Some crop products are sold soon after their production but others are stored for varied periods of the time. A few crops are stored on small scale at the farm level, and most are stored at the market level in Meiktila. During storage, grains are severally destroyed by insects. By understanding the role of stored grain insect pests on cereals and pulses as the main agents for destructing and deteriorating the quality of cereals and pulses, this research was conducted with the following objectives:

- to record and identify the insect pests in stored cereals and pulses in Meiktila
- to investigate the composition and occurrence of stored grain insect pests species

Materials and Methods

Study Area and Study Sites

Meiktila which is situated between latitude 20° 51' and 20° 55' N and between longitude 95° 49' and 95° 54' E was selected as the study area.

Two study sites were allocated, namely Study Site (A) and Study Site (B). Study Site (A) is Meiktila central market located between latitude 20º52'46"-20º52'59"N and longitude 95º51'28"- 95º51'39" E. In this Study Site, the stored crops were treated with insecticides to control insect pests from infestation and designated as the experimental site.

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Study Site (B) is Meiktila Industrial Zone that lies between latitude 20º53'54"-20º54'25"N and longitude 95º53'09"-95º53'20" E. The stored cereals and pulses from this area were not treated with any insecticides, and thus referred to as the control.

Study Period

Study period was from September, 2013 to February, 2015.

Collection of the Specimens

Different types of infested cereal grains and pulses with their respective insect pests were collected at monthly intervals from the grain bags in two study sites. In each study site, the six kinds of crops; rice, maize, green pea, cowpea, butter bean and groundnut were stored.

One kilogram grain each was taken as sample from the top, middle, and bottom of some bags of each kind of grains. The grain samples were sieved thoroughly (20 times minimum) over 0.8 mm sieve for rice and 2mm sieve for maize and pulses to separate and collect the insects for identification (Ashman, 1970). The insect pests were observed and counted by using hand lens (x 10 magnification) and/ or dissecting microscope. Moths were collected by using the insect net at the time of opening the grain bags. Necessary measurements and photographic records of insects were made using digital microscope (USB) (x 800 magnifications).

Identification of Species

Identification of the species was made based on distinctive characters; colour marking, wings, legs, antennae, pronotum, scutellum, elytra, abdomen, thorax and head of adults. Morphological characters were observed under the compound microscope and digital microscope (USB) (x800 magnification). The specimens were identified and classified according to the keys given by Pedersen *et al.* (1914), Borror and Delong, (1954), Haines, (1991), Rees, (2004) and Mason and Obermeyer, (2010). A clean glass container was also used during identification of the grain pests. Since weevils and saw-tooth grain beetles can walk up the wall of glass easily, but flour beetles, rusty grain beetle, flat grain beetle and lesser grain borer cannot.

Plate.1 Study sites (A) Meiktila Central Market

Source: Google Image, 2015

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Plate.2 Study sites (B) Meiktila Industrial Zone

Source: Google Image, 2015

Results

A total 18 species of stored grain insect pests was recorded from the study area.

Species Composition and Occurrence

A total number of 18 species, confined to 13 genera, 12 families and three orders were recorded from the study area during the study period. Out of 18 species, eight species are primary insect pests while others are secondary insect pests. The order Coleoptera was represented by 15 species distributed among 10 genera and nine families, namely Curculionidae, Bostrichidae, Bruchidae, Dermestidae, Lophocateridae, Laemophloeidae, Tenebrionidae, Silvanidae and Nitidulidae. The order Lepidoptera was represented by two species, *Sitotroga cerealella* and *Cadra cautella*, are confined to two genera and two families namely Gelechiidae and Pyralidae. The order Psocoptera was represented by a single species, *liposcelis* sp., confined to the family Pyralidae (Table 1).

During the course of study 18 species of insect pests belonging to 3 orders were recorded in the study area. Out of 18 species, 15 belong to order Coleoptera, one to Psocoptera and two to Lepidoptera. Species composition in order Coleoptera (83%) was the highest, followed by Lepidoptera (11%) and Psocoptera (6%) (Table 4 and Fig.1).

Site (A)

During this study period, more insects were found in stored rice and maize grain than pulses.

In rice, the most abundant species was Psocid (*Liposcelis* sp.), followed by sawtooth grain beetle (*Oryzaephilus surinamensis*) and rice weevil (*Sitophilus oryzae*). A total number of nine insect species were encountered in rice during the study period, namely, *Sitophilus oryzae, Sitophilus granaries, Cryptolestes ferrugineus, Cryptolestes pusillus, Tribolium castaneum, Tribolium confusum, Oryzaephilus surinamensis, Ahasverus advena* and *Liposcelis* sp.

