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Occurrence of insects species on jujube *Ziziphus jujube* (Miller, 1968) plantations in Shan Ywa Gyi environs, Amarapura Township, Mandalay, Myanmar

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Abstract
Occurrence of insect species on Jujube *Ziziphus jujube* was recorded in Shan Ywa Gyi environs. A total of 15 species were identified during August 2017 to January 2018. Six species were found before flowering, 9 species were found flowering and 8 species were found in fruit and ripe stages. *Apis mellifera* is the highest species composition 25.58% and *Sternochetus mangifera* is the lowest species composition 1.03% were recorded. The highest percentage species composition 33.33% was found in order Coleoptera and the lowest percentage species composition 6.67% was found in order Diptera. Regarding the status of insects, 1 species is beneficial, 4 species are both harmful and beneficial insects and others 10 species are harmful insects were observed. Local farmers and gardeners should be given the awareness of bio-control of insect pest by releasing predatory insects instead of using the chemical control method which can more affect consumers.

Keywords: Insect pest, occurrence, Jujube

Introduction
Insects are ever presented in human lives. They are at once awe inspiring, fascinating, beautiful, and, at the same time, a scourge of humans because of food loss and disease (Resh and Cardé, 2003) [1]. Insects are also important supplementary human food source of calories and protein in many regions of the world (Bodenheimer 1951[2], DeFoliart 1989, 1992, 1999) [2-5], with some 500 species in more than 260 genera and 70 families of insects known to be consumed (DeFoliart 1989, Groombridge 1992) [3, 6]. Conservatively, some 400,000 species of known insects are plant feeders (New, 1988) [7]. Under natural conditions, insects are a prime factor in regulating the abundance of all plants, particularly the flowering plants, as the latter are especially prone to insect attack (Brues 1946) [8].

Beneficial insects are any species of insects that available valued like pollination and pest control. The concept of beneficial is subjective and only arises in light of desired outcomes from a human perspective. In farming and agriculture, the goal is to raise selected crops, insects that hinder the production process are classified as pests, while insects that assist production are considered beneficial (Welsh, 2015) [9].

Harmful insects are represented by the few plant-eaters that congregate and feed, or occur in large numbers. Most plant-eating insects occur at low densities and cause minimal damage, so they can often be tolerated in the garden. Although humans generally regard insects as harmful, most insects are actually harmless or helpful. In fact, less than 2 per cent of all species are harmful; but among them, they can cause major crop damage and spread serious diseases on a large scale. Many insect pests are destroyed by predatory or parasitic insects. More than 600 species of insects are considered harmful pests. Insects not only harm or kill plants and animals, but they also spread diseases, infest stored foods and grains, and cause damage to homes and other buildings and to clothing and furniture (Kalman and Aloian, 2015) [10].

Beneficial arthropods that help maintain a garden with few or no outbreaks of damaging plant pests are either predators or parasitoids. Predatory insects hunt, attack, kill, and consume insect, usually smaller than themselves. Another group of beneficial insects are those that visit

flowers for nectar and provide pollination services. There are about 25 families of insects that contain predatory species, and virtually all of the more than 100 families of spiders are predatory (James, 2014) [11].

Insects provide more than economic or environmental benefits; characteristics of certain insects make them useful models for understanding general biological processes. Probably1000 or more species of insects in more than 370 general and 90 families one or have been used for food somewhere in the world. The pest status of an insect population depends on the abundance of individuals as well as the type of nuisance or injury that the insects inflict. Injury is the usually deleterious effect of insect activities (mostly feeding) on host physiology, whereas damage is the measurable loss of host usefullness (Cranston and Gullan, 2014) [12]. Insect management presents a challenge to organic farmers. Insects are highly mobile and well adapted to farm production systems and pest control tactics (Barbercheck *et al*., 2009) [13].

Myanmar is one of the developing countries where economy is mainly based on the agriculture. Many jujube plants are cultivated in Mandalay Region. The jujube plants *Ziziphus jujuba* is locally known as zi-pen-thi or taiwan-zi-thi. They are economically and widely cultivated in Shan Ywar Gyi Environs. Jujubes are usually infested by various insects, such as fruit flies, beetles, weevils and bugs in this area. Therefore, this research was conducted to identify the insect pests on jujube plants and to record the harmful and beneficial insect pest species on jujube plants in Shan Ywa Gyi environs.

