

BIBLIOGRAPHY

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ABSTRACT

This study was conducted at Balili, Swamp and Longlong, La Trinidad, Benguet to identify the spiders found on strawberry plantations and to determine their distribution and population.

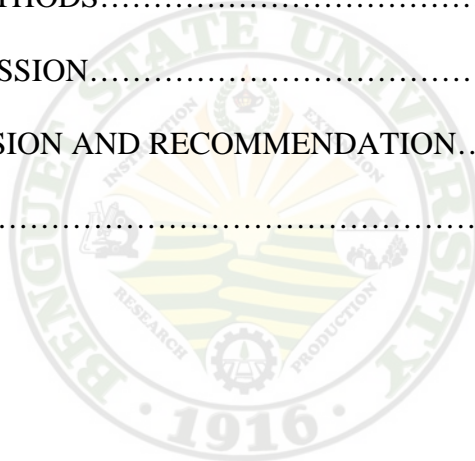
There were five families of spiders that were found on the strawberry plantations such as the family Araneidae, Lycosidae, Theridiidae, Tetragnathidae and Salticidae.

The family Tetragnathidae and family Salticidae were the least distributed that were only found in one site.

The population of spiders under the families were 69 Araneidae, 36 Lycosidae, 35 Theridiidae and 1 in both family Tetragnathidae and family Salticidae.

TABLE OF CONTENTS

	Page
Bibliography.....	i
Abstract.....	i
Table of Contents.....	ii
INTRODUCTION.....	1
REVIEW OF LITERATURE.....	3
MATERIALS AND METHODS.....	9
RESULTS AND DISCUSSION.....	12
SUMMARY, CONCLUSION AND RECOMMENDATION.....	20
LITERATURE CITED.....	22



INTRODUCTION

The strawberry belongs to the genus *Fragaria* in the rose family. They are low-growing perennial herb that may live for many years. Strawberry plants have short roots and long, slender stems that grow along the surface of the soil. They are propagated by cutting off and replanting the many long runners produced by the plant. It can grow best in cool, moist climate and in any kind of soil.

In the Philippines, strawberries are mostly grown in the municipality of La Trinidad, Benguet. It is a fruit known to attract tourists. The fruits may be eaten fresh and can be canned, frozen or used in making jam, jelly and wine which is the main source of income for farmers and some individuals.

The yield of strawberry is affected by the occurrence of pests, thus, the occurrence of natural enemies is a great help in keeping the population of pests lower.

Spiders can be found almost everywhere. In houses, they spin their webs along the ceiling, around the corners and in the houseplants where they can easily catch their prey and some are just walking on the walls and floors. In the field, they eat a lot of insects that destroy the crops.

Spiders, in its various kinds, are predators of orchard pests such as thrips, citrus scale and citrus psylla. On tomatoes, spiders eat red spider mites, two larval stages of the bollworm, as well as on aphids. Predation is not limited to the adult stage, but includes the egg and larval or nymphal stages as well (Schoemen, 2006).

The web-building spiders rarely capture caterpillars. Members of tangle web spiders prey on ground-dwelling insects like the ants or crickets and grass orb



moth. Whereas, the hunting spiders pry on grasshoppers, beetles and other arthropods including other spiders, sow bugs and scorpions. They inject digestive juices into the dead prey, reducing its tissue to a liquid that they can suck out as a meal (Wikipedia, 2008).

Studies on spider species on strawberry plantations has not yet been established. Having knowledge on the species and families of spiders found in the site will give information in order to maximize their use as predators in controlling the population of pest attacking strawberry.

This study therefore, was conducted to identify the spiders found on strawberry plantations and to determine their distribution and population.

This study was conducted at Longlong, Balili and Swamp area at the Municipality of La Trinidad, Benguet from May to December 2008.



REVIEW OF LITERATURE

Taxonomy

Spiders belong to order Araneae, class Arachnida and are members of the phylum arthropoda, the largest assemblage of animals with jointed legs and exoskeleton. They are eight-legged and no wings and no compound eyes.

The spiders have only two body regions- the cephalothorax (anterior part) containing the eyes, palp, mouthparts and legs and the abdomen (posterior part) which bears the respiratory openings, digestive and reproductive system, anal tubercle and the spinneret (Barrion et al., 1995).

