

The Effectiveness of Weed as Beetle Bank Against Abundance of Soil Arthropods on Corn (*Zea mays. L*)

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Abstract

Conservation of natural enemies on maize can be done by utilizing grass weeds as Beetle banks. Natural enemies of shelter and get food from the weed grasses that are in the land irrigated corn. Natural enemies observed in this research were the predator of ground arthropods in the form of ground beetles, tomcat, and predators arthropods in other lands. The trap used is the Pitfall trap. The percentage of arthropod predators was 69%, and arthropods herbivore was 31%. The abundance of soil arthropods in the treatment of weeds grass is higher than the control treatment It is because of the treatment of weed grass soil arthropods get habitat for a place to stay. Weed grasses provide food sources for the arthropods and get protection from an environment that is less supportive. The use of weed grasses in addition to Beetle banks also serves as a place to breed. The highest abundance of arthropods was situated on the treatment *Eleusine indica* that has a lush lawn and has a characteristic odor favored by arthropods. Arthropods that acts as a predator in the land are the family of Formicidae, Philodromidae, Carabidae, Staphylinidae, Pentatomidae. Some Arthropods from the Pentomidae family have a role as a pest and others as natural predators or predators. Arthropods found in the research was an arthropod that had a role as natural enemies or predator. The Pentomidae family that has a position as a predator is *Picromerus Bidens*. Ground beetles were found in the *C. fossor* and *Pheropsophus* sp. Ground beetles are dominant picking weeds *Setaria* sp. and *Eleusine indica* as habitat and place in search of food and life's survival.

Keywords: Beetle bank, soil arthropods, weeds.

INTRODUCTION

Corn production has been increased, although the decline is also occurred caused by various factors, one of which is the presence of pests and diseases of plants. Pest and disease control made much use of chemical pesticides. It needs to be reduced so that the pest population is not increasing. Pest and disease control can be done by using resistant varieties, planting time, and using biological control so it will not cause damage to the ecosystem [1]. Biological control can be defined as a business in pest control. It was done with biological action, for example, with the utilization of natural enemies of both the predators and parasitoids that are used to suppress populations of target pests. Biological control is done by utilizing the components of the biotic techniques, such as the conservation of natural enemies of specific pests to be controlled [2].

Conservation of natural enemies was conducted to increase the population of natural enemies and help in suppressing the population of the pest so that it can fix the diversity of the ecosystem. This activity is done to provide a

supportive environment for the survival of naturally occurring, mainly in providing the availability of feed. This activity can also be done by setting the cropping system and cropping pattern, do the intercropping between corn plants with other plants, and the utilization of the plant is flowering or refugia as towing natural enemies [3]. Beetle banks are one of the techniques of conservation control biologically, which aims to increase the population of natural enemies in controlling pests in plants [4]. Beetle banks can provide habitat for natural enemies so that the population of predators increased and pest populations low. Beetle banks are a plant grass planting performed with elongated in cropland and aims as the habitat of the predator, for example, ground beetles [5].

The use of grass weeds in the outskirts of the plant can be used as a habitat for predators to take place to live up next to the planting [6]. Weed grass could be a determinant for the presence of natural enemies of both predators and parasitoids because the plant acts as a protector and host for natural enemies of both predators and parasitoids [7]. Weed grasses can also act as a source of feed supplement and as a place to lay their eggs for the predators to breed.

The use of grass plants as a habitat for predatory ground beetles can be used as a strategy in the conservation of land and the

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ecosystem [8]. The type of weed can affect its effectiveness in increasing the diversity of the population of arthropods on the ground. The weed used are *Setaria* sp., *Eleusine indica*, *Cyperus rotundus*, *Echinochloa crus-galli*, and *Leptochloa chinensis*. The use of various types of weeds can affect the populations of natural enemies that come in and affect the number of eggs laid in the corn crop [9].

Weed grasses that have been studied to be used as beetle banks were *Setaria* sp., *Trifolium pretense*, and *Taraxacum officinale* [8]. Weeds can bring ground beetles to cropland. A species of ground beetle found in the previous research were *Pseudophonus rufipes* and *Harpalus differendus* [8]. This research was aimed to determine the effectiveness of weed *Setaria* sp., *Eleusine indica*, *Cyperus rotundus*, *Echinochloa crus-galli*, and *Leptochloa chinensis* in increasing the abundance of soil arthropods in maize. The

effectiveness or success can be seen from the type of weed used and rely on extensive Beetle banks that are used for the habitat of the ground beetles.

