Natural enemy population of corn main pests in Maros experimental station at various stages of plant growth

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Abstract. The study of natural enemy population density among the main predator species of corn plants was conducted in Maros Experimental Station (ES), Research Institute for Cereal Crops in 2018. The research uses direct patrol techniques, conducted by making direct observations in the field to record the presence of natural enemies. The natural enemies are observed by referring to Shepard et al. (1987) about insects which are beneficial for biological control of food crop pests. Identification of the presence of these natural enemies was carried out on several stadia (stages) of corn plants and on grass or plant habitus around the observation area as a comparison. Determination of plant samples was carried out on research plots and blocks around the Maros ES. The observation plots used 3 replications by taking 20–30 samples of plants per replication or a total of 60–90 observation/block units. Deuteronomy is a plot divided into 3 plots of observation whose width is adjusted to the area and length of the plot of the study. The recording of the insect population of natural enemies was conducted by calculating the number in each replicate plot by taking pictures of all types of insects found on the plant and then the results were identified in line with the guide book. The results of the recording were tabulated to find out the total average number of natural enemy populations that appear on the observation plot/block. Observations show that in Maros EF, the natural enemies identified and found in the observation area for observations are 8 types, each of which are Harmonia octomaculata (Fabricius) also called dome beetle, Agriocnemis pygmaea (Rambur) or needle dragonfly, Micraspis sp. or coccinellid beetles, Oxyopes javanus (Thorel) or sharp eye spiders, Conocephalus longipennis (de Haan) or grasshoppers, Lycosa pseudoannulata (Boesenberg and Strand) or wolf spiders, Limnogonus fossarum (Fabricius) or water bedbug, Tetragnatha maxillosa (Thorell) or long jaw spider.

1. Introduction
Corn has a strategic role in the national food map and as a mainstay commodity in accelerating the realization of food self-sufficiency. Corn has extensive adaptability and is relatively easy to cultivate so that it can be planted on various types of land, including dry land, wetland, swamp land, and tidal land, on various types of soil and climate types, in areas with altitude between 0–2,000 m above sea level [1].

Corn has many uses because almost all parts of the plant can be used for various purposes. Corn kernels contain various vitamins and minerals. The nutritional content per 100 g of corn is; calories
The contribution of corn as food and feed is 10% of total protein and calorie inputs, whereas in the national economy, corn is the second largest contributor to rice in the food crop sub-sector. The survey results show that the average consumption of cereals (rice and corn) per capita is around 15–20 kg/year [3]. This data shows that corn plays a major role in meeting national needs for food and feed. In 1996 alone, the need of corn for domestic industrial raw materials reached 3.51 million tons [4]. In addition to being a food commodity, corn is also used for animal feed. Data shows that around 60% of corn is used for industrial raw materials, 57% of which is for animal feed [5].

In Indonesia, corn is the second most important food commodity after rice, and based on the order of staple food in the world, corn ranks third after wheat and rice [6]. In the national economy, corn is the second largest contributor after rice in the food crop sub-sector. The contribution of corn to the GRDP continues to increase every year, even in times of economic crisis. In 2007, the contribution of corn in the Indonesian economy reached Rp9.4 trillion and in 2010 it rose sharply to Rp18.2 trillion. This condition illustrates the role of corn which is quite large in spurring the growth of the food crop sub-sector and the national economy in general. However, the increase in demand for corn in recent years is not in line with the rate of increase in domestic production so that the import of corn is getting bigger. During the period of 2000–2010, the use of imported corn as raw material for the domestic feed industry increased sharply at a rate of 11.81% per year. In 2010, the use of imported corn in the feed industry reached 47.04%, while the remaining 52.96% came from domestically produced corn [7].

Up to date, pest and disease disorders are still the main obstacles in corn cultivation in Indonesia. The yield loss caused by the main pest of corn can reach 37% [8; 9; 10], while the damage to pests in the period after harvest or to seeds stored in storage warehouses has been reported to reach 85% with shrinkage of seed weight reaching 17% [11; 1;12; 13].

Based on government regulation (PP No. 6 of 1995) in the framework of controlling Plant Pest Organisms (PPO), the use of insecticides should be the last resort or alternative. Similarly, the impact caused by the use of these chemical compounds must be considered as early as possible and should be as minimal as possible. Therefore, it is necessary to find ways to control pests that are effective and safe for non-target organisms and the environment, for example by biological control [1].