According to the latest estimates, approximately thirty seven thousand three hundred (7,300) species of spiders belonging to three thousand four hundred fifty (3,450) genera and one hundred eight (108) families are known from all over the world. It is believed that these figures represent only about one-fourth of total number of spider species present in nature. Over one thousand species of spiders belonging to two hundred thirty six genera and forty-four families are so far known from the Indian subcontinent. The world Book in 1990 stated that some kinds of spiders are smaller than the head of a pin, others are as large as a person's hand.

Groups of Spiders

There are two groups of spiders according to their way of life.

Hunting Spiders. These spiders creep on their prey or lie and wait on it or they run after the insect that land in their webs. Most kinds have large eyes and can see their prey from



a distance. This group includes the jumping spiders, water spiders, tarantulas, crab spiders, and wolf spiders.

Jumping spiders leaps into space after its prey, and floats to the ground on a dragline. They have short legs, but they can jump over forty times the length of their bodies. Their body is covered with many thick colored hairs and they are the most colorful of all spiders. Male jumping spiders have brightly colored hairs on their first pair of legs.

Water spiders are the only spiders that live most of their life underwater. This spider breathes underwater from air bubbles that it holds close to its body. Its underwater nests are silk web shape like a bell. The spiders fill the web with air bubbles, which gradually push all the water out of the bell. The animal can live for several months. They are found only in Europe and parts of Asia.

Tarantulas are the world's largest spiders. Many kinds of tarantulas dig burrows as nests. The trap spider, one kind of tarantula, covers the entrance of its burrow with a lid. Another, the California tarantula, builds a small tower of grass and twigs at the entrance of its burrow. This spider then sits on the tower of grass and watches for the insects moving in the nearby grass. Few tarantulas however, live on trees. Schoeman in 2006 reported that this kind of spiders prey on grasshoppers, beetles and other arthropods including other spiders, sow bugs, and scorpions. They inject digestive juices into the dead prey, reducing its tissues to a liquid that they can suck out as meal.

Crab spiders, on the other hand, have short, wide bodies and look like crabs. They can walk backwards and side wards as easily as crabs do. Some brightly colored crab spiders hide in flowers and captures bees and butterflies. Few kinds of spiders can



disguise themselves by changing the color of their bodies to match the color of the flower blossom. In addition, these spiders ambush their prey in flowers, capture more bees, butterflies, and some flies than other insects (Wikipedia, 2008).

Wolf spiders are very common and are excellent hunters. Many kinds have large, hairy bodies and run swiftly in search for food. Others look and act like other types of spiders.

Web-spinning Spiders. Web spinning spiders like hunting spiders, live in caves, in grass or shrubs, or in trees. They cannot catch their prey because of their poor vision. Instead, they spin webs to trap insects. A web-spinning spider cannot be caught on its own web. When walking across the web, it grasps the silk lines with a special hooked claw on each foot. This Web spinning spiders includes tangle-web, funnel-web, sheet-web, and orb-weaver spiders.

Tangle-web weavers spin the simplest type of web. It consists of a jumble of threads attached to a support, such as the corner of a ceiling. The cellar spiders' spins tangle web in dark, empty parts buildings. A comb footed spiders spin a tangle webs, tightly woven sheet of silk in the middle and the ogre-faced spiders spins a web that is made p largely of hackled bands.

Funnel-web spiders live in tall trees or under rocks or logs. The bottom part of the web is shaped like funnel and serves as the spiders hiding place. The top part of the web forms a large sheet silk spread out over grass or soil. When an insect lands on the sheet, the spider runs out the funnel and pounces on the victim

Sheet-web weavers weave flat sheets of silk between blades of grass or branches of shrubs or trees. They spin a net crisscrossed thread above the sheet web. Often, an



insect will fly directly into the sheet web. The spider which hangs beneath the web, quickly runs to the insect and pulls it through the webbing. The sheet web last long time because the spider repairs any damage parts.

Orb-weavers build the most beautiful and complicated of all webs. They weave their round webs in open areas, often between tree branches or flower stems. Threads of dry silk extend from an orb web's center like the spokes of a wheel. Coiling lines of sticky silk connect the spokes and serve as an insect trap. Some orb weavers lie and wait for their prey in the center of the web, and hold on to the trap line and when an insect lands in the web, the line vibrates. The spider then darts out and captures the insect.

