Collembola Diversity between Chemical Pesticide and Bioinsecticide in Broccoli Farm (Brassica oleraceae var. italica)

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Abstract. The existence of Collembola diversity was determined by how land system work. Farming systems with excessive pesticide application can reduce number of Collembola. On the other hand nowadays people aware of environment by using bioinsecticide. The Method were comparing two land system which use Chemical pestisice and Bioinsecticide. Procedure were using Trapping wells (PMS) in three plots; T0: control without treatment, T1: Chemical Insecticide, T2 : Bioinsecticide for 24 hours. The factors that measure are abiotic factors by taking 10 grams of soil planting Broccoli (Brassica oleraceae var Italica), after 24 hours of taking separates it with other land animals, then identifying Collembola species were using Microcam based on identification book of Collembola. The result showed that density and Biodiversity of land system bioinsecticide was the highest value and indic. It was found also that in Broccoli farm discovered 3 Familia and 8 species of Collembola both litter and soil. Species found that Isotomurus sp, Seira sp, Lepidosira sp, Coecobrya sp, Callyntura sp, Homidia sp, Sallina sp and Ascocytrus sp, three Family is derived from Isotomidae, Entomobryidae and Paronellid.

1. Introduction
Nowadays organic farm system is developed to a friendly environment since chemical-based agriculture not used anymore. The role of soil organisms in soil, decomposition processes of is more critical in organic farming than in chemical-based agriculture. According to Soehardjono et al., (2012) there are some advantages of organic system that connected in health food, clean environment, well organsed land structure, mineral cycle, land fertility restore.

One that play role of decomposition is Collembola. Collembolan together with mites, are among the most abundant soil microarthropods that play an important role in decomposing soil food webs [13]. Mites are dominant in forest soils and undisturbed habitats, whereas Collembola are increasingly important in managed grasslands and especially in arable land. Because of their large population sizes (10^4 to 10^5 m^-2), rapid reproduction rates, role in fragmenting detritus, and grazing upon microbes, Collembola have a significant impact on microbial dynamics [10]. Although, Collembola and other mesofauna have a function similar to macrofauna in attacking and fragmenting plant residues, they are considered to be more important in regulating microbial populations rather than macrofauna, e.g., amphipods, isopods, centipedes and millipedes, earthworms and mollusks like snails and slugs [17]. Collembola closely interact with all elements of the decomposer food web [9] and are active under most environmental conditions – unlike nematodes, bacteria or earthworms.
The supply and availability of plant nutrients in the soil is mainly regulated by rate of release of plant nutrients from soil organic matter. The soil fauna is likely to play an important role in this process. The effect of the use of organic fertilizer on decomposition and mineralization of organic matter by soil fauna is a question of interest. Hence, a better understanding of these processes is needed to find out whether the decomposition and mineralization of nutrients from organic matter could be enhanced by improving soil conditions for soil fauna. This will have significant implications for sustainable agroecosystem management in the future. Thus the aim of this study is to investigate diversity of Collembola as decomposer with pesticide and biopesticide treatment in Broccoli farm.

2. Experimental Method
This research was conducted in a vegetable farm that located in North Bandung West Java Indonesia. Plastic bags filled with 3 kg soil were prepared for each treatment using Randomized Complete Block Design with five treatments and one control, with three replications. Each treatment comprised of a raised-bed plot measuring 1 m x 7 m with a distance of 30 cm between them. The field experiment had the same treatments as the greenhouse experiment. The treatments in this study were formulated as follows:
- T0: control without treatment
- T1: Chemical Insecticide
- T2: Bioinsecticide (Tephrosia vogelii)

2.1. Soil Sampling, Extraction and Collembola Identification
Soil samples for the study of Collembola were taken three times during the growth season (three replicate plots per treatment). Samples were collected at three sampling points per plot using steel cylinders (0-10 cm depth, 100 cm²). Soil microarthropods were extracted from the soil samples using an extractor based on the method by Tullgren (1918) for 24 hours. The extraction used standard 25 W electric light bulbs. Microarthropods were collected in small plastic bottles filled with 70% isopropanol. The extraction was terminated after 5 days. Collembola were identified at the Research Center for Biology, Indonesian Institute of Science, Cibinong, West Java.

