

BIBLIOGRAPHY

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ABSTRACT

The study aims to know the insects and other arthropods feeding on the leaves, stem and rhizomes ginger in La Trinidad, Benguet and at Pampang, Cayapa, Nueva Viscaya, record the degree of injury caused by these pest on ginger, and to determine the status of different insects and other arthropod associated with ginger.

The insect pest associated with ginger in Benguet State University Balili Experimental Station, La Trinidad, Benguet and at Pampang, Cayapa, Nueva Viscaya were; *Conocephalus upluensis*, *Atractomorpha similes*, *Ostrinia furnacalis*, and *Euproctis fuessely*. The *Chortoicetes terminifera*, *Metopochelus* sp. and *Achatina fulica* were the pest not present in Benguet.

The *Conocephalus upluensis*, *Chortoicetes terminifera*, *Atractomorpha similes* and *Euproctis fuessely* feed on the leaves of ginger. The *Ostrinia furnacalis* bore in the stem while the *Achatina fulica* feed on the rhizome of ginger. Lastly, the *Metopochelus* sp. was noted as saphrophage on the decayed rhizome of ginger.

The most destructive pest of ginger and considered the major pest is the *Achatina fulica* which causes 51% to 75% damage on the plant. The minor pests were the *Conocephalus upluensis*, *Atractomorpha similes*, *Ostrinia furnacalis*, *Euproctis fuessely*, *Chortoicetes terminifera*, and *Metopochelus* sp. which cause 1% to 51% damage on the plant.

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INTRODUCTION

Ginger (*Zingiber officinale* R.) is a herbaceous perennial plant of the family Zingiberaceae, a native of southern Asia (Bautista and Aycardo, 1979). Its generic name *Zingiber* is derived from the Greek Zinibgeris, which comes from the Sanskrit name of the spice, Singabera which means “shaped like a horn” that refers to the roots. Ginger was one of the first oriental; spices known in Europe (Perez, 2005).

Considering Philippine setting specifically Cordillera, ginger production is not given priority by local farmers. In case they plant, less intervention is given. In fact, they plant ginger only for their family consumption and some may plant and sell to the market in small amount.

Gingers are also attacked by different insects which destroy or disrupt the normal growth of the plant. The common insect pests of ginger are from the group of Lepidoptera, Orthoptera, Coleoptera, and some of the Diptera (Bautista and Aycardo, 1979). The most abundant stage of Lepidoptera is the larval stage. Some larva cut the stem which causes the drying up of the leaves. Other larva feeds on the shoots and leaves. Orthopterans also feed on the shoots and leaves but some feed on the rhizome of the plant that causes the drying and yellowing of the leaves. Coleoptera and Diptera feed on the shoots and leaves of the plants. The feeding injury of these insects might decrease the production of ginger.



Identification of the different insect pest and other arthropods attacking ginger, the information would be of great help to ginger growers for future management of this pest when there would be mass production of ginger for exportation. It would also be a guide for crop programming to the growers to avoid the infestation of insect pests.

The study was conducted to know the insects and other arthropod feeding on the leaves, stem and rhizomes ginger in La Trinidad, Benguet and at Pampang, Cayapa, Nueva Viscaya, record the degree of injury caused by these pest on ginger, and to determine the status of different insects and other arthropod associated with ginger.

The study was conducted at Benguet State University Balili experimental area, La Trinidad, Benguet and at Pampang, Cayapa, Nueva Vizcaya from July 2005 to February 2006.



REVIEW OF LITERATURE

Distribution of Ginger

Ginger grows best in tropical and subtropical areas, which have a good rainfall with hot and humid conditions during the summer seasons. At present, 50% of the world's harvest is produced in India; the best quality is exported in Jamaica. Ginger plantation is also done at Brazil, Nigeria, Africa, Fiji, Thailand and other parts of the globe where it proliferates in suitable environment (Bautista and Aycardo, 1979).

Ginger is commonly propagated by planting rootstalk cuttings and it no longer develops into seed. Harvesting is done simply by lifting the rhizomes from the soil, cleansing them, and drying them under the sun. The leafy stem of ginger grows about a meter high. The leaves are 6 to 12 inches long, elongated, alternate in two vertical rows and arise from the sheath enwrapping the stem. The flowers are in dense, cone like spikes about 1 inch thick and 2 to 3 inches long composed of overlapping green bracts, which may be edged with yellow. Each bract encloses a single small, yellow-green and purple flower (Stephen, 2005).