Theoretically, it can be said that if the balance between insect pests and natural enemies is equal, no attack will occur. Control by utilizing natural enemies of insects is known as biological control, namely the technique of controlling insect pests by utilizing their natural enemies (biological control agents), such as predators, parasites, and pathogens. Biological control is also defined as a technique or method of pest management by utilizing natural enemies for the sake of control. In biological control, it is usually conducted by multiplying natural enemies in the laboratory, whereas in natural control, the control process runs on its own without human intervention, and there is no natural enemy propagation process [14].

Judging from its function, natural enemies are grouped into predators, parasitoid, and pathogens. Predators are animals or insects that live by preying on other insects. Parasitoid can be classified based on the host body phase that is attacked: egg parasitoid, egg-larva parasitoid, larval parasitoid, larva-pupa parasitoid, pupa parasitoid, and imago parasitoid, whereas pathogens are microorganisms that cause insects to be sick and eventually die. Microorganisms that can be pathogens are viruses, bacteria, protozoa, fungi, rickettsia, and nematodes [15]. This study aims to see the population density of predatory insects as natural enemies of corn pests on several stadia (stages) of plant life.

2. Materials and Methods
The study of natural enemy population density among the main pests of corn plants was conducted in Maros EF in 2018. The research uses direct patrol techniques, conducted by making direct observations in the field to record the presence of natural enemies. The natural enemies are observed
by referring to [15] about insects which are beneficial for biological control of food crop pests. Identification of the presence of these natural enemies was carried out on several stadia (stages) of corn plants and on grass or plant habitus around the observation area as a comparison.

Determination of plant samples was carried out on research plots and blocks around the Maros E and Bajeng (Gowa) EF. The observation plots used 3 replications by taking 20–30 samples of plants per replication or a total of 60–90 observation/block units. Deuteronomy is a plot divided into 3 plots of observation whose width is adjusted to the area and length of the plot.

The number of adult natural enemy insects and larvae was recorded by counting the number of adult natural enemies and larvae in each replicate plot with bare eye observations. The results of the recording were tabulated to determine the total average number of population seen in the observation plot/block.

3. Results and Discussion

Based on the Guidebook of [14], there are some natural enemies that have been encountered and have been identified as having an important role in suppressing crop pests, among others, grouped in types: predator (16 types), parasites (4 types), pathogens (6 types) and viruses (2 types). In this study, the focus will be on identifying the presence of predatory species such as the Dome Beetle or Coccinellid Beetle, Land Beetle, Cricket, Grasshopper, Water Bedbug, Needle Dragonfly, Earwig, Ant, Hornet, and Spider.

3.1. Observation Results in Maros Experimental Farmn

On observations in Maros EF, the natural enemies identified and found in the location of observations are 8 types, each of which are *Harmonia octomaculata* (Fabricius) also called the Dome Beetle, *Agriocnemis pygmaea* (Rambur) or Needle Dragonfly, *Micraspis* sp. or coccinellid beetles, *Oxyopes javanus* (Thorel) or sharp eye spiders, *Conocephalus longipennis* (de Haan) or Grasshoppers, *Lycosa pseudoannulata* (Boesenberg and Strand) or wolf spider, *Limnogonus fossarium* (Fabricius) or Water Bedbug, *Tetragnatha maxillosa* (Thorell) or Long Jaw Spider.

3.2. Dome Beetle, *H. octomaculata* (Fabricius)

*H. octomaculata* (Fabricius) Dome Beetle is a predator beetle that has black spots and only catches slow-moving prey. There are 2 types of beetles, namely *H. octomaculata* and *Menochilus sexmaculatus*, but only *H. octomaculata* is found in the location of observations. Adult beetles can produce 150–200 eggs in 6–10 weeks and take 1–2 weeks to develop from eggs to adults. Beetle larvae can eat 5–10 prey from eggs, nymphs to adult insects. If there is interference, the adult beetle reacts quickly by flying or flopping if it is disturbed [16; 17]. From the results of field observations, it appears that the Dome Beetle population is found in rice-I, Corn Nasa 29 and edge corn of Anoman, each with a population density of 2, 1, 1 with an average of 0.6, 0.3 and 0.3 (Figure 1).