The life of Spiders

Each species of spiders has a different life history. Many kinds of spiders live only about a year. Large wolf spiders live several years. Some female tarantulas' have lived up to twenty years in captivity. Spiders become adults at different times of the year. Some mature in the fall and then mate and die during the winter. Others live through the winter, mate in the spring, and then die.

Courtship and Mating

Spiders perform a courtship ritual before mating. Male wolf spiders weave their pedipalpi to attract female. In many web-spinning spiders, the courting male plucks the threads of the web in a special way so that the female will not mistake him for prey. Before mating begins, the male spins a web onto which he drops semen, and fills a reservoir at the tip of his pedipalp with a



sperm. During mating, he inserts the pedipalp in to a special pouch in the female, in which the sperm are stored (World Book, 1997).

Eggs

The number of eggs that lays at one time varies with the size of the animal. A female of average size lays about one hundred eggs. Some of the largest spiders lay more than two thousand eggs. The female of spider wraps the fertilized egg in layers of silk to form a protective cocoon, which the spider hides or carries around until they hatch.

Spiderlings

They hatch from the egg sac and remain there until warm weather arrives. One by one, they leave the egg sac through tiny holes that they tear in its side. They immediately begin spinning draglines. Many spiderlings then travel to other areas, usually by ballooning.

Spiders as Predators

According to Davidson and Lyson (1987) as cited by Ligat in 2002, spiders are probably the most important of all insect predator.

Spiders Natural Enemies

Many animals which are predacious on insect are predators of spiders as well, and this includes themselves. Perhaps the most serious enemies are the wasps of the families Psammocharidae and Sphecidae. Wasps of some species prey only on spiders belonging to particular families or genera. Such wasps sting and paralyze the spider and then carry it to their previously excavated burrow where they lay an egg.



Characteristics of the Different Family of Spiders

Family Salticidae. Jumping spiders: they are medium to small in size, stout-bodied, and short-legged with a distinctive arrangement of the eyes. The body is rather hairy and is often brightly colored or iridescent; some species are ant-like in appearance. These spiders are hunters and pursue their prey; they construct silken retreats under stones and debris.

Family Lycosidae. Wolf spiders or ground spiders. They are spiders that chase their prey, and some are relatively large. Most of them are dark brown in color. The members of this group can be recognized by the characteristic arrangement of their eyes; four small eyes in the first row, two very large eye on the second row, and two small or medium eyes in the third row. The egg sac is carried about by the female, attached to her spinnerets; when the young hatch, they are carried about on the back of the female for a time.

Family Theridiidae. Comb-footed spiders. The webs of these spiders are an irregular network in which the spider usually hangs upside down. The cephalothorax is usually small, the abdomen large and rounded and the legs are usually bent.

Family Araneidae. Orb-weavers. These are very large and widely distributed groups and nearly all its members construct an orb web. There is great deal of variation in size, color, and shape in this family.

Family Tetragnathidae. Four-jawed spiders. These spiders have very large and protruding chelicerae, especially in the males. Most species are brownish in color and rather long and slender, and the legs, especially the front pair, are very long.



MATERIALS AND METHODS

Materials

The materials used in the study were microscope, lamp, record book, digital camera, film canister, vials, carfuls, 70% ethyl alcohol, nail polish, bond paper and pointer. The reference materials were books, dictionaries, encyclopedia and internet.

Study Site

The study was conducted at La Trinidad, Benguet at three sampling sites namely: Longlong, Balili and Swamp area.

Scheme of Collection

The study was conducted by scouting on the ground and on the strawberry plants taking a width of 1 m following the transect method. Collection of spiders through scouting was done by walking from the tip of the line going along the other tip following the X-line and taking turn on its vicinity.

Spiders sitting on their orb webs were collected using a card and a plastic container (film canister) with a wide opening by slowly bringing up the card behind the spider web and at the same time bringing the open wide container towards the spider with a quick push of the card. Collecting of spiders walking on flat surfaces was done by placing the film canister over the spider and sliding the card underneath. An area planted with strawberry, regardless of variety and topography, was considered as sampling site. Sampling was done for eight months and collection of spider was done once a week and any time of the day.