MATERIAL AND METHOD

Trial Plot

The preparation was done is to determine the treatment land of corn plants. We used a microscope, a camera, a bottle of mineral water, rope, stake, stationery, tweezers, and other tools that support the research. The necessary seeds included corn seeds, seeds of weeds *Setaria* sp., *Eleusine indica*, *Cyperus rotundus*, *Echinochloa crusgalli*, and *Leptochloa chinensis*. We also used alcohol, detergent, plastic bag, organic fertilizer, soil. The research design used Randomized block Design experimental plots, each measuring 1.6 m x 2 m with a distance treatment of 2 m (Fig. 1).

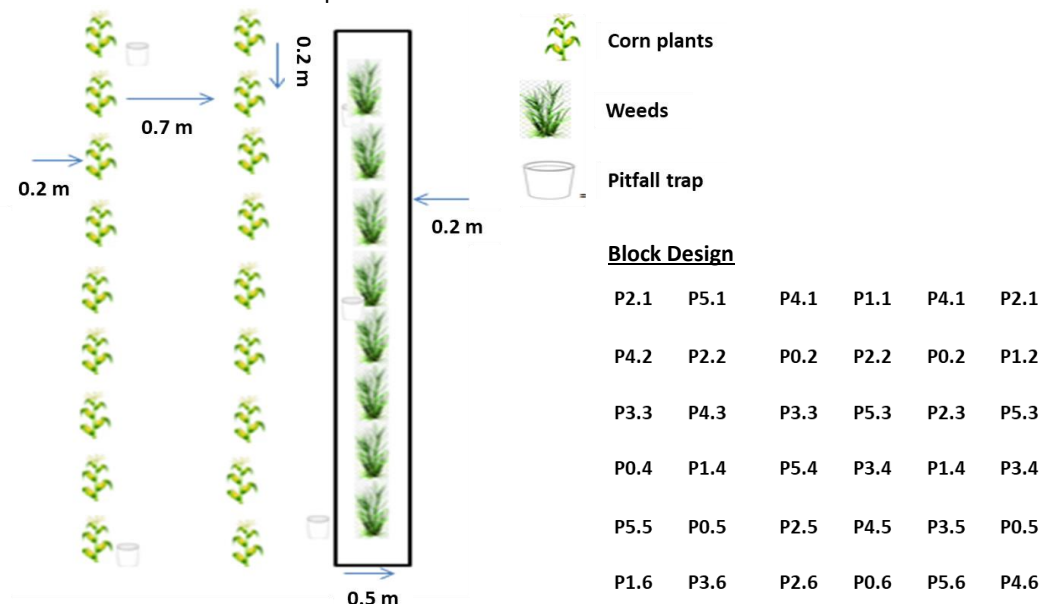


Figure 1. Trial plot plan



Figure 2. Pitfall traps

Data Collection

Observed variables measured are the population of soil arthropods, the diversity of soil arthropods, the abundance of arthropods on the ground. The observations made that use trap hole trap or pitfall trap (Fig. 2). Pitfall traps or hole traps were used to catch predator insects that are active at the surface of the soil. Pitfall trap was made of plastic cups volume of 250 ml, which is filled with detergents that are laid on the surface of the soil in the rice fields. Traps are installed in every corner of the map and mounted each morning at 07.00 PM. Insects captured were collected and put in a plastic bag or bottle of aqua used then taken to the laboratory to be identified insects. The collection of insects was done every seven days, starting from 14 days after planting until harvest.

Insect Identification

Insect identification was performed in the Laboratory of Agrotechnology, Faculty of Agriculture, University of Jember. Identification was done by book guide through the site

Bugguide.net [10] and see the guidebook Borror *et al.* [11].

RESULT AND DISCUSSION

Observation of the arrival of arthropods on weed grasses in corn planting was held at the age of 14 up to 77 days after planting. Soil arthropods found comes from five orders, i.e. Hymenoptera, Araneae, Coleoptera, Hemiptera, and Orthoptera. These orders were into six families, namely Formicidae, Philodromidae, Carabidae, Staphylinidae, Pentatomidae (Fig. 3).

The arrival of ground arthropods at the plant will be increased when the habitat and food of the arthropod can be met so that the population of arthropods increased. Habitat or place of residence for ground arthropods can be done by providing the plant herbage called beetle banks. The highest percentage of order found was Araneae by 38%, then followed by Coleoptera by 31% and Hymenoptera by 25%. The lowest percentage of orders found was Orthoptera and Hemiptera of each 3% (Fig. 4).

