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## Research Article

# Comparison of Insects Biodiversity in Green Spinach Ecosystem Using Farmer and Commercial Seeds

Sri Nur Aminah Ngatimin and Andi Nasruddin

Department of Plant Pests and Diseases, Faculty of Agriculture, Hasanuddin University Makassar, Makassar, South Sulawesi 90245, Indonesia

### Abstract

**Background and Objective:** Green spinach (*Amaranthus* sp.) grow well in many areas around the worldwide. The present work had the purpose of observing insects biodiversity on green spinach used farmer and commercial seeds in south Sulawesi, Indonesia. **Materials and Method:** Research as a survey was conducted to observe insects biodiversity in green spinach ecosystem during February-June, 2017. The region lies 3°43'-4°09' south latitude and 119°41'-120°10' E longitudes with an elevation about 30 m from the sea level. The counting of individuals was performed by using visual searching method. To study the insects diversity in different green spinach source seeds, Simpson's diversity index was used. Both pest and insects predator population were observed in the green spinach ecosystem. **Results:** The result was showed grasshopper (*Valanga* sp.) was ranked first in respect to the frequency followed by taro caterpillar (*Spodoptera litura*), leaf miners (*Liriomyza* sp.), Coccidae (*Planococcus* sp.), *Riptortus* sp. and *Phyllotreta* sp. Green spinach used commercial seeds was showed grasshopper (*Valanga* sp.) as dominant pests followed leaf miners (*Liriomyza* sp.) and *S. litura*, respectively. Coleoptera was the most important predator order divided into two species *Coccinella* sp. dan *Menochilus* sp. find in both field. Only Formicidae in green spinach from farmer seeds. In the other hand, green spinach harvest from commercial seeds more higher than harvest from farmer seeds. **Conclusion:** The study showed various insects pest attacking two field experiment. Both pest and insects predator population were observed in the green spinach ecosystem. Among the insects pest species, three species were found as major pest such as: *S. litura*, *Valanga* sp. and *Liriomyza* sp. In another finding, Coccinellidae, Formicidae and Staphylinidae were the most common predaceous insects in the green spinach ecosystem. Impact of research is useful information for farmers reduce synthetic pesticides in management of agricultural crop.

**Key words:** Green spinach, seeds, commercial, farmer, insects, predator

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**Corresponding Author:** Sri Nur Aminah Ngatimin, Department of Plant Pests and Diseases, Faculty of Agriculture, Hasanuddin University Makassar, Makassar, South Sulawesi 90245, Indonesia

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**Competing Interest:** The authors have declared that no competing interest exists.

**Data Availability:** All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Spinach plants grow well in many areas of the country in the worldwide. Green spinach (*Amaranthus* sp.) from Amaranthaceae is a major and famous crops in Indonesia especially in south Sulawesi as the centre of vegetable in the eastern part of the country. In general spinach divided into 2 types: Green and red spinach based leaves color. The high demand of spinach because contain many of Fe, vitamins and beneficial carotenoids increasing healthy. Green spinach is grown year because spinach is a dicotyledon with two seed leaves can adapted well in extreme condition especially in tropical areas<sup>1,2</sup>. Spinach has a broadleaf also makes it susceptible for insects pests especially chewing species.

Currently pest problems in spinach plantation in tropic areas especially insects activities such as taro caterpillar (*Spodoptera litura*), *Thrips* sp. and green peach aphid (*Myzus persicae*)<sup>1</sup>. Commonly farmers controlled insects pest in green spinach plantation with synthetic insecticides. Unfortunately, the extensive use of conventional insecticides in green spinach has resulted in the development of pest resistance to insecticides, outbreak of secondary pests, direct hazard to the users and adverse effect on environment and non-target organism<sup>3</sup>. Non-target organism means natural enemies<sup>4,5</sup> such as parasitoids and predators<sup>6,7</sup> surrounding habitat of green spinach. This is interesting topic observed insect biodiversity (pest, predator, parasitoid) in green spinach ecosystem and impact of insects pest in number of harvest.

Commonly green spinach plantation in south Sulawesi used two seeds sources : Farmer seeds and commercial seeds. Farmer seeds or traditional/conventional seeds coming from plants harvested in the last season, sometimes more degradation in the quality of their growth and easy attacked by insects pest. In fact, farmers seeds in south Sulawesi resistant to leaves diseases than insects. Commercial seeds as another source for plantation has benefit such as: Sealed packaging in aluminium, seeds quality guarantee, free from seed borne pathogenic, registered and certain brand. Also number of their harvest higher more than farmer seeds. Unfortunately, commercial seeds are more expensive than farmer seeds<sup>8</sup>. Based on the description above, the present work had the purpose of observing and comparing insects biodiversity on green spinach used farmer and commercial seeds.