In maize, the most abundant species was Psocid (*Liposcelis* sp.), followed by sawtooth grain beetle (*O. surinamensis*) and maize weevil (*Sitophilus zeamais*). A total number of nine species, *S. oryzae, S. zeamais, S. granaries, C. ferrugineus, T. castaneum, T. confusum, O. surinamensis, A. advena* and *Liposcelis* sp.

But in pulses, only single species, Psocid (*Liposcelis* sp.), was recorded and other insect pests were not found (Table 2).

Site (B)

In rice, the most abundant species was Psocid (*Liposcelis* sp.), followed by sawtooth grain beetle (*Oryzaephilus surinamensis*) and rice weevil (*Sitophilus oryzae*). A total number of 12 insect pest species, namely, *S. oryzae, S. granarius, R. dominica, C. ferrugineus, C. pusillus, T. castaneum, T. confusum, O. surinamensis, A. advena, Liposcelis* sp., *S. cerealella*, and *C. cautella* were recorded during the study period.

In maize, the most abundant species was Psocid (*Liposcelis* sp.), followed by maize weevil (*Sitophilus zeamais*) and sawtooth grain beetle (*O. surinamensis*). A total number of 16 species, *S. oryzae, S. zeamais, S. granarius, R. dominica, C. ferrugineus, C. pusillus, T. granarium, L. pusillus, T. castaneum, T. confusum, O. surinamensis, A. advena, C. hemipterus, Liposcelis* sp., *S. cerealella* and *C. cautella* were recorded.

In stored green pea, the most abundant species was Cowpea weevil (*Callosobruchus maculatus*), followed by Psocid (*Liposcelis* sp.) and maize weevil (*S. zeamais*). A total number of collected species was nine species. There are *S. oryzae, S. zeamais, R. dominica, C. maculatus, C. chinensis, C. ferrugineus, O. surinamensis, A. advena* and *Liposcelis* sp.

In cow pea, the most abundant species was Cowpea weevil (*C. maculatus*), followed by Psocid (*Liposcelis* sp.) and Southern cowpea weevil (*Callosobruchus chinensis*). A total number of 13 species, *S. oryzae, S. zeamais, R. dominica, C. maculatus, C. chinensis, C. ferrugineus, C. pusillus, T. granarium, L. pusillus, T. castaneum, O. surinamensis, A. advena* and *Liposcelis* sp., were recorded during the study period.

In butter bean, the most abundant species was Southern cowpea weevil (*C. chinensis*), followed by Psocid (*Liposcelis* sp.) and Cowpea weevil (*C. maculatus*). A total number of 13 species, *S. oryzae, S. zeamais, R. dominica, C. maculatus, C. chinensis, C. ferrugineus, C. pusillus, T. granarium, L. pusillus, T. confusum, A. advena, Liposcelis* sp. and *S. cerealella* were recorded during the study period.

In groundnut, the most abundant species was Psocid (*Liposcelis* sp.), followed by Southern cowpea weevil (*C. chinensis*) and sawtooth grain beetle (*O. surinamensis*). A total number of 13 insect pest species, *S. oryzae, S. zeamais, R. dominica, C. maculatus, C. chinensis, C. ferrugineus, C. pusillus, O. surinamensis, ssA. advena, C. hemipterus, Liposcelis* sp., *S. cerealella* and *C. cautella* were recorded during the study period (Table 3).

Table 1. List of insect pest species recorded in stored cereals and pulses and their pest status

No	Order	Family	Common name	Scientific name	Status
1.	Coleoptera	Curculionidae	Rice weevil	*Sitophilus oryzae*	Primary
2.			Maize weevil	*Sitophilus zeamais*	Primary
3.			Granary weevil	*Sitophilus granarius*	Primary
4.		Bostrichidae	Lesser grain borer	*Rhyzopertha dominica*	Primary
5.		Bruchidae	Cowpea weevil	*Callosobruchus maculatus*	Primary
6.			Southern cowpea weevil	*Callosobruchus chinensis*	Primary
7.		Dermestidae	Khapra beetle	*Trogoderma granarium*	Primary
8.		Lophocateridae	Siamese grain beetle	*Lophocateres pusillus*	Secondary
9.		Laemophloeidae	Rusty grain beetle	*Cryptolestes ferrugineus*	Secondary
10.			Flat grain beetle	*Cryptolestes pusillus*	Secondary
11.		Tenebrionidae	Red flour beetle	*Tribolium castaneum*	Secondary
12.			Confused flour beetle	*Tribolium confusum*	Secondary
13.		Silvanidae	Sawtooth grian beetle	*Oryzaephilus surinamensis*	Secondary
14.			Foreign grain beetle	*Ahasverus advena*	Secondary
15.		Nitidulidae	Driedfruit beetle	*Carpophilus hemipterus*	Secondary
16.	Psocoptera	Liposcelididae	Psocid (booklice)	*Liposcelis* sp.	Secondary
17.	Lepidoptera	Gelechiidae	Angoumois grain moth	*Sitotroga cerealella*	Primary
18.		Pyralidae	Almond moth	*Cadra cautella*	Secondary