Materials and Methods

The insect pests were recorded from Shanywa Gyi enivrions, Amarapura Township during August 2017 to January 2018. It is South-East of the Mandalay and about eight kilometers away from it. It is situated between 21°50′48.38″ to 21°52′24.50″N and 96°10′49.50″E to 96°12′57.57″E.

Data collection

Specimens were collected and recorded once a month. They were collected by means of insect net and some pests were picked up by hand with the aid of plastic bags. All the different stages of insects as mature (adult) or immature (nymph, larvae and pupae) found on jujube plants were collected from flowing season to until the rape. A total of particular selected 50 trees from the site were involved in the study. The adults were taking on photograph and some adults were killed, pinned, set and preserved in insect box for identification.

Identification

Identification of the specimens was made under a dissecting microscope. The classification of the specimens were based on the Fauna of British India, including Ceylond and Burma, Marshall (1916) [14], Distant (1902) [15], Borror and Delong (1964) [16], Davidson (1966) [17].

Data analysis

Collected data was analyzed as follow after Bisht et al., 2010[18].

$$\text{Species composition} = \frac{\text{Total no. of individuals in each species}}{\text{Total no. of individuals in all species}}$$

Results

A total of 15 insects were recorded. Among these, 6 species were found after flowering, 9 species were flowering and 8 were found in fruit and ripe stages (Table 1). The most occurrence of insect was found in November, followed after 8 species in October and January and in 6 species in September and December. The lowest occurrence was found in August only 5 species (Table 2).

The highest species composition 25.58% was found in *Apis mellifera* and the lowest species composition 1.03% was found in *Sternochetus mangifera* (Table 3). The percentage species composition 33.33% was found in order Coleoptera follower after 26.67% in order Lepidoptera, 20% in order Hymenoptera, 13.33% in order Hemiptera and the lowest composition 6.67% was found in order Diptera (Figure 1).

Regarding the insect status, 1 species of insect (predator) was found as beneficial insect, 4 insect species were found as both harmful and beneficial insect. Other 10 species were found as harmful insect pests (Table 4).

Table 1: List insect pest species found in *Ziziphus* plants

No.	Order	Family	Scientific name	Common name
1	Coleoptera	Curcuionidae	*Hypomeces squamosus*	True weevil
2			*Lixus angustatus*	Rhubarb weevil
3			*Sternochetus mangiferae*	Mango seed weevil
4		Elteridae	*Agritoes mancus*	Wheat wireworm
5		Coccinellidae	*Coccinella* sp.	Lady bug
6	Hemiptera	Membracoidae	*Oxyrachis tarandus*	Treehopper
7		Cicadellidae	*Cicadella* sp.	Green leaf hopper
8	Hymenoptera	Formicidae	*Formica rufa*	Red wood ant
9			*Lasius niger*	Black garden ant
10		Apidae	*Apis mellifera*	Western honey bee
11	Diptera	Tephritidae	*Bactrocera tryoni*	Fruit fly
12	Lepidoptera	Nyphalidae	*Phalantha phalantha*	The common leopard
13		Pieridae	*Catopsilia pomona*	Common emigrant
14		Papilionidae	*Graphium agamemnon*	The tail jay
15			*Papilio polytes*	The common mormon

Table 2: Monthly occurrences and species composition of insects found in *Ziziphus* plants

No.	Species	Before flowering		Flowering		Fruit			Species composition (%)
		Aug	Sep	Oct	Nov	Dec	Jan	Total	
1	*Hypomeces squamosus*	0	0	4	2	3	8	17	4.39
2	*Lixus angustatus*	0	0	0	3	4	7	14	3.62
3	*Sternochetus mangiferae*	0	0	0	0	3	1	4	1.03
4	*Agritoes mancus*	0	0	0	0	4	6	10	2.58
5	*Coccinella* sp.	0	0	0	0	0	7	7	1.81
6	*Oxyrachis tarandus*	4	3	0	0	0	0	7	1.81
7	*Cicadella* sp.	5	8	0	0	0	0	13	3.36
8	*Formica rufa*	20	28	0	0	0	0	48	12.40
9	*Lasius niger*	13	11	8	14	18	20	84	21.71
10	*Apis mellifera*	10	12	22	21	16	18	99	25.58
11	*Bactrocera tryoni*	0	4	8	2	0	6	20	5.17
12	*Phalantha phalantha*	0	0	12	8	0	0	20	5.17
13	*Catopsilia pomona*	0	0	11	6	0	0	17	4.39
14	*Graphium agamemnon*	0	0	9	4	0	0	13	3.36
15	*Papilio polytes*	0	0	6	8	0	0	14	3.62
	Total no. of individuals	52	66	80	68	48	73	387	
	Total no. of species	5	6	8	9	6	8	15	