![Figure 1. Population density graph of Dome Beetle, *H. octomaculata* (Fabricius)](image-url)
3.3. Needle Dragonfly, Agriocnemis pygmaea (Rambur)

Needle Dragonflies or also called *kinjeng dom* are insect enemies of nature with narrow winged features. The flying ability of these insects is weak compared to other floating species. Adult dragonflies are yellow-green and black, and have long, slender abdomen. Male dragonflies are more colorful than females.

Adult dragonflies are yellow-green and black, and have a long, slender abdomen. The abdominal end of male *A. pygmaea* is of moderate orange in other species such as male *A. femina femina*, the tip of the abdomen is blue green on the thoracic side, while the female body is greenish in color. This insect can mate while flying in a male position to link the back of the female to avoid themselves from the enemy. This needle dragonfly nymph lives in water and can climb rice stalks to look for planthopper nymphs. Adults generally fly under the rice leaf canopy to look for flying insects including plant hopper [16; 17].

Field observations find that many Needle Dragonfly insects are mainly found in rice-I and rice-II and edge corn of Anoman variety, respectively 13, 5 and 1 insects in 90 observation groups with a mean per plot of observation of 4.3; 1.6; and 0.3 (Figure 2).

![Figure 2](image)

**Figure 2.** Population density graph, Needle Dragonfly, *A. pygmaea* (Rambur)

3.4. Coccinellid Beetle, Micraspis sp.

Coccinellid is a natural enemy with the name coccinellid beetle (Coleoptera: Coccinellidae), which has a dome-like shape and is bright reddish in color. The dome beetle is active throughout the day in the upper half of the rice leaf canopy in dry rice and wet rice habitat. The larvae of this beetle are dark in color and prey on larvae and eggs of planthoppers. Adult insects are yellow with various spots on the back of the head [16; 17]. Field observations show that the population can be seen only in rice-I and rice-II with low densities, each with 1 insect per 90 observation groups This is in line with what is called in Shepard et al. 2011 that these natural enemy insects are indeed predators of eggs and nymphs of rice stem borer (Figure 3).
3.5. **Sharp Eye Spider, Oxyopes javanus (Thorel).**

There are 2 species of this spider from *Oxyopes javanus* Thorell and *Oxyopes lineatipes* (C. L. Koch). *Oxyopes javanus* Thorell (Araneae: Oxyopidae) is a hunter spider and does not make nets. The female has two pairs of diagonal white images on the side of the abdomen while the male has an enlarged palpus. In species *O. lineatipes*, there are two reddish brown lines and two white lines stretching over the abdomen. These sharp-eyed spiders live in rice leaf canopies, and prefer dry habitats, and begin to make colonies on rice fields after a rice leaf canopy is formed. Unlike *Lycosa*, these spiders hide from their prey, mostly in the form of moths, until the prey is within its distance.

Female spiders maintain a group of eggs that have cocoons located on the leaves. These spiders produce 200–350 offspring and can live up to 3–5 months. These spiders have an important role because one spider can kill 2–3 moths every day so that they can prevent a rising population of a new generation of pest insects [16; 17].

Field observations show that sharp eye spiders are not found in rice plants in both rice-I and rice-II as well as in observations of Nasa 29 and Bima-3 maize plants. However, it is found in the edge corn of Anoman variety and purple glutinous corn with high grasses, each with 1 and 2 insects/60 observation groups with an average of 0.3 and 0.6 insect (Figure 4).
3.6. Wolf spiders or hunter spiders *Lycosa pseudoannulata* (Boesenberg and Strand) (Araneae: Lycosidae)

This spider is a type of natural enemy on whose back there is a picture resembling a fork, while on the abdomen there is a white picture. These insects like to move around and have colonized in rice fields or dry rice plants that have just been processed and prey on plant pests before the pest population increases. Female spiders can lay eggs and produce offspring of 60–80 spiders which are on the back of the spider mother.

Wolf spiders are often found around the base of rice stems and will spread across the water surface if disturbed. This spider does not make a net but attacks its prey directly. Adult spiders eat various types of insects including borer’s moths. Young spiders attack stem hopper and nymph leafhopper. Hunter spiders consume 5–15 prey every day. Male spiders have a large palpus [16; 17].

