

## The role of trap crops for conserving of natural enemies of leafminer on onion in Central Sulawesi, Indonesia

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**Abstract:** The study aiming in evaluating prospect of trap crop for controlling leafminers pest on onion crop has been conducted in Palu valley, Central Sulawesi Indonesia. The study used a randomized block design with 3 species of trap crops (tomatoes, cucumbers, and beans) grown at different times (0, 2, and 4 weeks before planting shallots). Variable observed were population and infestation level of leafminers as well as diversity of leafminers and its parasitoids. The results showed that the treatment significantly reduce the infestation level of the pest. Population density of leafminers at control and shallots with tomatoes as trap crops plots were higher than the other treatments. The attack rate of the pest on onion crop with trap crops was significantly lower than those without trap crops regardless of the grown time of trap crops. Three species of leafminers and 5 parasitoids species were collected from trap and onion crops indicating that grown trap crop as a border surrounding the shallots was able to attract and preserve the natural enemies of leafminers and suppressing the pest infestation.

**Keywords:** Trap crops, leafminers, onion Palu Variety, conservation, parasitoids

### INTRODUCTION

Leafminer is an exotic pest and becomes a new important pest of onion crops in Central Sulawesi. Infestation level of this pest on onion crops and other vegetable crops in Palu Valley is around 21-51% [1]. Nevertheless, if the population of this pest was high abundance it may reduce the onion yield up to 100 % [2]. Leafminers was originally not consider as important pest because the population of pests can be controlled by natural enemies (predators, parasitoids and insect pathogens), but by 1970 their status become a prominent pest because their natural enemies was kill as a result of the intensive use of insecticide [3]. This is supported by a number of recent studies [4,5]. Therefore it is important to develop a more sustainable control techniques that can preserve and empower the natural enemies as biological control agents. This is because the successfull of pest control program is determined by the extent to which the implementation of sustainable control system against this pest [6].

Intercropping of pepper and sugarcane has been reported could suppress infestation of leafminer (*Liriomyza huidobrensis*) in pepper (7) because it can enhance the role of parasitoids of these pests. Intercropping onion with several other plant species can also suppress pest thrips in onion (8). Preliminary studies indicate that the plant beans, tomatoes, cucumbers, and cabbage plants has the potential to be a trap against leafminer on onion [1]. However, the effectiveness of the trap crops to control pests is also influenced by the time of planting the crop [9, 10].

### MATERIALS AND METHODS

The research was conducted in 2015 at the farmer's onion field in Langaleso Village, Dolo Sub District, Donggala Regency, Central Sulawesi. The field experiment was arranged according to a randomized block design. The applied treatment was the 3 species of trap crops (tomato, cucumber and string bean) grown at different times (0, 2, and 4 weeks before planting shallots). There were three replicates for each treatment. The plot size was 3 x 1,5 m<sup>2</sup>. Onion seeds were planted with a spacing of 15 x 20 cm and 30 cm spacing between plots. The trap crops were grown as a border surrounding the onion crops following "perimeter and sequential trap cropping method" [9]. Variable observed were population and infestation level of leafminers as well as diversity of leafminers and its parasitoids.

Yellow sticky traps were used to count the leafminer population. The trap model used was modified from Herlinda *et al.* [11]. The trap was made from a yellow plastic bottle (600 ml. in volume) and wrapped by a transparent plastic which is coated with glue insects on both sides. The trap was placed every week for one day in the center of the plot with a height of about 10 cm above the onion canopy from 2 weeks after onion planting (WAP) until one week before harvest. Imago of leafminer was also collected manually using plastic bags for identification purposes. The pest infestation rate was determined based on the number of mines at the 10 plant samples [12].