Importance of Ginger

Ginger is among the most important and valued spices in the world because ginger was thought to have magical powers. In fact, King Henry VII of England recommends ginger as a remedy to the great plague in the 16th century. It was often use also by pregnant women for “morning sickness”. The gingers are occasionally used to flavor breads, sauces, curry, dishes, confections, pickles and ginger tea. The fresh



rhizome is used in cooking. The peeled rhizomes may be preserved by boiling in syrup. Slices of ginger are eaten between dishes or courses to clean the palate. It is also used to treat abdominal pain, anorexia, arthritis, dyspepsia, bleeding, cancer, chest congestion, chicken pox, cholera, chronic bronchitis, cold extremities, colitis, common cold, cough, cystic fibrosis, difficulty in breathing, disorders of gall bladder, hyperacidity, hyperglycemia, indigestion, rheumatism, sore throat, stomach ache and vomiting (Anon., 2003). Ginger contains 2% essential oil, the principal component is Zengiberene and the pungent principle of the spice is Zingerone. The oil is distilled from rhizomes for use in the food and the perfume industries.

Insects Associated with Ginger

According to Bautista and Aycardo (1979). The insect pests of ginger includes the shoot/stem borer (*Ostrinia furnacalis*), cutworm (*Spodoptera litura*), mealy bug, scale insects and other arthropods while Anon.(2005) said that the insect pest of ginger are moth and beetles.



MATERIALS AND METHODS

Materials

The materials used were seed pieces of ginger, grab hoe, shovel, watering can, plastic containers, data sheets, camera, microscope, ball pen and organic and inorganic fertilizers.

Methods

Land preparation and planting. An area of 50 square meters was prepared at Balili, La Trinidad, Benguet and at Pampang, Cayapa, Nueva Vizcaya. The plots were cultivated until the soil was suitable for planting. The plots were constructed 30cm high. It was then applied with organic fertilizer and mixed properly.

The plots were prepared making a hole that was 10cm deep and each hole was 30cm apart. The seed pieces were planted on the hole and were covered properly with soil. When the plants had germinated, application of inorganic fertilizer was done.

Monitoring of the pest. Insects attacking ginger were collected and be fed in the laboratory. The insects collected were observed everyday if they really caused damage on the particular part of the plant. Insects that sustain their life at least two growth stages in the laboratory was considered pest.

The observation was done upon the germination of the plants until it was harvested. The collection of data was done twice a day, one in the morning and one in the afternoon at Balili, La Trinidad, Benguet while at Nueva Vizcaya, the observation was done twice every month.



Identification of the insect. The insect collected was properly identified on their taxonomic hierarchy: order, family, genus, species and common name if possible with the aid of entomological books and internet and was also properly identified through the use of microscope.

Monitoring the degree of injury. The degree of injury was determined through percentage by taking the whole plant through visual estimate. The sample plants were rated by visual observation using the following rating index:

<u>Rating Index</u>	<u>Qualitative Index</u>	<u>Description</u>
1	No Damage	No Injury
3	Slightly Damage	1 to 25% damage on the plants
5	Moderately Damage	26 to 50% damage on the plants
7	Severely Damage	51 to 75% damage on the plants
9	Very Severely Damage	76 to 100% damage on the plants

Any insect that damage the plant in above 51% are the major pest and below 50% were the minor pest.

Data Gathered

1. Identity of the pest. The insects and arthropod collected were identified on their taxonomic hierarchy using entomological books, and other references through the used of microscope.

2. Degree of injury. Amount of leaves, stem and rhizomes eaten by the pest.

3. Status of the pest. The pest that has the degree of injury above 51% are considered the major pest and below 50% are considered the minor pest.



RESULTS AND DISCUSSION

Pests Associated with Ginger

There were seven (7) insect pests associated with ginger (*Zingiber officinale* Roscoe). These were the katydid, grasshopper and slant faced grasshopper under the order Orthoptera; stem borer and tussock moth under the order Lepidoptera, medium legged flies under the order Diptera and the African snail under the order Pulmonata.

Insects and snail associated in ginger is shown in Table 1 and the characteristics of adult and immature insects associated with ginger are shown in Table 2 and 3.

The order Orthoptera. There were three (3) families of Orthoptera feeding on the ginger. These were Tettigonidae, Phygomorphidae and Acrididae (Figures 1, 2 and 3).

The order Lepidoptera. There are two (2) families of Lepidoptera on the ginger. These are the Pyralidae (Figures 4 and 5) and Lymantriidae (Figures 6, 7 and 8)

The order Diptera. Under this order Diptera, the family Micropezidea was noted and these insect saprophage on the decayed rhizome of ginger (Figures 9, 10, and 11)

The order Pulmonata. One (1) family of order Pulmonata feeding on ginger was noted and this was the family Achatinidae (Figure 12).