Table 2. Occurrence of insect pest species in stored cereals and pulses in Site A during the study period

		Crops					
No	Scientific Name	Rice	Maize	Green pea	Cowpea	Butter bean	Groundnut
1	*Sitophilus oryzae*	+	+	-	-	-	-
2	*Sitophilus zeamais*	-	+	-	-	-	-
3	*Sitophilus granarius*	+	+	-	-	-	-
4	*Cryptolestes ferrugineus*	+	+	-	-	-	-
5	*Cryptolestes pusillus*	+	-	-	-	-	-
6	*Tribolium castaneum*	+	+	-	-	-	-
7	*Tribolium confusum*	+	+	-	-	-	-
8	*Oryzaephilus surinamensis*	+	+	-	-	-	-
9	*Ahasverus advena*	+	+	-	-	-	-
10	*Liposcelis* sp.	+	+	+	+	+	+
	No. of species	9	9	1	1	1	1

Table 3. Occurrence of insect pest species in stored cereals and pulses in Site B during the study period

No	Scientific Name	Crop					
		Rice	Maize	Green pea	Cowpea	Butter bean	Groundnut
1	*Sitophilus oryzae*	+	+	+	+	+	+
2	*Sitophilus zeamais*	-	+	+	+	+	+
3	*Sitophilus granarius*	+	+	-	-	-	-
4	*Rhyzopertha dominica*	+	+	+	+	+	+
5	*Callosobruchus maculatus*	-	-	+	+	+	+
6	*Callosobruchus chinensis*	-	-	+	+	+	+
7	*Cryptolestes ferrugineus*	+	+	+	+	+	+
8	*Cryptolestes pusillus*	+	+	-	+	+	+
9	*Trogoderma granarium*	-	+	-	+	+	-
10	*Lophocateres pusillus*	-	+	-	+	+	-
11	*Tribolium castaneum*	+	+	-	+	-	-
12	*Tribolium confusum*	+	+	-	-	+	-
13	*Oryzaephilus surinamensis*	+	+	+	+	-	+
14	*Ahasverus advena*	+	+	+	+	+	+
15	*Carpophilus hemipterus*	-	+	-	-	-	+
16	*Liposcelis* sp.	+	+	+	+	+	+
17	*Sitotroga cerealella*	+	+	-	-	+	+
18	*Cadra cautella*	+	+	-	-	-	+
	No. of species	12	16	9	13	13	13

Table 4. Orderwise relative percentage of stored grain insects recorded

	Order	No. of species	Species composition (%)
1.	Coleoptera	15	83
2.	Lepidoptera	2	11
3.	Psocoptera	1	6

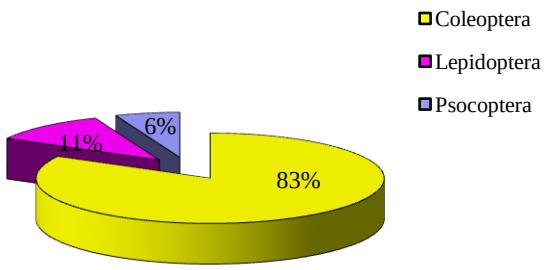
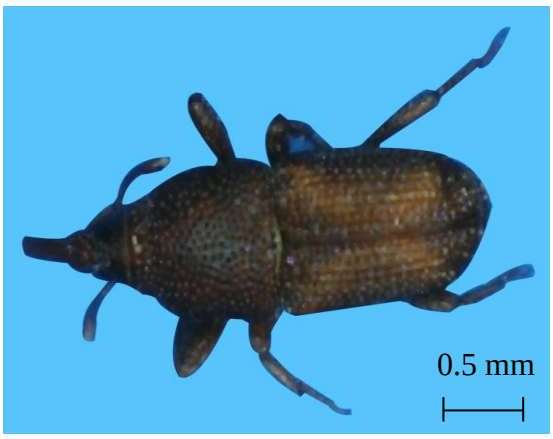
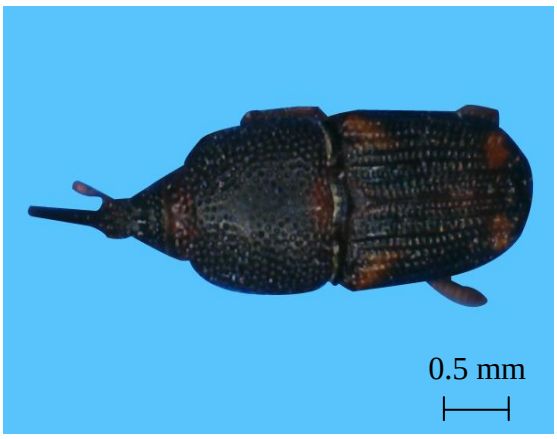