The results of field observations in Maros show that the population of wolf spiders is only found in edge corn of Anoman and glutinous corn with a condition of high grasses, each with population density of 4 and 1 insects in 90 plant clusters observed with an average population density of 1.3 and 0.3.

![Figure 5. The density graph of the Wolf Spider population](image)

3.7. Long Jaw Spider, *Tetragnatha maxillosa* (Thorell).

This spider has a long leg and body and always stretches its body along the rice leaves. Male spiders can be known by the presence of a long/enlarged jaw. The life span of these insects ranges from 1–3 months and can lay eggs up to 100–200 items. The eggs are placed in groups which are covered with cotton silk material at the top of the middle of the rice stem.

These spiders prefer wet places and they rest in the rice canopy at noon (midday) and wait for prey in the net in the morning. They use flexible nets to trap prey. Leaves, flies and moths that enter the net are quickly bound inside. The predatory ability of these spiders ranges from 2–3 prey per day [16; 17].

Field observations show that populations of natural enemy insects are only found in rice plants, both rice-I and rice-II. Population density from the results of the observation of 90 plant clusters was recorded as 2 and 1 insects with an average of 0.6 and 0.3 insect (Figure 6).
3.8. Grasshopper, Conocephalus longipennis (de Haan) (Orthoptera: Tettigoniidae).
These natural enemies are found mostly in grasses, which are large insects. The difference with ordinary grasshoppers is the long antenna, which is more than twice the length of the body. Adult grasshoppers are very active and ready to fly when disturbed. These grasshoppers are active at night, mostly found in rice plantations that are ready for harvest. This grasshopper nymph is green that can be distinguished from an adult grasshopper which is green and yellow without the wings and ovipositor resembling a sword. Adult grasshoppers live for 3–4 months.

The Tettigoniidae grasshopper eats rice leaves and Conocephalus longipennis has a double eating habit. On the one hand, the grasshopper eats leaves and rice panicles and on the other hand, also preys on rice bedbug/sangit hopper’s eggs and stem borer’s eggs and stem hopper and leafhopper. One predator can consume 3–4 groups of yellow banter borer eggs in one day [16; 17].

Similar to sharp eye spiders, observations on grasshoppers show that there is no population in rice-I, rice-II, Nasa 29 and Bima-3 maize plants. However, it is only found on the edge corn of Anoman and purple glutinous corn with high grass, each with a density of 1 and 2 insects/60 observation groups with an average of 0.3 and 0.6 insect (Figure 7).
3.9. Water Bedbug, *Limnogonus fossarum* (Fabricius) (*Hemiptera: Gerride*).

Water bedbug or water striders are large, long-legged and very agile. This natural adult enemy insect is black with two pairs of very long hind legs. The middle leg pair functions as a rower forwards during wives. Only a few of these insects can be found under the canopy of plants and immediately migrate when there is interference. This insect can lay 10–30 eggs in rice stalks that are close to the surface of the water and can live for 1–1.5 months. Adult and nymph fangs prey on rice leafhoppers, moorings and larvae that fall on the surface of the water. Each water bedbug can be from 5 to 10 in each day [16; 17]. Field observations show that the presence of bedbug is only found in rice-I and rice-II and is not found whatsoever in samples of corn and grass. Population density from the observations of 90 grasses is 5 insects per grass both in rice-I and rice-II with an average value of 1.6 insect (Figure 8).

![Figure 8. The population density graph of Water Bedbug, *L. fossarum* (Fabricius)](image)

4. Conclusions

On observations in Maros E F, the natural enemies identified and found in the location of observations are 8 types, each of which are *H. octomaculata* (Fabricius) also called Dome Beetle, *Agriocnemis pygmaea* (Rambur) or Needle Dragonfly, *Micraspis* sp. or Coccinellid Beetle, *O. javanus* (Thorel) or sharp eye Spider, *C. longipennis* (de Haan) or Grasshopper, *L. pseudoannulata* (Boesenberg and Strand) or Wolf Spider, *L. fossarum* (Fabricius) or Water Bedbug, *T. maxillosa* (Thorell) or Long Jaw Spider.

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