2.2. Application of chemical insecticide and Tephrosia vegolii extract
Two weeks later in the three plots of field in the planting of broccoli (Brassica oleraceae var Italica) apply chemical pesticides at T0 and T1 while on T1 added insecticide treatment plant of Tephrosia vegolii. Chemical pesticides by mixing 25 pesticide in into 7 liters of tap water. Giving pesticide and insecticide plant by spraying the surface of the leaves of Cauliflower (Brassica oleraceae var Italica). Two weeks later in the three plots of land in the planting of Broccoli (Brassica oleraceae var Italica) is re-treated by adding chemical pesticides at T0 and T1 while on T1 added insecticide treatment plant of leaves bean pig (Tephrosia vegolii). Chemical pesticides by mixing 5 ml Antracol, 10 ml and 10 ml Cucrakon Dursban into 7 liters of tap water. Giving pesticide and insecticide plant by spraying the surface of the leaves of broccoli (Brassica oleraceae var Italica).

3. Collection data
Soil samples taken were taking after treatment to get Collembola. Samples were collected per plot using plastic cylinders (0-10 cm depth, 250 cm²). Samples were identified in animal lab. and confirmed at the Research Center for Biology, Indonesian Institute of Science, Cibinong, West Java. Collembola was identified up to the genus level. According to [6].

Trapping wells. Thre traps were design int three plots and were observed for 24 hours. Take 10 grams of ground planting Cauliflower (Brassica oleraceae var Italica), after 24 hours of taking the Trapping wells and separating Collembola with other land animals, then identify Collembola are already caught using Microcam based identification book Collembola.

4. Result and Discussion
4.1. Relative Abundance of Each Genus of Collembola

A higher number of genera of Collembola were *Isotomurus, Ascocytrus sp and Homidia sp*. *Ascocytrus sp* was the most dominant. It is notable that some species from four genus were most abundant under organic crop management [2].

| Genus         | Control Before treatment | Control After treatment | Pesticide Before treatment | Pesticide After treatment | Biopesticide Before treatment | Biopesticide After treatment |
|---------------|--------------------------|-------------------------|---------------------------|---------------------------|-------------------------------|------------------------------|
| *Isotomurus sp* | 8                        | 19                      | 7                         | 12                        | 8                             | 16                           |
| *Ascocytrus sp* | 26                       | 28                      | 22                        | 29                        | 22                            | 27                           |
| *Lepidosira sp* | -                        | -                       | -                         | -                         | -                             | -                            |
| *Seira sp*     | -                        | -                       | -                         | -                         | -                             | 7                            |
| *Homidia sp*   | 9                        | 8                       | 13                        | 13                        | 10                            | 18                           |
| *Coecobrya sp* | -                        | -                       | -                         | -                         | -                             | -                            |
| *Callyntura sp* | -                        | 2                       | -                         | 2                         | -                             | -                            |
| *Sallina sp*   | -                        | -                       | -                         | -                         | -                             | -                            |
| **Total**      | **43**                   | **57**                  | **42**                    | **56**                    | **40**                        | **80**                       |

In dry periods, Collembola normally would seek a more favorable habitat. They will go into the deeper layers in order to survive until the rain again [10]. As a result, Collembola who move on the surface will go into the litter and soil. This is consistent with the above results, which led to high or low number of individuals using traps "pit fall trap" due to the migration of Collembola ground. Soil temperature can affect the migration of Collembola, due Collembola will find a suitable place for its survival [14]. Organic matter, temperature, and humidity of the air and soil in the forest nature reserve is low. Organic matter, temperature, and humidity can affect the abundance of Collembola. Because there are several species of Collembola are sensitive to soil moisture so that the variation in species composition and different populations [7].