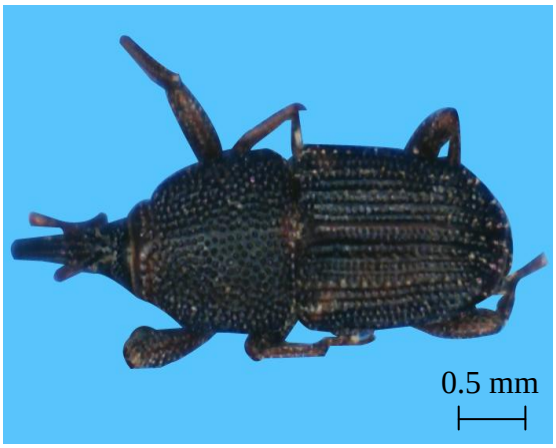
Figure 1. Orderwise relative percentage of stored grain insects recorded



(A) *Sitophilus oryzae*

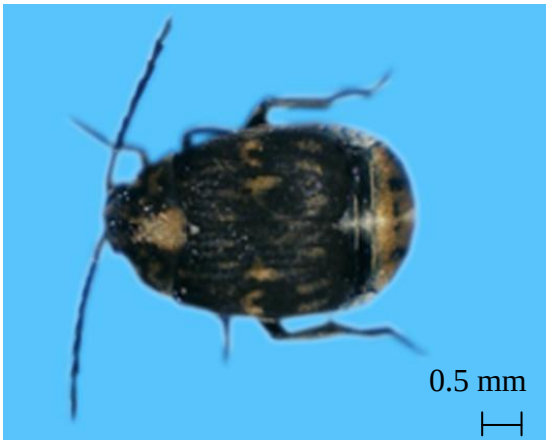


(B) *Sitophilus zeamais*

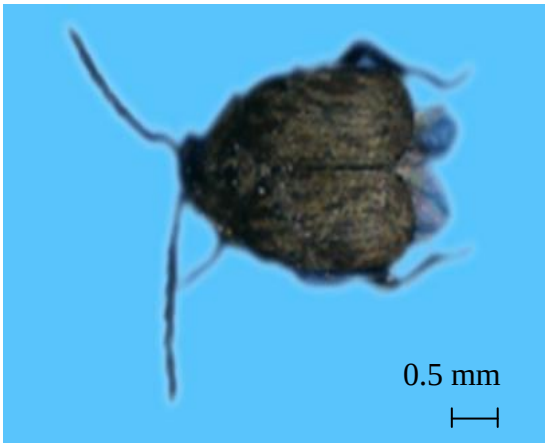


(C) *Sitophilus granarius*

(D) *Rhyzopertha dominica*

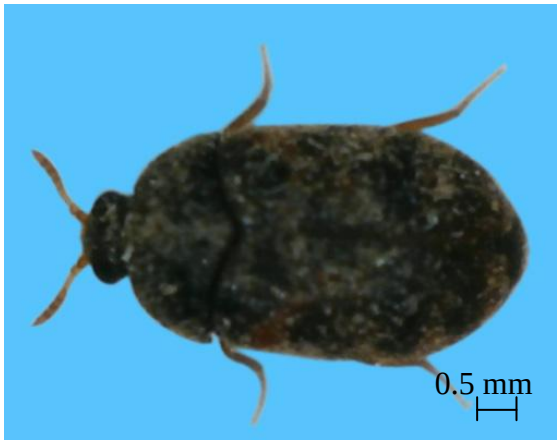


(E) *Callosobruchus maculatus*

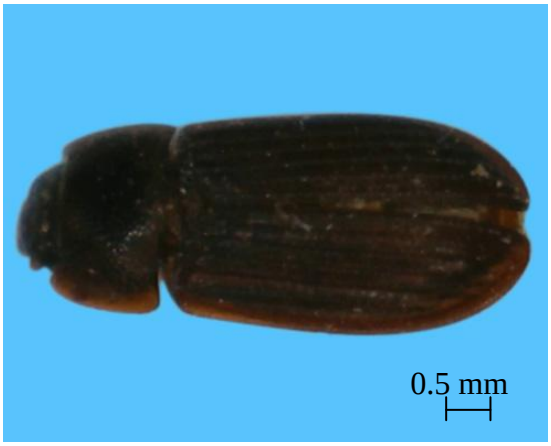


(F) *Callosobruchus chinensis*

Plate 1. Insect pest species of Order Coleoptera

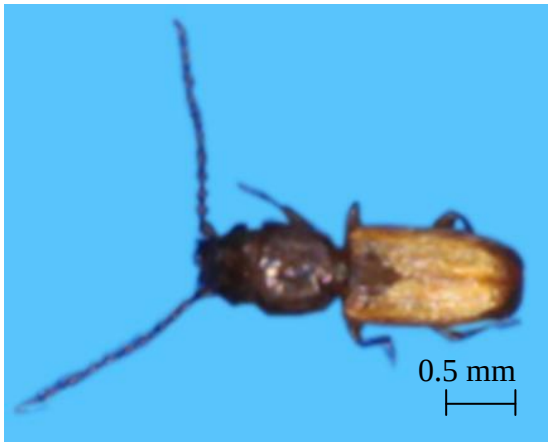


(G) *Trogoderma granarium*

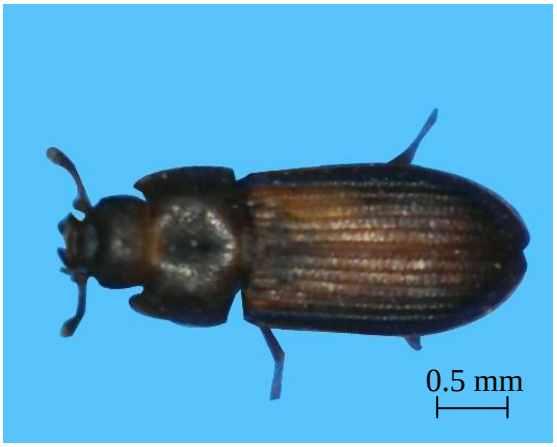


(H) *Lophocateres pusillus*

(I) *Cryptolestes ferrugineus*



(J) *Cryptolestes pusillus*

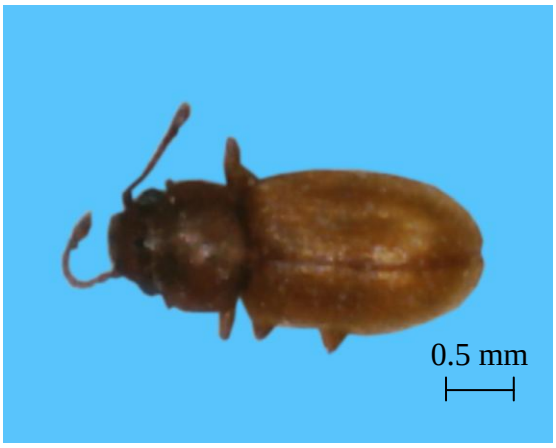


(K) *Tribolium castaneum*

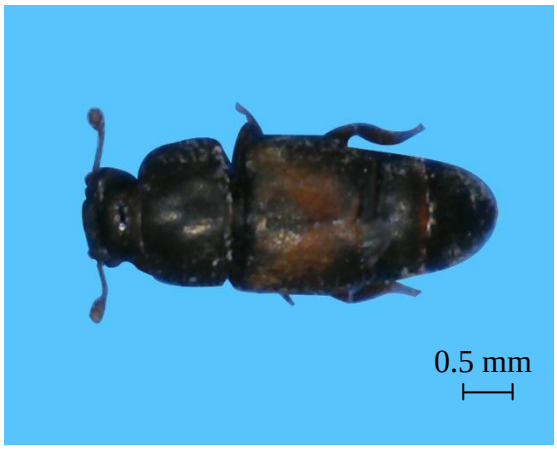
(L) *Tribolium confusum*

Plate 1 Continued

(A) *ryzaephilus surinamensis*

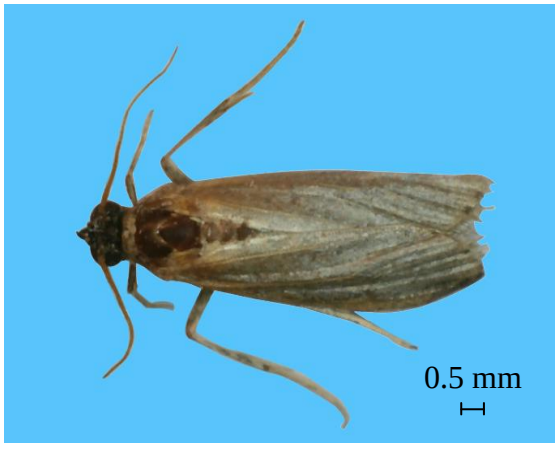


(B) *Ahasverus advena*



(C) *Carpophilus hemipterus*

(D) *Liposcelis* sp.



(F) *Sitotroga cerealella*

(G) *Cadra cautella*

Plate 2. Insect pest species of Order Coleoptera, Psocoptera and Lepidoptera

Order Coleoptera

Discussion

During the study, the total numbers of 18 insect pest species were recorded on stored grains and pulses from two storage sites in Meiktila.

In Site A, nine species of insect pests comprising eight Coleopteran and one Psocopteran were encountered on cereal grains and pulses treated with insecticides. Nine species of insect pests were found in stored cereal grains and the total numbers of insect pest species in cereals was the highest. But in pulses, only Psocid (*Liposcelis* sp.) species was found. It is assumed that this species may have acquired resistance since insecticides were used in this site. Ahmedani *et al.