Table 1. Insects and snail associated with ginger

ORDER/FAMILY	SCIENTIFIC NAME	COMMON NAME
Order Orthoptera		
Tettigonidae	<i>Conocephalus upluensis</i>	Katydid
Phyrgomorphae	<i>Atractomorpha similes</i>	Slant face grasshopper
Acrididae	<i>Chortoicetes terminifera</i>	Grasshopper
Order Lepidoptera		
Pyralidae	<i>Ostrinia furnacalis</i>	Stem borer
Lymntriidae	<i>Euproctis fuessely</i>	Tussock moth
Order Diptera		
Micropezidae	<i>Metopochelus</i> sp.	Medium legged flies
Order Pulmonata		
Achatinidae	<i>Achatina fulica</i>	African snails



Table 2. Description of adult insect/snail genus associated with ginger

ORDER/FAMILY	GENUS	DESCRIPTION
Order Orthoptera		
Tettigonidae	<i>Conocephalus</i>	Type of leg, jumping. Eye is medium, wings present forewings and hindwings, body color greenish. Long antennae-filiform. Thread-like, body measure 18mm, wing span 24mm, abdomen 7 segments.
Phyrgomorphae	<i>Atractomorpha</i>	Type of leg, jumping. Eye is medium. Wings present hind and forewing. Spand measurement 23mm, body color green. Body measure 22mm, short antennae filiform and threadlike, abdomen 7 segment.
Acrididae	<i>Chortoicetes</i>	Type of leg, jumping. Eye is large. Wings present hind and forewing. Spand measurement 23mm, body color brown and green Body measure 25mm, short antennae filiform and threadlike, abdomen 7 segment.
Order Diptera		
Micropezidae	<i>Metopochelus</i> .	Short antennae, aristate, body color black with hair erect on the thorax part wings present with 6mm, body measure 10mm.
Order Pulmonata		
Achatinidae	<i>Achatina</i>	Body colored brown with black markings



Table 3. Description of immature insects associated with ginger

ORDER/FAMILY	GENUS	DESCRIPTION
Order Lepidoptera		
Pyralidae	<i>Ostrinia</i>	Body color brownish and erect short hairs, body measured 19mm, abdomen 11 segmented, and medium eye.
Lymantriidae	<i>Euproctis</i>	Body color yellow spotted with black, many long and short erect hairs, body measured 23mm with medium eye.
Order Diptera		
Micropezidae	<i>Metopochelus</i>	Color white, smooth body measuring 16mm with 11 segments, medium eye and head part is bigger than body.





Figure 1. Katydid
 Order: Orthoptera
 Family: Tettigoniidae
 Genus: *Conocephalinae*
 Species: *upoluensis*



Figure 2. Slant face grasshopper
 Order: Orthoptera
 Family: Phygomorphidae
 Genus: *Attractomorpha*
 Species: *similes*



Figure 3. Grasshopper
 Order: Orthoptera
 Family: Acrididae
 Genus: *Chortoicetes*
 Species: *terminifera*



Figure 4. Stem borer larvae
 Order: Lepidoptera
 Family: Pyralidae
 Genus: *Ostrinia*
 Species: *furnacalis*





Figure 5. Stemborer adult
 Order: Lepidoptera
 Family: Pyralidae
 Genus: *Ostrinia*
 Species: *furnacalis*



Figure 6. Tussock moth larvae
 Order: Lepidoptera
 Family: Lymantriidae
 Genus: *Euproctis*
 Species: *fuessely*



Figure 7. Tussock moth pupa
 Order: Lepidoptera
 Family: Lymantriidae
 Genus: *Euproctis*
 Species: *fuessely*



Figure 8. Tussock moth adult
 Order: Lepidoptera
 Family: Lymantriidae
 Genus: *Euproctis*
 Species: *fuessely*



Figure 9. Medium legged flies larvae
Order: Diptera
Family: Micropezidae
Genus: *Metopochelus*



Figure 10. Medium legged flies pupa
Order: Diptera
Family: Micropezidae
Genus: *Metopochelus*



Figure 11. Medium legged flies adult
Order: Diptera
Family: Micropezidae
Genus: *Metopochelus*



Figure 12. African snail
Order: Pulmonata
Phylum: Gastropoda
Family: Achatinidae
Genus: *Achatina*
Species: *fulica*

Destructive Stages and Time They Attack the Ginger

The insects and snail has different stages that feeds on the different parts of the ginger and different time they attack the ginger (Table 4).