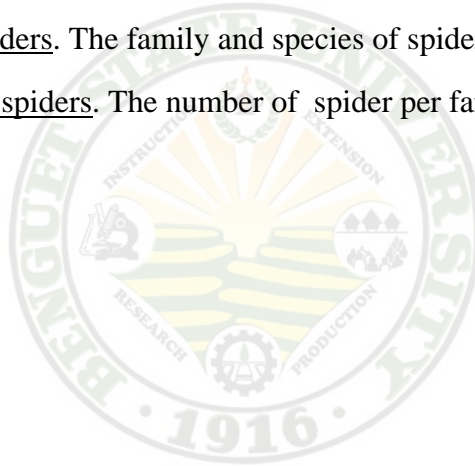


Classifying Spiders

A dissecting microscope was used to see the detailed parts of the spider since the collected ones are small. The families and species of the spider were classified according to their eye patterns (Fig. 1). Their color, body length and leg length were noted. Spider identification was made using taxonomic keys (Barrion et al., 1995, and the internet). Classification was noted up to the family level and species if possible .

Data Gathered

1. Identity of spiders. The family and species of spiders.
2. Population of spiders. The number of spider per families and species



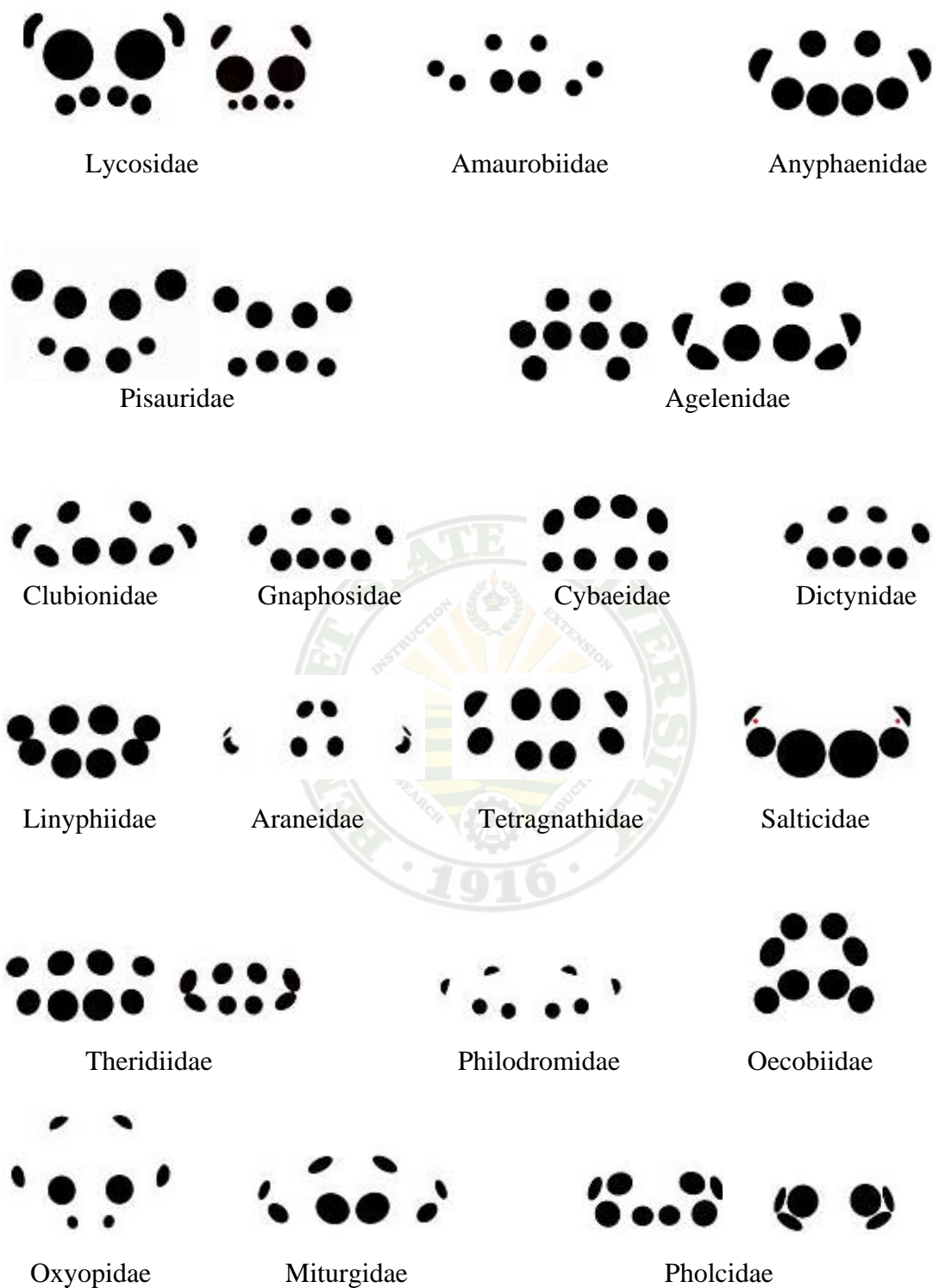


Figure 1. Eye patterns of spiders



RESULTS AND DISCUSSION

Spiders' classification

There were five families of spiders collected on the strawberry plantations. These were the family Araneidae, family Lycosidae, Theridiidae family, Tetragnathidae family and family Salticidae (fig. 2-10).

The less family of spiders found may be due to the fact that some spiders live only in some parts or a particular place in the world and or they have the preference of the environment where to live.



Figure 2. *Argiope* species

Araneidae family

Family Araneidae

They construct an orb web and hang down from the center.

Argiope Species. The ocular area is black. Its abdomen is spotted with chalk white in rectangular pattern and its colored black on its posterior. It has a silver white cardiac mark (not clear on the figure). The first pair of its legs is colored red and black. Its body length measures 2mm. Length of legs from first pair to (anterior) to the last pair (posterior) were 2.5mm, 2.2mm, 2mm and 2.4mm.





Figure 3. *Neoscona* species (1)

Araneidae family

Neoscona species (1). Its abdomen on the anterior portion has a black marking like a flower-shape (not clear on the figure) and a black V-shape on the posterior portion. The body measures 2.4mm. Its legs from the first pair (anterior) to the last pair (posterior) measures 2.6mm, 2.3mm, 1.2mm and 2.3mm.



Figure 4. *Neoscona* species (2)

Araneidae family