* (2010) reported that these insects have developed high levels of resistance to various insecticides in grain storage systems. Other insects were not found in pulses. This is because insecticide treatment was less practised in rice than in pulses. In pulses, bags of phosphine tablets were put into stored pulse bags. But this practice was not directly employed in rice bags. However, in site B, all the 18 species of insect recorded during the whole study were encountered, and alluded to the stored cereals and pulses being not treated by any insecticides.

No No Wai (2012) listed eight (8) species, *S. oryzae, S. zeamais, S. granaries, C. maculates, C. chinensis, R. dominica, O. surinamensis* and *T. confusum,* found in rice, maize, wheat and pulses at Bago wholesale market. In contrast, a total of 18 species including these eight species were recorded in the present work.

Among the recorded insect pests, rice weevil (*Sitophilus oryzae*) and maize weevil (*Sitophilus zeamais*) were found both in cereals and pulses, but granary weevil (*Sitophilus granarius*) was found only in cereals. Similarly, Brich (1945a) described that *Sitophilus* spp. are pests of whole grains such as wheat, corn, barley, sorghum, rye, oats, cottonseed, and rice but rice weevils and maize weevils have been reported to feed on beans, nuts, processed cereals and spaghetti (cited by Hagstrum *et al*., 2012).

Wang *et al*. (2000) indicated that Psocids (*Liposcelis* sp.) feed on a variety of animal and plant matter, including fungi, but do not actually damage grain, but they can become a nuisance because of their presence, especially when they occur in large number (cited by Hagstrum *et al*., 2012).

In this study, these insect pests were found both in cereals and pulses. Insecticides were treated in Site A but not used in Site B. So, the total number of species and abundance of insect pests between Site A and Site B differed relatively. In rice, nine species were found in Site A and 12 species were found in Site B. In maize, nine species were found in Site A and 16 species in Site B. In pulses, only one species was found in Site A but different kinds of species were found in Site B.

Conclusion

In Myanmar, cereals and pulses are the most important both for food production and for export to neighboring countries. However, during storage, stored crop products are usually attacked by pests especially insects. Regularly, sampling of stored grain is needed in order to detect or estimate inset populations because it enables early detection of pests and will permit more accurate management decisions to be made. The results obtained in this study may be useful in the management of stored grain pests for commercial purposes. Identification of the insect is the first step in understanding and controlling insect problems. Knowledge of composition and occurrence of insect is necessary for integrated pest management programs. Based on the results obtained in the study, it may be concluded that for long term storage, pest management is needed to protect stored grain from insect pest damage. Therefore, during

storage of the stored products to minimize pest infestation, various safety strategies and effective control strategies need to be employed.

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