On the other hand, under chemical fertilizer + insecticide conditions lower density of Collembola was observed. Obviously, under organic condition, Collembola preferred organic manure compared to control as their diet or substrate. It is well known that Collembola food preference depends on the substrate on which the fungus is grown [8]. Field condition is likely to provide better condition for microorganisms, including organic fertilizer and pesticide which contains bacteria, actinomycetes and fungi, to grow on green manure. While in the field condition, this association between microorganisms, Collembola and green manure were greatly influenced by heavy rain.

[10] mentions that Collembola have a high response to differences in environmental and ecological factors such as changes in the chemical content of the soil, the configuration microhabitat and agricultural activities contained therein. So that the reconstruction in this Broccoli plantation can change the situation in the surrounding microhabitat that directly impact the presence of Collembola in it. Some studies suggest that Collembola have their own preferences in choosing its habitat. The existence of Collembola more on natural forest than in agricultural areas. Additionally, [12] states that the density and diversity of Collembola more numerous in areas not disturbed than disturbed areas.

4.2. Abiotic factors

The results of measurements of abiotic parameters in Broccoli plantation include air temperature, light density soil moisture and soil pH. Can be seen on Picture 1. This is according to the results of research [16] which states that the presence of soil fauna is strongly influenced by environmental factors, such as soil moisture and soil pH. Based on Table 4.1 it can be seen that the temperature of the soil in the Broccoli plantation of 25.3 °C-26.60°C. This is consistent with the results of the study of [1] which states that Collembola that live in the area have a tendency survive better in winter than
summer. Overall the optimum temperature required by Collembola to live including a lowly situated between 5-15ºC, but there was also active at temperatures -2ºC or 28ºC (Ganjari, 2012). Resistance to high and low temperature varies depending on the type and age (Amir and Andrew, 2008). Humidity in the botanical garden that is 76.7%, the moisture in the Botanical garden UPI were high. This is consistent with the proposed [5] soil moisture suitable for the survival of the Collembola high humidity. If the humidity is low Collembola will migrate to deeper soil layers. Based on Table 4.1 it can be noted that in the botanical garden soil pH is acidic which is equal to 6.5. This happens because the Collembola belong to the land mesofauna whose population is most prominent in the land with soil pH that is acidic ([18]; [4]).

**Figure 1.** Abiotic factors of Callombolan existance in Broccoli plantation

### 4.3. Callombolan Diversity

Based on the research that has been conducted in the area of Broccoli plantations, there are seventh genera, where the four genera is included into three families, namely Entomobryidae, Isotomidae, and Paronellidae. The number of individuals at most that the Entomobryidae Familia, precisely genus Acrocyrtus by the number of 241 individuals with an abundance of 0.267 while the smallest number of individuals in the Family Isotomidae, precisely genus Isotomurus by the number of individual 4 with an abundance of 0.0004. This is caused by the dryness of soil and temperature of the surface layer [5].
Collembola low diversity can be seen also from biotic and abiotic factors in Broccoli plantation. Vegetation is one of the biotic factors that indirectly affect the diversity of Collembola [11]. Dense plantation will form a stable microclimate that supports the activities and development of soil arthropods. The density of the vegetation in an area can lead to fall-out, so that the thickness of the litter can be increased. The existence of this litter thickness may increase the availability of food resources better to ground arthropods [15]. Vegetation in Broccoli plantation is dense. So that the nutrients contained in it is only capable of supporting life some Collembola only. [11] states that the more varied vegetation will become more varied litter also described as a food source. The existence of diverse sources of feed is likely to impact the increase in animals that consume them. Vegetation in early growth plan relatively homogeneous, so that Collembola contained in the vicinity is relatively not much different. The existence of a less dense vegetation in the botanical gardens influenced the abiotic factors in the vicinity. This happens because the sunlight can be directly on the ground without any obstructions. So it can improve soil moisture and temperature in it. At temperatures and low soil moisture, Collembola will move towards the deeper layers. As a result, the Collembola sampling will be more difficult.

5. References

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Figure 2. Diversity index of Callombolan with non synthetic treatment
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**Acknowledgments**

I would like to thanks to the management of “Little Farm” that facilitate us coundercting the biopesticide experiment.