The presence of parasitoids was determined by collecting 10 infested leaves from each plant sample. The infested leaves from the field were brought to the laboratory and placed in plastic containers (10 cm diameter and 16 cm high) and the lids were mounted with upside down funnels. A small plastic cup was assembled on the funnel stems to trap the emerging parasitoids and flies. All caught parasitoids and flies were counted and preserve into vials with 70% ethyl alcohol for further identification. The identification was conducted in Plant Pest & Diseases Laboratory, University of Tadulako by using available keys [13, 14]. Identification was also done by sending the specimens to the expert at the Museum Zoological Bogorienze, Indonesian Institute of Sciences (LIPI). Data were analyzed using a statistical program, i.e. Statsoft 7 for analysis of variance (ANOVA). Mean

comparison was done using Honestly Significant Difference (HSD).

## RESULTS AND DISCUSSION

The results showed that trap crops significantly reduce infestation of leafminer. Population density of leafminers at control and shallots with tomatoes as trap crops plots were higher than the other treatments (Figure 1). In general, the attack rate of the pest on onion crop with trap crops was significantly lower than those without trap crops regardless of the grown time of trap crops. Although effect of trap crops species and planted time on leafminer infestation was not different significantly, tomatos showed a higher potency as a trap crop for attracting leafminer, while the time of planting trap crops 4 weeks before planting onions was also tend to attract more leafminer (Figure 2).

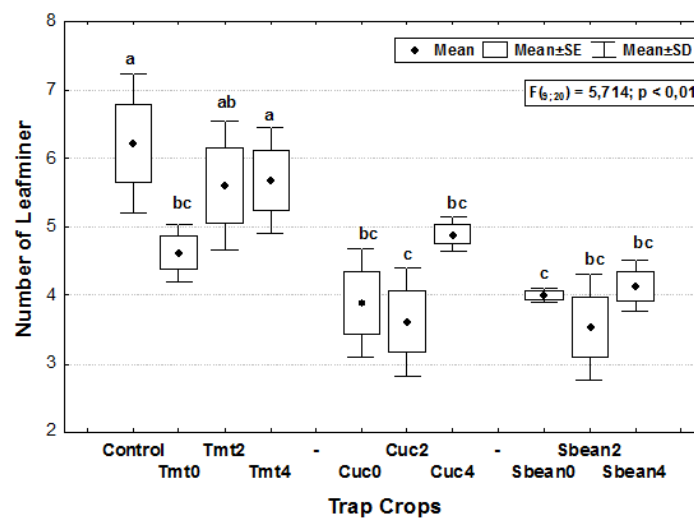


Fig-1: Effect of trap crops (Tmt = Tomato, Cuc = Cucumber, Sbean = string bean) on leafminer population in onion. Number 0,2, 4 following trap crop indicating its grown time; the same time (0), two weeks (2) and four weeks (4) before onion was planted. Bars sharing the same letter do not differ significantly (Tukey's HSD test,  $p < 0.05$ )

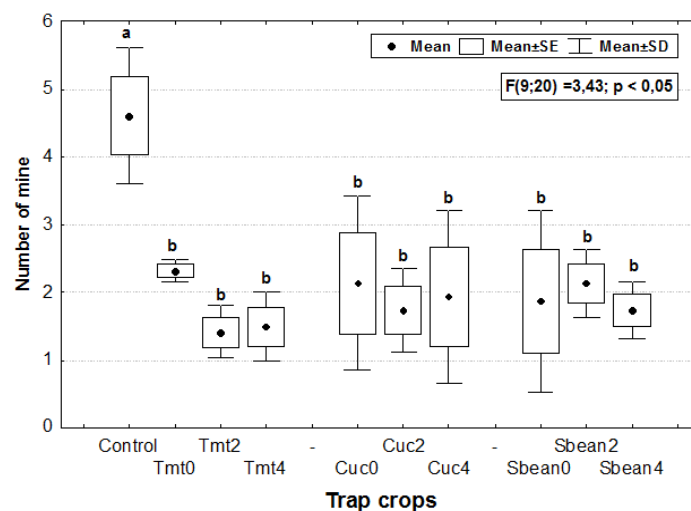


Fig-2: Effect of trap crops (Tmt = Tomato, Cuc = Cucumber, Sbean = string bean) on leafminer infestation in onion. Number 0,2, 4 following trap crop indicating its grown time; the same time (0), two weeks (2) and four weeks (4) before onion was planted. Bars sharing the same letter do not differ significantly (Tukey's HSD test,  $p < 0.05$ )

