

PAPER • OPEN ACCESS

The potential of soil surface arthropods in spinach plantation

To cite this article: S N Aminah *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **575** 012089

View the [article online](#) for updates and enhancements.

You may also like

- [Locomotion of arthropods in aquatic environment and their applications in robotics](#)
Bokeon Kwak and Joonbum Bae
- [Diversity of Soil Arthropods in Different Soil Stratification Layers. The National Park of Gede Pangrango Mountain, Cisarua Resort, West Java, Indonesia](#)
Meitiyani and A P Dharma
- [Diversity and abundance of arthropods inhabiting peat soil in monoculture and polyculture of balangeran \(*Shorea balangeran*\) plantation in South Sumatra, Indonesia](#)
S Utami, I Muslimin, A Kurniawan et al.



ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

The potential of soil surface arthropods in spinach plantation

S N Aminah, T Abdullah, A Gassa, Fatahuddin, and R Miranda

Department of Plant Pests and Diseases, Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia

E-mail: srifirnas@gmail.com

Abstract. The purpose of the research is to study the role of soil surface arthropods in spinach plantation. The experimental research was held in Moncobalang village, Gowa district, South Sulawesi, Indonesia. The findings of the research were showed the highest order is: Coleoptera (Coccinellidae) (-0.35) similar to Diptera (Tachinidae), Hymenoptera (Vespidae) (-0.28). Arachnida as a potential predator such as Lycosidae and Pholcidae (-0.20) and (-0.15), respectively. The total number from collected arthropods in a yellow trap about 131 individuals. In the future, the result of research is very useful information for management potential soil surface arthropods in improving the quality of spinach harvest and monitoring the presence of insect pest based environmentally friendly methods.

1. Introduction

Spinach (*Amaranthus* sp.) family Amaranthaceae as the famous vegetable around the world and major crop in Indonesia. South Sulawesi, as the center of vegetables in the eastern part of Indonesia very crucial, increasing the productivity of spinach. Spinach is dicotyledonous with two seed leaves. They are easily grown and harvest fast (only 1 – 1.5 months). However, spinach development in the tropical country had many insects pests such as: *Spodoptera* sp. and *Thrips* sp.[1].

Few alternatives for monitoring and control of insects in spinach plantations such as mechanical control used yellow trap. In the principal, yellow trap as one alternative monitoring insect presence in the field, more safety than chemical control. The extensive use of conventional insecticides in spinach resulted in the development of pest resistance to insecticides, outbreak of secondary pest, a direct hazard to the users, and adverse effect on the environment and non-target organism. Non-target organisms meaning natural enemies such as predatory insects surrounding the plantation [2,3]. According to Abdullah *et al.* (2017), in the principal and technique, insect trap different depend on crop and insect target [4].

Shannon-Wiener index diversity as the famous technique measure diversity of organism. Langmack *et al.* (2001) reported that few factors affected the fluctuation of biodiversity such as: 1) the biodiversity in the specific habitat increasing based the time; 2) the heterogeneity of habitat will affect complexity of animal and plant species; 3) competition if the source of food cannot cover the consumers; 4) stability of the climate and 5) plant productivity because plant as the main producer in the food chain [5].

Based the reason previously, the purpose of the research is to study the role of soil surface arthropods in spinach plantation. In the future, the result of the research is very useful information for management potential soil surface arthropods in improving the quality of spinach harvest and monitoring the presence of insect pest based environmentally friendly methods.



2. Material and Methods

2.1. Field study site

Research was conducted with survey methods at Moncobalang village, Gowa district, South Sulawesi, Indonesia (5°15'47.4"S, 119°24'13.7"E) from December 2018 to January 2019.

2.2. Soil surface arthropods observation

Before the application of the treatment, farmers agree to all of the research treatment into their crop not applied by herbicide, insecticide, fertilizers and another chemical material. Commonly farmer used conventional methods to manage their plantation with a hoe. The plot measure length 27 m, width 4 m and height 30 cm. The spinach seed was a green variety from farmers generative plant. Before planting, farmers mixed well the seeds of spinach with ash and sown followed the longitudinal path on the plot. The research used 4 plots size (length = 27 m, width = 4 m, height = 30 cm). The observation of soil surface arthropods with a yellow trap was held in farmer spinach plantation at 10 days after planting with interval 5 days.