The order Orthoptera. The *C. upoluensis*, *A. similes* and *C. terminifera* are the orthopterans that feed on the leaves of ginger during the day time and they are very destructive on their nymph and adult stage.

The order Lepidoptera. The *O. furnacalis* feed on the stem of ginger during the night and day time and this was very destructive on their larval stage. The larva feed on the inner part of the stem which may lead to the yellowing and drying of the shoots of the stem.

The *E. fuessely* feed on the leaves of ginger during the day time. This insect was very destructive on their larval stage.

The order Diptera. The *Metocephalus* sp. Were the insects found to be a saprophage on any decaying part of the plant where they usually complete their life cycle.

The order Pulmonata. The *A. fulica* feed on the rhizomes of ginger early in the morning and late in the late in the afternoon until the middle of the night. They are destructive on their adult stage.



Table 4. Destructive stages and the time were they are active in attacking the ginger

ORDER/FAMILY	TIME THEY ATTACK		DESTRUCTIVE STAGE			PARTS OF THE PLANT THEY EAT			SAPROPHAGE
	Day	Night	Larva	Nymph	Adult	Leaves	Stem	Rhizome	
Order Orthoptera									
Tettigonidae	X			X	X	X			
Phyrgomorphidae	X			X	X	X			
Acrididae	X			X	X	X			
Order Lepidoptera									
Pyralidae	X	X	X					X	
Lymantriidae	X		X			X			
Order Diptera									
Micropezidae									X
Order Pulmonata									
Achatinidae	X	X			X			X	



Insect Pests Associated with Ginger in Benguet

Two (2) orders of insects associated with ginger were found in Benguet State University Balili Experimental Station, La Trinidad, Benguet. These were orders Orthoptera and Lepidoptera.

There are two families under order Orthoptera and these were Tettigonidae and Phygomorphidae. Under the order Lepidoptera, there were two families and these were Pyralidae and Lymatriidae (Table 5).

Insect Pests and Snail Associated with Ginger in Nueva Viscaya

Four (4) orders of insect and one (1) order in Gastropoda are associated with ginger found in Bambang, Cayapa, Nueva Viscaya.

There are three (3) families in order Orthoptera and these were Tettigonidae, Phygomorphidae and Acrididae; two (2) families under order Lepidoptera and these were Pyralidae and Lymatriidae; one (1) family under order Diptera and this was Micropezidea and one family under order Pulmonata that is Achatinidae (Table 6).



Table 5. Insect pests associated with ginger in Benguet

ORDER/FAMILY	SCIENTIFIC NAME	COMMON NAME
Order Orthoptera		
Tettigonidae	<i>Conocephalus upluensis</i>	Katydids
Phyrgomorphidae	<i>Atractomorpha similes</i>	Slant faced grasshopper
Order Lepidoptera		
Pyralidae	<i>Ostrinia furnacalis</i>	Stem borer
Lymantriidae	<i>Euproctis fuessely</i>	Tussock moth

Table 6. Pests associated with ginger in Nueva Viscaya

ORDER/FAMILY	SCIENTIFIC NAME	COMMON NAME
Order Orthoptera		
Tettigonidae	<i>Conocephalus upoluensis</i> (Karny)	Katydids
Phyrgomorphidae	<i>Atractomorpha similes</i> (Bolivar)	Slant faced grasshopper
Acrididae	<i>Chortoicetes terminifera</i> (Walker)	Grasshopper
Order Lepidoptera		
Pyralidae	<i>Ostrinia furnacalis</i> (Glenee)	Stem borer
Lymantriidae	<i>Euproctis fuessely</i>	Tussock moth
Order Diptera		
Micropezidae	<i>Metopochelus</i> sp.	Medium legged flies
Order Pulmonata		
Achatinidae	<i>Achatina fulica</i> (Bowditch)	African snails



Degree of Injury

The degree of injury was determined through percentage by taking the whole plant through visual estimation.

The most destructive pest was african snail under the order Pulmonata which has the rating index of 7 which is severely damage (Figure 13) and had a 51 to 75% damage on the plant followed by the stem borer under the order Lepidoptera which has a rating index of 5 which is moderately damage (Figure 14) and had a 26 to 50% damage on the plant, then the tussock moth that was comparable to katydid, slant face and grasshopper under the order Orthoptera with a rating index of 3 which is slightly damage (Figures 15, 16, 17, and 18) and had a 1 to 25% damage on the plant and lastly the medium legged flies under the order Diptera with a rating index of 1 which has no damage (Figure 19) and no injury on the plant (Table 7).