There were three species of *Liriomyza* collected at the study sites: *L. chinensis*, *L. huidobrensis*, and *L. sativae*. While the study recorded *L. sativae* at cucumber and *L. huidobrensis* at tomato crops, two species were collected in the onion crops (i.e. *L. chinensis* and *L. huidobrensis*) (Table 1). The study also found 5 species of parasitoids belongs to 3 families of Hymenoptera: *Hemiptarsenus varicornis*, *Chrysocharis pentheus*, *Sympiesis* sp., *Gronotoma micromorpha*, and *Opius* sp. (Figure 3). Of 35 collected parasitoids, 21 (60%) of them were *H. varicornis* (Table 1). The species composition of parasitoids in our previous study [1] was similar with the present study.

Trap crops have been widely used for control of various types of pests and diseases of plants [7,8,9,10]. However, this study is the first reporting applications of trap crops against leafminer pest on local variety of onion in Palu Valley. The use of tomato plants, beans, and cucumbers can suppress leafminer pest on Palu valley varieties of onion (Figure 1 and Figure 2). Although the effectiveness of the three plants trap used are relatively similar, prospect of tomato as a trap crop was higher than bean and cucumber. It is indicated by the highest population of parasitoids on onion with tomato as trap crop especially which is grown in the 4th week before planting shallots.

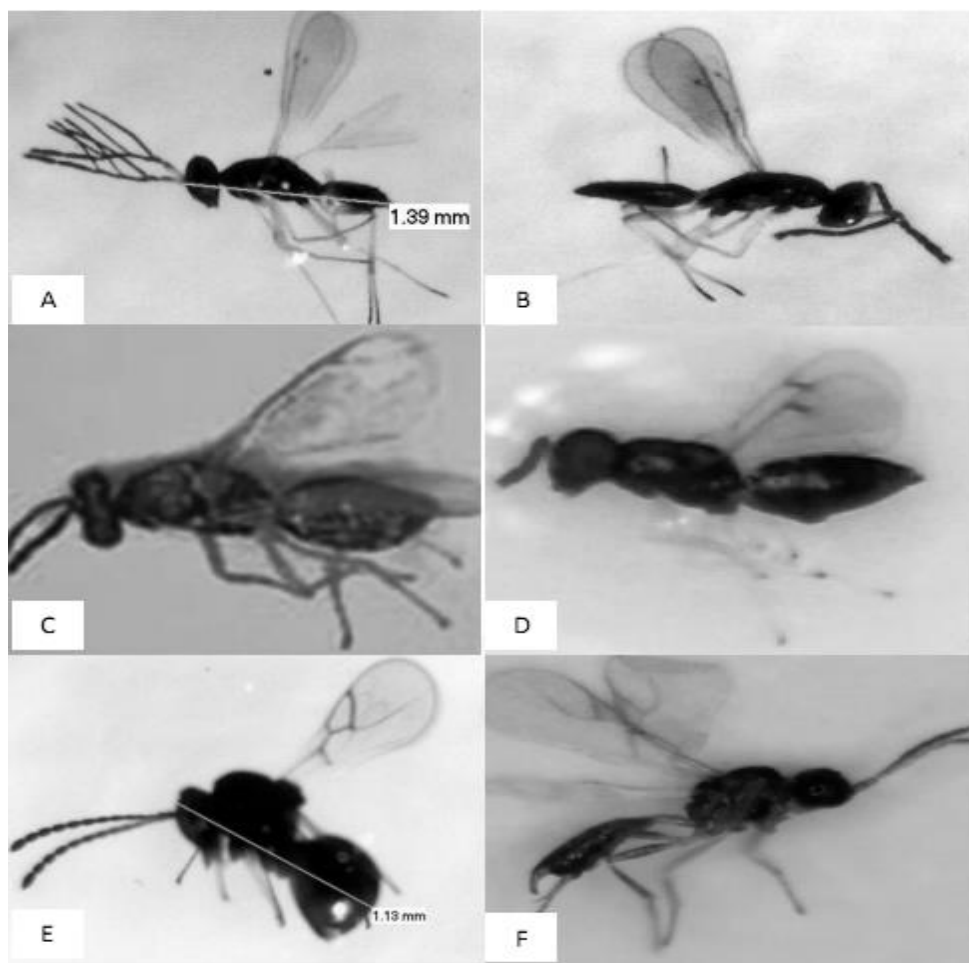
Grown trap crops, surrounding onion crop seems to be able to attract more leafminer pest but also supporting the presence of several species of parasitoids including two parasitoid species on onion crops. (Table 1). It is generally known than leafminer species attacking onion crops is *L. chinensis* [15, 1,2].