Yellow trap made from pieces of yellow paper, wrapped in plastic and their surface, contain safety adhesive for trap insects. Yellow trap was installed in the morning then used for 24 hours. This trap focused collect flying insects in the plant canopy.

2.3. Data analysis

The insects' collection counting used Shannon-Wiener index diversity with the formula [6] :

$$H' = - \sum_{i=1}^n (p_i) (\ln p_i)$$

- H' = Shannon-Wiener index diversity
 P_i = The number of individual species
 n_i = Number of individu at -i
 N = Total individual

Table 1. Scoring the number of Shannon-Wiener index diversity [6].

Number of Scoring	Category
$H' < 1.0$	Low index diversity and productivity as indicator the pressure in unstable ecosystem.
$1.0 < H' < 3.322$	Middle index diversity, productivity and ecosystem in balance.
$H' > 3.322$	High index diversity and productivity, stable ecosystem, resistant in ecology pressure.

3. Result and Discussion

Commonly insect collected in research with purpose identification and determined their role in the ecosystem. Table 2 was showed the index diversity of pest in spinach plantation.

Table 2. Index diversity of pest in spinach plantation.

Order	Family	Shannon-Wiener Index Diversity
Lepidoptera	Pieridae	-0.07
	Noctuidae	-0.18
Diptera	Tephritidae	-0.12
	Drosophilidae	-0.36
Hemiptera	Pentatomidae	-0.36
	Alydidae	-0.12
Orthoptera	Acrididae	-0.27

Coleoptera	Chrysomelidae	-0.12
	Scarabaeidae	-0.16
Total		-1.80

Table 2 was showed the index diversity of pests insect collected from yellow trap. The highest order is : Hemiptera (Pentatomidae) (-0.36) similar to Diptera (Drosophilidae), then Orthoptera (Acrididae) (-0.27) and Lepidoptera (Noctuidae) (-0.18). The lowest number is Lepidoptera (Pieridae) (-0.07). Yellow trap as the passive trap for insect adult. The total number from collected insect pest is 105 individual. Abdullah *et al.* (2017) state that various of trap affected types of insect trapped. For example, yellow trap effective trapped flying insects or surrounding plant canopy [4]. In the next, Table 3 was showed index diversity of arthropods predator in spinach plantation.

Table 3. Index diversity of arthropods predator in spinach plantation.

Order	Family	Shannon-Wiener Index Diversity
Araneae	Lycosidae	-0.20
	Pholcidae	-0.15
Coleoptera	Carabidae	-0.23
	Coccinellidae	-0.35
Diptera	Tachinidae	-0.35
Hymenoptera	Vespidae	-0.28
Odonata	Aeshnidae	-0.15
Orthoptera	Gryllidae	-0.06
Total		-1.81

Table 3 was showed the index diversity of arthropods predator collected from yellow trap. The highest order is : Coleoptera (Coccinellidae) (-0.35) similar to Diptera (Tachinidae), Hymenoptera (Vespidae) (-0.28). Arachnida as a potential predator such as Lycosidae and Pholcidae (-0.20) and (-0.15), respectively. The total number from collected arthropods is 131 individuals. It has based the result, not only soil arthropods catches in yellow trap but dominant by flying insects. According to Menta and Remelli (2020)= state that commonly insect interest to object contain yellow color, because it indicated the presence of nectar as an important food source [7]. Barberi *et al.* 2010 state that commonly insect visited crops for nectar, pollen or other products of the plant [8].