Neoscona species (2). The cephalothorax and abdomen is black, except that, in the abdomen it has a white band in an inverted V-shape on the lateral sides on the anterior portion. The body length measures 1mm. Leg lengths from first pair (anterior) to the last pair (posterior) measures 1.2mm, 1.3mm, 1mm and 1.4mm.





Neoscona species (3).
 Cephalothorax gray to black. Abdomen with a black longitudinal band not reaching the posterior part with a two pairs of horizontal band not reaching the lateral sides. On the posterior part is an open inverted umbrella-shape, black in color and with a pair of white spots. Legs are whitish in color. Its body length is 1.2mm. Leg length from the first pair (anterior) to the last pair (posterior) was 2.3mm, 1.3mm, 1.2mm and 2mm.

Figure 5. *Neoscona* species (3)

Araneidae family



Family Lycosidae

They walk so fast.



Figure 6. *Pardosa* species
Lycosidae family

Pardosa species. The eyes were all dark in color. There is a yellow band on the cardiac area. Its body is covered with brown hairs. Abdomen is dark brown in color spotted with yellowish dots (not clear on the figure). The sternum is yellowish with black hairs. The body length measures 8.11mm. Its leg length from first pair (anterior) to the last pair (posterior) measures 10mm, 9.12mm, 8mm and 13.16mm.

Family Therididae

Their legs are long.





Figure 7. *Steatoda* specie
Theridiidae family

Steatoda species. Cephalothorax is yellowish brown to gray. Abdomen is gray. Its body length measures 4mm. Its legs from first pair (anterior) to the last pair (posterior) measures 4.7mm, 3.4mm, 3.3mm and 5mm.





Figure 8. *Enoplognatha* species

Theridiidae family

Enoplognatha species. Cephalothorax is whitish with a mark of seems like letter M which is gray in color. Abdomen is yellowish with a longitudinal dark brown to black band and has a two pairs of white spots. Body length is 1.2mm. Its legs from the first pair (anterior) to the last pair (posterior) measures 2.4mm, 2mm, 1.2mm and 2.5mm.



Figure 19. *Leucauge* species

Tetragnathidae family

Leucauge species. Abdomen (ventral view) has a pair of C-shape band which is silver white in color. The abdomen (dorsal view) is spotted with chalk white and has a brown to black longitudinal band (not reaching the spinnerets). Body length is 1.3mm. Its legs from first pair (anterior) to the last pair (posterior) measures 1.4mm, 1.2mm, 1.3mm and 1.5mm.