However this study recorded the presence of *L. huidobrensis* on onion as reported also by Martin *et al.* [16]. The fact that two leafminers and three parasitoids species were found on onion indicates that trap crop used in this study could attract and become a reservoir of natural enemies of leafminer. This may explain why leafminer infestation on the onion plots that enrich with crop trap was lower than the onion crop alone. (Figure 2). The most abundant of parasitoids collected was *H. varicornis* suggesting their high potential as natural enemies of leafminer. A Study in Vietnam reported that of 5 parasitoids species infesting leafminer on onion, *H. varicornis* was the minor parasitoid and dominated by *Neochrysocharis okazakii* [15].

These results was in line with hypothesis that the conservation of natural enemies of insect pests can be done by ecological engineering or habitat management [17, 3]. One example of this control strategy is by growing plant that can attract pests and their natural enemies (trap plant) or reject the presence of pests (repellent plant) to the crop. A group of plants that act directly or indirectly in the control of pests are known as biocontrol plant [18]. Planting a trap crop is an attempt to shift the pest to trap crop so that pest populations are not concentrated at the economic crop as suggested by the “resource concentration hypothesis” [19]. Moreover this control techniques primarily aimed at improving or conserving natural enemies on agricultural land in accordance with the “natural enemies hypothesis” [19] and eventually the use of synthetic insecticides can be minimized or not used at all.

**Table 1. Leafminers and its parasitoids collected from trap crop and onion.**

Host plant	Leafminers	Parasitoids
Cucumber	<i>L. sativae</i>	<i>H. varicornis</i> ,
		<i>Chrysocharis pentheus</i>
		<i>Gronotoma micromorpha</i>
		<i>Opius</i> sp.
String bean and cucumber	<i>L. huidobrensis</i>	<i>H. varicornis</i> ,
		<i>C. pentheus</i>
		<i>G. micromorpha</i>
Onion	<i>L. chinensis</i> & <i>L. huidobrensis</i>	<i>H. varicornis</i>
		<i>C. pentheus</i>
		<i>Sympiesis</i> sp.



**Fig-3. Adult parasitoids of leafminers collected from onion and trap crops**

A: Male *Hemiptarsenus variconis* (Girault) (Hymenoptera : Eulophidae); B: Female *Hemiptarsenus variconis* (Girault) (Hymenoptera : Eulophidae); C: Female *Sympiesis* sp. (Hymenoptera : Eulophidae); D: Female *Chrysocharis pentheus* Walker (Hymenoptera : Eulophidae); E: Female *Gronotoma micromorpha* (Hymenoptera : Figitidae) ; F: Female *Opius* sp. (Muesebeck) (Hymenoptera : Braconidae)

## CONCLUSION

Based on the results it is concluded that tomatoes, cucumbers, and string beans has a high potential as trap crop against leafminer on onion crop varieties Palu valley. This is indicated by the lower infestation level of leafminer on onion which are surrounded by trap crops than those without trap crops. Planting trap crops surround the shallots was able to preserve the parasitoids as natural enemies of leafminer pest.

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