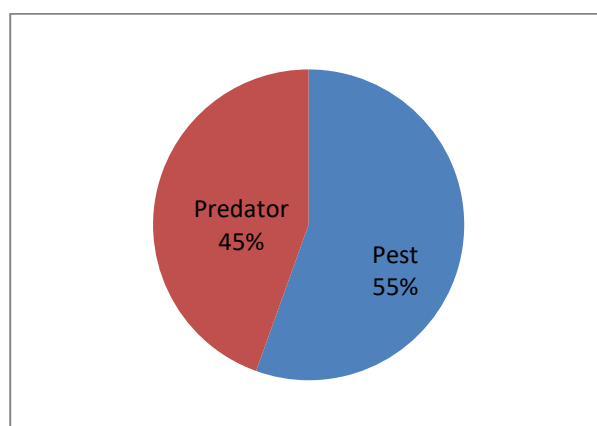


Figure 1. Comparison between insects pest and predator in spinach plantation (%)

Figure 1 was showed a comparison of the collection number between pest (55%) and predator (insect and arachnid) (45%). Langmack *et al.* (2001) state that habitat management is very important

in conserve natural enemies, especially arthropod predator in crops. Presence crops as food source and refugia as the benefit of insect development in nature [5]. Commonly many food sources result in natural insect enemies in higher population numbers and size better more than the poor field (dry land). The manipulating plant resources to enhance beneficial arthropods in agricultural landscapes. Manipulating habitat needs more attention to avoid the starvation of natural insect enemies. For example, the management of weeds as the best way to conserve natural enemies in crops. The one recommendation avoid the outbreak of insect pest with monitoring activities to detect the presence of pest used various trap based on the landscape structure, pattern, and crop variety.

Pearson and Tooker (2017) and Aminah *et al.* (2013) state that commonly, the species diversity and abundance of arthropods increasing by presence vegetation cover and methods controlling of pests in the field [9,10]. The communities under vegetation mainly respond to food availability and the presence of natural enemies. The availability of plant as a source of food and refugia seem to play a critical role as a reserve and source of arthropods diversity. The decreasing vegetation cover and changes in vegetation patterns can fast lead to a significant loss of more arthropods diversity.

4. Conclusion

The findings of the yellow trap applied in spinach plantation were showed collected more of arthropods predator (131 individual) than pest insect (105 individual). Based on the research data was showed the comparison of the collection number between pest (55%) and predator (insect and arachnid) (45%). In the future, the result of the research is very useful information to apply insect monitoring based environmentally friendly.

References

- [1] Ngatimin S N A and Nasruddin A 2019 Comparison of Insects Biodiversity in Green Spinach Ecosystem Using Farmer and Commercial Seeds *Trends Appl. Sci. Res.* **14** 210–4
- [2] Kodandaram M H, Rai A B and Halder J 2010 Novel insecticides for management of insect pests in vegetable crops: A review *Veg. Sci.* **37** 109–23
- [3] Kotikal Y K, Suvarna P and Kumar K C K 2017 Evaluation of poison baits against *Spodoptera litura* Fab. (Lepidoptera: Noctuidae) in spinach. *Int. J. Plant Prot.* **10** 122–7
- [4] Abdullah T, Said A E, Ngatimin S N A and Nasruddin A 2017 Attractiveness of Trap Size and Direction to Adult Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) in Chili Pepper *Res. J. Pharm. Biol. Chem. Sci.* **8** 1082–5
- [5] Langmaack M, Schrader S and Helming K 2001 Effect of mesofaunal activity on the rehabilitation of sealed soil surfaces *Appl. Soil Ecol.* **16** 121–30
- [6] Wolda H 1978 Seasonal fluctuations in rainfall, food and abundance of tropical insects *J. Anim. Ecol.* **47** 369–81
- [7] Menta C and Remelli S 2020 Soil Health and Arthropods: From Complex System to Worthwhile Investigation *Insects* **11** 54
- [8] Barberi P, Burgio G, Dinelli G, Moonen A C, Otto S, Vazzana C and Zanin G 2010 Functional biodiversity in the agricultural landscape: relationships between weeds and arthropod fauna *Weed Res.* **50** 388–401
- [9] Pearsons K A and Tooker J F 2017 In-field habitat management to optimize pest control of novel soil communities in agroecosystems *Insects* **8** 82
- [10] Ngatimin S N A, Syatrawati S and Widarawati R 2013 Weed Management on the Abundance of Insect Natural Enemies in a Cabbage Field *Int. J. Agric. Syst.* **1** 65–70