Family Salticidae



Simaetha species. The cephalothorax and abdomen is dark brown in color with white hairs (not clear on the figure). Legs are short.

Figure 10. *Simaetha* species

Salticidae family

Distribution of spider species

Table 1 shows the distribution of spider species.

Neoscona species, having three distinct characteristics, hence designated as *Neoscona* species (1), *Neoscona* species (2), and *Neoscona* species (3) was found to be present in three sites. Both *Neoscona* species (2), and *Neoscona* species (3) were both found in Balili and Swamp while *Neoscona* species (1), was present in the three sites. *Pardosa* species and *Enoplognatha* species, belonging to different family, were both found in Balili and Swamp. Other species of spider such as *Steatoda* species, *Leucauge* species, and *Argiope* species were found solely in Balili while *Simaetha* species was collected in Swamp.



It was noted that some spider species were present in all the sites while other were only found in one or two sites. This may be due to the application of pesticides that may have killed them or their preference of an environment in which to live in.

Table 1. Distribution of spider species on the strawberry plantations from (May December 2008)

SPIDER FAMILY	BALILI	SWAMP	LONGLONG
Araneidae family			
<i>Neoscona</i> species (1)	Present	Present	Present
<i>Neoscona</i> species (2)	Present	Present	Absent
<i>Neoscona</i> species (3)	Present	Present	Absent
<i>Argiope</i> species	Present	Absent	Absent
Lycosidae family			
<i>Pardosa</i> species	Present	Present	Absent
Theridiidae family			
<i>Enoplognatha</i> species	Present	Absent	Present
<i>Steotoda</i> species	Balili	Absent	Absent
Tetragnathidae family			
<i>Leucauge</i> species	Present	Absent	Absent
Salticidae family			
<i>Simaetha</i> species	Absent	Present	Absent

Population of spider families per site

Table 2 shows the population of different spider families per site.



Spiders, particularly the family Araneidae has the highest number of collection having a total of 69 spiders (Table 2). This is followed by the family Lycosidae, family Theridiidae and the family Tetragnathidae and Salticidae family with a total population of 36, 35, 1 and 1 spiders respectively.

The less population of the different spider families in the three sites may be due to the use of pesticides which are toxic to them.

Table 2. Population of different spider families on the three strawberry plantations from (May – December 2008)

SPIDER FAMILY	BALILI	SWAMP	LONGLONG	TOTAL
Araneidae	43	19	7	69
Lycosidae	22	14	0	36
Theridiidae	0	26	9	35
Tetragnathidae	1	0	0	1
Salticidae	0	1	0	1



SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted on three strawberry plantations in Balili, Swamp and Longlong, La Trinidad, Benguet from May to December 2008 to identify the spiders found on strawberry plantations and to determine their distribution and population.

The spiders were collected on the strawberry plants and within the vicinity of the strawberry plantation. This was done by scouting through transect method using vials and plastic containers (film canister) to trap the spiders.

There were five families of spiders that were identified. The family Araneidae with two species identified, *Argiope* species and *Neoscona* species which was further classified into three according to their characteristics.

Second is the family Theridiidae with two species identified, *Enoplognatha* species and *Steatoda* species. Family Lycosidae, family Tetragnathidae and family Salticidae having only one species each followed respectively.

Results showed that the family Araneidae has the highest number of species collected from the three sites having a total of 69. Family Lycosidae has a total number of 36 spiders collected from two sites while family Theridiidae has 35 spiders also found in two sites. While family Tetragnathidae and family Salticidae has 1 spider each.

Furthermore, there were seven identified species of spiders; the *Neoscona* species (with three classification according to their characteristics) and *Argiope* species of the family Araneidae, *Pardosa* species of family Lycosidae, *Steatoda* species and



Enoplognatha species of the family Theridiidae, *Leucauge* species of the family Tetragnathidae and the *Simaetha* species of the Salticidae family. *Neoscona* species has the highest population and was found to be the most widely distributed family of spiders identified.

Conclusion

The family Araneidae has the highest number of spiders collected thus, the most widely distributed family of spider. In contrast, family Lycosidae and family Tetragnathidae have the lowest number of spiders found. Their presence was found in one site only, hence, they were the least distributed species found.

On the other hand, *Neoscona* species was the widely distributed species of spiders.

Recommendation

It is therefore recommended that collection and proper preservation of collected spiders should be done to be placed in the museum for future references.



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