## MATERIALS AND METHODS

**Site of research:** The research as a survey was conducted at farmer field in Pituriawa village, Sidrap district, south Sulawesi

Indonesia, in summer season during the period from February-June, 2017. The region lies 3°43'-4°09' south latitude and 119°41'-120°10' E longitudes with an elevation about 30 m from the sea level. The field was situated in the tropical climatic zone, characterized by heavy rainfall during the month of October-December and scanty rainfall during the rest of the year. The soil of the farmer field was sandy loam in texture in pH of around 6-9. The whole field for experiment was separated in two types of seeds: Farmer and commercial. The field distance of farmer and commercial seeds separated about 200 m were tilled using a hoe. Seedling of farmer and commercial seeds are planted into three plot of equal size having 1.5 m between the plots and the unit plot size was 3×2 m. Each plot contain three lines for seeds planting. Treatment were arranged in a randomized complete block design with three replications. The treatments were used: (1) Green spinach from traditional farmer seeds and (2) Green spinach from commercial seeds (registered and sealed packages). All of plots free from chemical fertilizer and pesticides.

**Data collection:** The number of arthropods in green spinach was the simplest measure of species diversity. However, for limitation in species identification, concept was restricted to order and family level. The counting of individuals was performed by using visual searching method.

**Visual searching method:** Adult of insects pest in green spinach were counted from a random sample of 10 plants taken from each plot. Five leaves were chosen randomly on each green spinach, two from the bottom (older leaves), one from the middle and two from the top (younger leaves), respectively. The lower surface of the leaf was thoroughly examined for the presence of insects. Counts were made in early morning 07:00 h (Middle Indonesian local time) to avoid the excessive mobility of the adult insects after this time, but nevertheless, the migration of the fast moving and mobile adults from one plot to the other could not be totally avoided. Observation of each plot at weekly interval. All collected insects were brought to natural laboratory for further identification using insect identification references<sup>9-11</sup>.

**Measurement of diversity index:** To study the arthropods diversity in different green spinach source seeds, Simpson's diversity index was used:

$$\text{Simpson's index (D)} = \frac{1}{\sum_{i=1}^s P_i^2}$$

where,  $P_i$  is the proportion of individual for the  $i$ th insect family and  $S$  is the total numbers of insect family in the community<sup>12</sup>.

## RESULTS

**Biodiversity of insects pest in green spinach:** The result of observation was showed five orders of insect pests were recorded in green spinach at both field throughout the cropping season from February-June. Coccidae such as *Planococcus* sp. as important sucking insect pests were found in stem and buds of green spinach. Most of chewing species such as *Spodoptera litura*, *Valanga* sp., *Liriomyza* sp. and *Phyllotreta* sp. caused injury to the foliage (Table 1).

Table 1 was showed grasshopper (*Valanga* sp.) as chewing insect was ranked first followed by taro caterpillar (*S. litura*); leaf miners (*Liriomyza* sp.); Coccidae (*Planococcus* sp.). Green spinach used commercial seeds was showed grasshopper (*Valanga* sp.) as dominant pests followed by leaf miners and *S. litura*, respectively. The chewing insects such as grasshopper, taro caterpillar and leaf miners showed the top position in green spinach ecosystem. This is our findings chewing insects pest in green spinach caused more damage in leaves. Moreover, sucking insects such as Coccidae and Coreidae caused damage only in green spinach from farmer seeds than commercial seeds during the current study. Although the number of harmful species seems

to be high, the significant crop damage was caused by only three key pests (*S. litura*, *Valanga* sp. and *Liriomyza* sp.) attacked green spinach leaves.

**Presence of insects predator:** The insects predator were recorded in two orders. Coleoptera was the most important predator order divided into two species *Coccinella* sp. and *Menochilus* sp. find in both field. Only Formicidae in green spinach from farmer seeds. Result of research was showed all of the predators in forming adult in green spinach with farmer and commercial seeds. Diversity index of insects predator in farmer seeds lowest than commercial seeds (Table 2).

## DISCUSSION

The findings was showed significant crop damage was caused by only three key pests (*S. litura*, *Valanga* sp. and *Liriomyza* sp.) attacked green spinach leaves. Green spinach using farmer seeds indicated the seeds more vulnerable for chewing insects. The result of observation was showed low index diversity for the same species in commercial seeds indicated green spinach from commercial more resistant than farmer seeds. This indicated market of seeds have gone through various selection processes including laboratory testing especially avoid insects pest and seed-borne diseases.