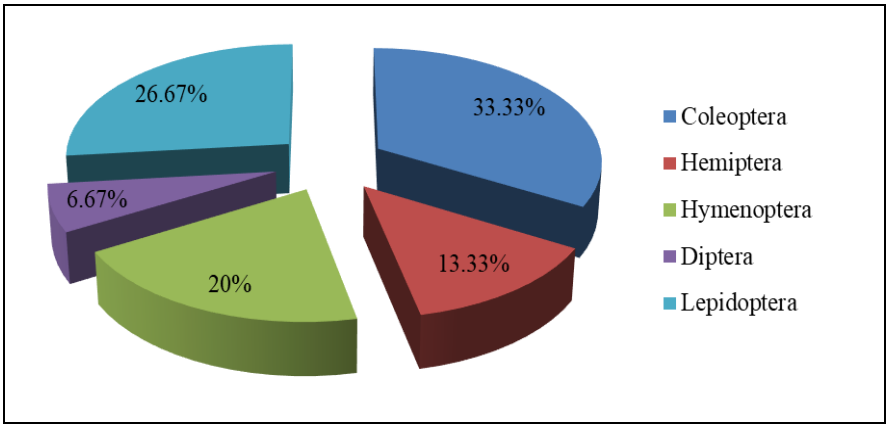

Fig 1: Percentage composition of species in orderwise occurrence

Table 3: Insect pests recorded species status and infestation on jujube plants

0	Species	Status	Stage		Vale/ Injury
			Harmful	Beneficial	
1	*Hypomeces squamosus*	major pest	larva, adult		Feeding causes significant defoliation and stunting of the plant growth and the leaves a skeletonized appearance.
2	*Lixus angustatus*	major pest	larva, adult		Feeding causes significant defoliation plant growth and the leaves a skeletonized appearance.
3	*Sternochetus mangiferae*	minor pest	larva, adult		Causes significant defoliation and stunting of the plant growth and then the leaves a skeletonized appearance.
4	*Agritoes mancus*	minor pest	larva, adult		Feed on foliage until it is completely devoured.
5	*Coccinella* sp.	predator		adult	Larvae feed on aphids, soft-scale insects, mealybugs, spider mites, and other pests.
6	*Oxyrachis tarandus*	major pest	nymph, adult		Feed by inserting their mouthparts into the plant and sucking the juices. This can cause injury in the form of wilting and yellowing of ten called hopperburn, and then can transmit deadly plant diseases.
7	*Cicadella* sp.	minor pest	nymph, adult		In large populations, twigs and branches may be damaged. Injection of phytotoxic salivary substances during feeding. Weakened pines can suffer in weather conditions that encourage disease.
8	*Formica rufa*	minor pest	larva, adult		Eat woody plants but they often nest in it. They may cause damage to structures when they nest in or hollow out wood boards for shelter.
9	*Lasius niger*	minor pest	larva, adult		When a mound is disturbed that can damage crops by feeding on seeds, seedlings, and developing fruit.
10	*Apis mellifera*	minor pest	larva, adult		Effective pollinators of many plants, flowers, and crops. As pollinators; produce honey and beeswax.
11	*Bactrocera tryoni*	minor pest	larva, adult	adult	Valuable to forensic investigations in determining time of death. Transmitting pathogens (Salmonella, Shigella, etc).
12	*Phalantha phalantha*	minor pest	caterpillar	adult	Adults are pollinators in some plants. Caterpillar feed on leaf tissue in between the veins.
13	*Catopsilia pomona*	minor pest	caterpillar	adult	Adults are pollinators in some plants. Caterpillar feed on

					leaf tissue in between the veins.
14	*Graphium agamemnon*	minor pest	caterpillar	adult	Adults are pollinators in some plants. Caterpillar feed on l eaf tissue in between the veins.
15	*Papilio polytes*	minor pest	caterpillar	adult	Adults are pollinators in some plants. Caterpillar feed on leaf tissue in between the veins.

Discussion

Shan Ywa Gyi is one of the orchard and garden cultivated village near Mandalay. It plays very important role in local economic. In this area, there are many orchards and gardens such as mango, lemon and juju plants. In this research work was based on juju plant insects. A total of 15 insects belonging to five orders, 11 families and under 15 genus were recorded. Among these, 6 species were found after flowering, 9 species were flowering and 8 were found in fruit and ripe stages. The most occurrence of insect were found in November, followed after 8 species in October and January (8 species) each and in September and December (6 species) each. The lowest occurrence was found in August only five species.