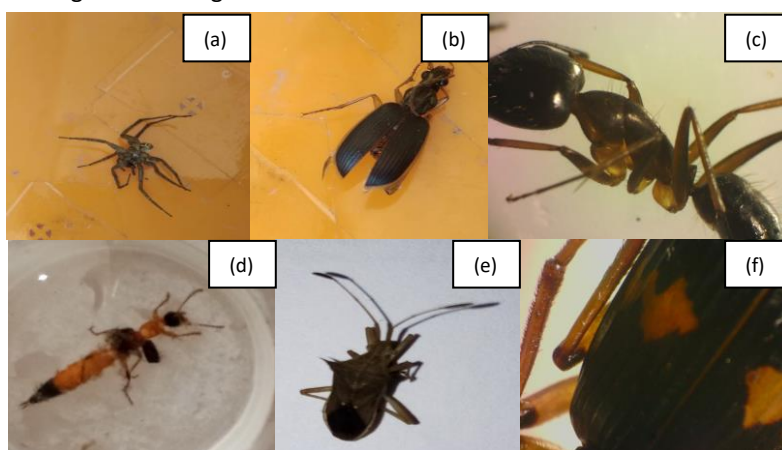


Figure 3. Soil arthropods: (a) Famili Philodromidae, (b) Famili Carabidae, (c) Famili Formicidae, (d) Famili Staphylinidae, (e) Famili Pentatomidae, (f) Famili Carabidae

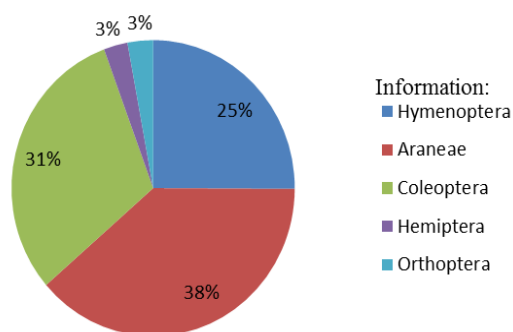


Figure 4. The total percentage of soil arthropods in corn cultivation based on insect order

The percentage of the Hemiptera ranks was low due to habitat for arthropods did not support the survival of arthropods. Arthropods from the Hemiptera Order do not like dry and hot ground so that when grown in cornfields, the habitat does not support its survival [12]. The attracted Coleoptera order is quite high. It was because the environmental conditions are sufficient, which include moisture, temperature, and precipitation. The population of soil arthropods will be increased when precipitation is high, therefore when the dry season, the population decline [13].

The percentage of attracted arthropod predators was mostly found in wild plants than

plant corn (Fig. 5). It is because in the wild plant, food is available, and arthropods get protection from the grass. Thus, they are like living in wild plants more. At the corn crop, there is a competition of food with pests.

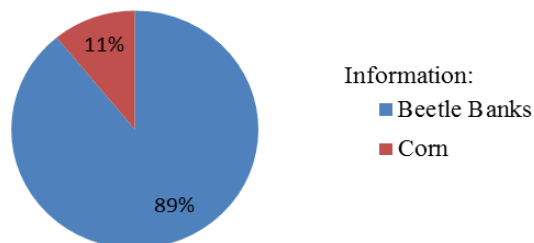


Figure 5. The percentage of attracted predators arthropod on weed and corn crop.

Methods that can keep the *Eleusine indica* grass growth well is by continuously taking care of it—watering it so that it will not wither and seeding from that grass till it can grow well and prolific. Therefore, *Elusiane indica* can be constantly used with years of the life cycle so that breeding can be conducted on them.

The predator population was very dependent on the place of residence and the source of food as well as shelter. The provision of shelter and

food sources is needed with the use of wild plants as microhabitats so it can increase the population of predators. The weed was derived from weed grass. Family Poaceae is the family of a grasses group that can be used as an alternative habitat provider of food to increase the population of predators. The abundance of arthropods in each observation is different. It was caused by the availability of food and the habitat of the weed. The highest abundance of arthropods was located on the weeds age 30-45 days after planting because at that age, the availability of food of weed is still abundant, and weed growth is still better. Therefore, the predator has enough food to survive [14].

Predators found in the beetle bank were *Philodromus* sp, *Camponotus* sp, *Paederus fuscipes*, *Astenus* sp, *Clivina fossor*, and *Pheropsophus* sp. Ground beetles found in the corn crop were family Carabidae, i.e. *C. fossor* and *Pheropsophus* sp. (Table 2). The population of ground beetles found is still relatively low. It is because the habitat and availability of food are not sufficient for the survival of ground beetles [15].