Table 1: Diversity index of insects pest in green spinach ecosystem

Insects pest					
Seed sources	Order	Family	Genus	Site of damage	Diversity index (%)
Farmer	Lepidoptera	Noctuidae	<i>Spodoptera litura</i>	Leaf	-0.33
	Homoptera	Coccidae	<i>Planococcus</i> sp.	Stem and buds	-0.24
	Orthoptera	Acrididae	<i>Valanga</i> sp.	Leaf	-0.36
	Hemiptera	Coreidae	<i>Riptortus</i> sp.	Young stem	-0.19
	Diptera	Agromyzidae	<i>Liriomyza</i> sp.	Leaf	-0.32
	Coleoptera	Chrysomelidae	<i>Phyllotreta</i> sp.	Leaf	-0.19
Commercial	Lepidoptera	Noctuidae	<i>Spodoptera litura</i>	Leaf	-0.13
	Orthoptera	Acrididae	<i>Valanga</i> sp.	Leaf	-0.31
	Diptera	Agromyzidae	<i>Liriomyza</i> sp.	Leaf	-0.27

Table 2: Diversity index of insects predator in green spinach field and their stages

Insects predator					
Seed sources	Order	Family	Genus	Stage of development	Diversity index (%)
Farmer	Coleoptera	Coccinellidae	<i>Coccinella</i> sp.	Adult	-0.18
	Coleoptera	Coccinellidae	<i>Menochilus</i> sp.	Adult	-0.22
	Coleoptera	Staphylinidae	<i>Paederus</i> sp.	Adult	-0.20
	Hymenoptera	Formicidae	<i>Oecophylla</i> sp.	Adult	-0.36
Commercial	Coleoptera	Coccinellidae	<i>Coccinella</i> sp.	Adult	-0.19
	Coleoptera	Coccinellidae	<i>Menochilus</i> sp.	Adult	-0.36
	Coleoptera	Staphylinidae	<i>Paederus</i> sp.	Adult	-0.27

The commercial seeds produced by the company as the result of seeds in long selection processes that feasible to grow and release with guaranteed quality. Treatment of commercial seeds production is to reduced pest attack and improving quality of green spinach including maintain their purity. Purity of seed quality was assessed through plant growth in the field including uniform in shape and weight of the seeds. Seeds is a good quality if they has high percentage of survival, it means sprouts are not affected by the growing environment, the physical appearance of the seeds is flawless, physiologically and genetically guaranteed<sup>8</sup>.

The presence of insect attacked green spinach from farmer seeds started early (approximately 10 day after planting) because seeds no selection process such as treatment to prevent insect pests<sup>7,5</sup>. The number of pests attacked plants affected green spinach harvest<sup>6,2,13,14</sup>. This research was held near village where the land has been polluted by chemical pesticides on previous planting season. Also reduce of natural enemies indicating insects pest in the higher diversity index. In addition to growing environmental conditions, weather that often changes suddenly greatly affected plant growth. Weather and environmental micro climates are very influential on the development of insect pests<sup>4,5</sup>. The higher the ambient temperature, the metabolic processes of insects, especially the life cycle, will be faster<sup>15</sup>. The main factor of presence insects pest in ecosystem very influential on the growth and production of cultivated plants, especially vegetables<sup>6</sup>. Insects pest is the one of important factors in agricultural loss harvest due to fluctuations in pest populations in the field that are strongly influenced by plant age and environmental conditions. For example rainy season can reduced number of pests in the field<sup>6,16</sup>. On the other hand, in green spinach ecosystem also find two species predator insects from Coccinellidae such as *Menochilus* sp. and *Coccinella* sp. as a potential predators in form adult and larvae.

### CONCLUSION

The current study has shown that there were various insects pest attacking two field experiment. Both pest and insects predator population were observed in the green spinach ecosystem. Among the insects pest species, three species were found as major pest such as: *S. litura*, *Valanga* sp. and *Liriomyza* sp. In another finding, Coccinellidae, Formicidae and Staphylinidae were the most common predaceous insects in the green spinach ecosystem.

### SIGNIFICANCE STATEMENT

This study discovered the green spinach from farmer seeds more vulnerable attacked by insects pest than commercial seed. This finding can be beneficial mainly for farmers increasing their quality product and habitat management for natural enemies including shelter and source of additional food from flowering weeds surrounding green spinach ecosystem. Impact of research is useful information for farmers reduce synthetic pesticides in management of agricultural crop.

This study will help the researchers to uncover the critical areas of insects biodiversity around green spinach plantation that many researchers were not able to explore. Thus a new theory on role of insects and their biodiversity will enrich in future research.

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