Table 7. Degree of injury of insects and snail on ginger plant

ORDER/ COMMON NAME	RATING INDEX	QUALITATIVE INDEX	DESCRIPTION
Orthoptera			
Katydid	3	Slightly damage	1 to 25% damage on the plant
Slant face	3	Slightly damage	1 to 25% damage on the plant
Grasshopper	3	Slightly damage	1 to 25% damage on the plant
Lepidoptera			
Tussock moth	3	Slightly damage	1 to 25% damage on the plant
Stem borer	5	Moderately damage	26 to 50% damage on the plant
Diptera			
Medium legged flies	1	No damage	No injury
Pulmonata			
African snail	7	Severely damage	51 to 75% damage on the plant





Figure 13. African snail adult damage on rhizomes of ginger



Figure 14. Stemborer larvae damage on the stem of ginger



Figure 15. Tussock moth larvae damage on the leaves of ginger



Figure 16 Katydid adult and nymph damage on the leaves of ginger





Figure 17. Slant face grasshopper adult and nymph damage on the leaves of ginger



Figure 18. Grasshopper adult and nymph damage on the leaves of ginger



Figure 19. Medium legged flies larvae saphrophage on the decayed rhizome of ginger

Status of Different Insects and other Arthropod



Any insect and other arthropods that reduce the yield with the rating index of 7-9 and had a 51-100% damage on the plants are considered major pests while those had a rating index of 1-5 and had a 1-50% damage on the plant are the minor pest as shown in Table 8.

Major pest. The major pest of ginger encountered was under the order Pulmonata (african snail). The pest feeds on the rhizome of the ginger that causes the deformation of it and decreases the quality of ginger.

Minor pests. The minor pests of ginger encountered were under the order Orthoptera (slant faced grasshopper, grasshopper, and katydids) that feeds on the feeds on the leaves; order Lepidoptera (stem borer and tussock moth) that feeds on the leaves and stem; and the order Diptera (medium legged flies) that are found to be saprophage on the decayed rhizome of Ginger.



Table 8. Major and minor pests associated with ginger

ORDER/FAMILY	COMMON NAME	MAJOR PEST	MINOR PEST
Order Orthoptera			
Tettigonidae	Katydid		X
Phyrgomorphidae	Slant face grasshopper		X
Acrididae	Grasshopper		X
Order Lepidoptera			
Pyralidae	Stem borer		X
Lymantriidae	Tussock moth		X
Order Diptera			
Micropezidae	Medium legged flies		X
Order Pulmonata			
Achatinidae	African snails	X	



SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Benguet State University Balili Experimental Area, La Trinidad Benguet and at Pampang, Cayapa, Nueva Viscaya from July 2005 to February 2006. The study aims to know the insects and other arthropod feeding on the leaves, stem and rhizomes ginger in La Trinidad, Benguet and at Pampang, Cayapa, Nueva Viscaya, record the degree of injury caused by these pest on ginger, and to determine the status of different insects and other arthropod associated with ginger.

Four orders were identified feeding on the different parts of ginger namely; Lepidoptera, Diptera and Pulmonata. Under the order Orthoptera were the slant face grasshopper, katydids and grasshopper, order Lepidoptera were the tussock moth and stem borer, order Diptera was the medium legged flies and the order Pulmonata was the african snail.

The order Orthoptera (slant faced grasshoppers, katydids and grasshoppers) are feeding on the leaves of the ginger during the day time early in the morning. The order Lepidoptera (tussock moth and stem borer) feeds on the stem and leaves. The tussock moth feed on the leaves of ginger during daytime early in the morning and late in the afternoon. The stem borer feed on the stem of the ginger about daytime and nighttime. The order Diptera (medium legged flies) don't feed on the ginger larva just saprophage on the decayed plant like to decayed rhizome ginger. Lastly, the order Pulmonata (African snail) feed on the rhizomes of ginger during daytime and nighttime



The most destructive pest of ginger was the african snail which has the rating index of seven (7) followed by the stem borer with the rating index of five (5). The tussock moth was the same with the slant face grasshopper, katydids and grasshopper which has the rating of three (3) while the medium legged flies had a rating index of 1.

Conclusion

I therefore conclude that the major pest of ginger was the african snail under the order Pulmonata. The minor pests were: katydid, slant face grasshopper and grasshopper under the order Orthoptera; stem borer and tussock moth under the order Lepidoptera; and the medium legged flies under the order Diptera.

Recommendation

It is suggested to continue the study to determine the different stages of the ginger that were attack by the insect so that we know when to apply pesticides.



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