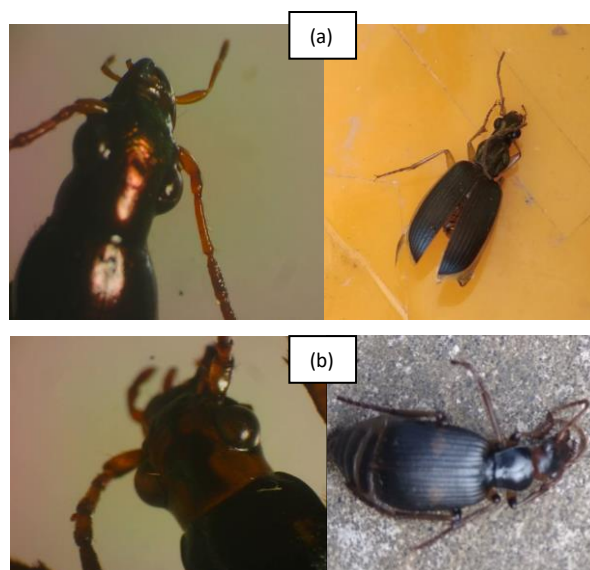


Figure 6. Ground beetles found; (a) *Clivina fossor*, (b) *Pheropsophus* sp.

Table 2. Population of Ground Beetle in corn crop

No	Ground Beetle	Function	Population (Indiv.)
1	<i>Clivina fossor</i>	Predators	34
2	<i>Pheropsophus</i> sp.	Predators	95

There are biotic and abiotic factors that cause the population of ground beetles to decrease. The survival of ground beetles is determined by the habitat of the ground beetles, namely the availability of wild plants preferred by ground beetles [16]. The population of ground beetles, along with the creation of suitable habitat, also depends heavily on the existence of temperature in the environment around. Ground beetles are active at the beginning of the summer will be predators important in the active predation of crop pests [17]. Ground beetles *C. fossor* and *Pheropsophus* sp. found in the cropland serve as predators in maize. The existence of ground beetles *C. fossor* and *Pheropsophus* sp. can help to reduce or suppress the population of pests' family Noctuidae, which damage the corn crop. *Clivina fossor* and *Pheropsophus* sp. can be agents of biocontrol or biological control that is able to suppress the pest population [18]. *Clivina fossor* and *Pheropsophus* sp are soil arthropods from the Carabidae family, which have a role as predators. *Pheropsophus* sp is a bug that attacks stem borers in corn plants [19].

Index of arthropod diversity (H') in all treatments has intermediate results. In this index (table 2), the diversity of all treatments was with a value of $1 < H < 3$. The lowest value of diversity found in the treatment of P5 *Leptochloa chinensis* amounted to 1.57, and the highest value of diversity index was located on the P2 treatment *Eleusine indica* that is equal to 1.70. The low index value diversity means there are no species that dominate and the availability of food for arthropods. The layout of a corn plant that is adjacent to the beetle bank will also greatly affect the value of the diversity. The value of the index of diversity will be low when the location of the adjacent. The value of the index of diversity will be low when the location is adjacent. It is caused by the absence of a significant difference for arthropods to make the shift in their existence so that the diversity of the medium [20].

Diversity is relatively low because the research ground is only composed of a few species. Meanwhile, if the ground is lapped by many species, then their diversity will increase [21]. The relative abundances of soil arthropods cropland were low (0.1). We found that the highest diversity of ground Arthropods lies in the family of Philodromidae, namely spiders as much as 212 individuals. The second-highest abundance of arthropods lies in the family of Formicidae as many as 138 individuals. The

abundance of arthropods is relatively low because the value of biodiversity is low, and because of the availability of food in the land insufficient for arthropods so that their abundance in the land is low [22]. The low value of abundance is also caused by the installation of the trap that is exposed to rainwater so that the soil is wet, which resulted in the position of the bottle is higher than the ground so that the arthropods are more difficult to get into the trap. The use of weed grasses was not only attracted one specific species of arthropod but general species so that the value of each species abundance was low. Weeds that act as *Beetle banks* attract more than one species (general arthropod species).

Table 3. Diversity index and relative abundance of Arthropods

Treatment	H' (Diversity Index)	Relative Abundance
Control	1.69	0.1
<i>Setaria</i> Sp.	1.67	0.1
<i>E. indica</i>	1.70	0.1
<i>C. rotundus</i>	1.59	0.1
<i>E. crusgalli</i>	1.64	0.1
<i>L. chinensis</i>	1.57	0.1

CONCLUSION

The use of weed grasses could provide a habitat for ground beetles to survive and provide food for beetles the ground to breed. Treatment that is effective in providing habitat for ground beetles is *Eleusine indica* and *Setaria* sp., followed by control treatment, *Cyperus rotundus*, *Echinochloa crusgalli*, and *Leptochloa chinensis*. Ground beetles that were found included in the family of Carabids, namely *C. fossor* and *Pheropsophus* sp. Weeds can be used as Beetle banks to provide habitat for ground beetles in the irrigated corn land. The abundance of the highest population on *Eleusine indica* treatment was 120 individuals. The lowest value of diversity was in the *Leptochloa chinensis* treatment for 1.57, and the highest value of the diversity index was in *Eleusine indica* treatment for 1.70. The relative abundance value of soil arthropods in cropland was low, i.e. 0.1.

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