Reza, *et al* (2005) [19] recorded that a total of 12 species belonging to 6 genera and 7 families of 6 orders on jujube. Namely, Lepidoptera, Coleoptera, Hemiptera, Hymenoptera, Diptera and Acarina were recorded in Khuzestan state. Among them, there are the same five orders (Lepidoptera, Coleoptera, Hemiptera, Hymenoptera and Diptera) and different species as with the present observation. Among these five orders, Coleoptera is the highest species number was found. This may be due to geographical differences and others environmental factor such as temperature and humidity. Myint Myint Naing (2007) [20] reported the fruit fly of *Carpomyia vesuviana* infested to jujube tree in Yangon area, Lower Myanmar. However this species was not encountered during the study period. These variations may be due to different habitat and different weather.

The most common insect which frequently attacked and severely damaged jujube fruits was fruit flies species such as *Bactrocera* spp. and *Carpomyia* sp. which were the greatest enemies of the products of jujube fruit (Sarwar, 2006) [21]. Similarly, in the present study *B. tryoni* was also observed to be the important pest since at happened to be a fruit borer, causing loss of fruits; however the other *Carpomyia* sp. was not encounter during the present research work. The highest species composition 25.58% was found in *Apis mellifera* and the lowest species composition 1.03% was found in *Sternochetus mangifera*. The percentage species composition 33.33% was found in order Coleoptera follower after 26.67% in order Lepidoptera, 20% in order Hymenoptera, 13.33% in order Hemiptera and the lowest composition 6.67% was found in order Diptera. It may be due to Coleoptera species is more suitable for habitat and their feeding types to host jujube plants.

In the present observation, one species of insect (predator) was found as beneficial insect, four insect species were found as both harmful and beneficial insect. Other 10 species were found as harmful insect pests. Shepard, *et al.* (1987) [22] stated that the natural balance between insect pests and their natural enemies is often disrupted by indiscriminate use of chemical insecticides. Although insecticides are needed in some cases, they must be used judiciously to save these vulnerable natural control agents. There are juju plant communities of beneficial and harmful insects, spiders, and diseases that attack insect pests of jujube plant and it products. The beneficial species often control insect pests, especially in the places where use of broad-spectrum pesticides is avoided. Without these valance of beneficial and harmful species, the insect pests would multiply so quickly that they would completely consume the crops. In present study, one species: Lady beetle was rarely found. It is because of the gardeners or farmers used chemical insecticides in this area.

Many beetles, some predatory grasshoppers, and crickets prefer insect eggs. It is not uncommon to find 80-90% of the eggs of certain insect pests consumed by predators. An adult wolf spider may attack and consume 5-15 brown plant hoppers each day. The immature and adult stages of most predators attack insect pests and many prey are required for the development of each predator (Shepard, *et al.*,1987) [22]. In the present observed, two beetles were recorded. It is clearly that biological control and environmental valance is different between predators and pests.

Insect pest infestation and disease may cause hug economic losses in some circumstance. The numerous insect feed on foliage either by direct disruption of plants tissue or by sucking the plants sap. The foliage insect pests are not only cause damage on leaves but their attacks ultimately loosen the vigor of tree and thus the fruit production is also reduce (Khaskheli, *et al.*, 2015) [23].

In the present research work, two major pests: *Hypomeces squamosus* and *Lixus angustatus* were record. Their feeding causes significant defoliation and stunting of the plant growth, the leaves a skeletonized appearance. Other important insect pests are *Oxyrachis tarandus* feed by inserting their mouthparts into the plant and sucking the juices. This can cause injury in the form of wilting and yellowing often called hopperburn, can transmit deadly plant diseases. *Cicadella* sp., large populations, twigs and branches may be damaged and injection of phytotoxic salivary substances during feeding. Weakened pines can suffer in weather conditions that encourage disease.

Conclusion

In conclusion that above the description shows the economic importance and use of harmful and beneficial insect. Lack of awareness among the farmers about these insects and their benefits and injuries they use different management practices to kill them along with the insect-pests. Thus, local farmers and gardeners should be given the awareness of bio-control of insect pest by releasing predatory insects instead of using the chemical control method which can more affect consumers. Broad principles for supporting the beneficial insects and more specific management practices were skill to use in Shan Ywa Gyi and its environs. Thus, better understanding of the benefits can make conservation more effective and more harmonious land use with effective crop production.

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