The Effect Of Using UV Plastic Shade And Soil Amendments In Suppressing The Presence Of Thrips Pests On Tomato Plants In Dry Land

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Abstract.

This study examined the control of thrips through technical culture on tomato plants by combining soil amendments and UV plastic shade. An experiment was conducted in dry land in Gumantar village, North Lombok Regency, from May to September 2024. This study tested three levels of soil amendments (without soil amendments, with chicken manure, and biochar) and two levels of shade (without shade and with UV plastic shade). The treatments were arranged factorially using a randomized block design with three replications. The population of thrips, both larvae and imago, and the intensity of thrips pest attacks were observed. The results showed an interaction between soil amendments and UV plastic shelters in suppressing the first instar larvae of thrips pests on young leaves. The soil amendment factor significantly affected the presence of first instar larvae on old and young leaves. The UV plastic shelter treatment had a significant impact on all observation parameters, namely thrips pest imago on old and young leaves, first instar larvae on old and young leaves, second instar larvae on old and young leaves, and the intensity of thrips pest attacks.

Keywords: *Thrips; tomato plants; chicken manure; seaweed biochar; ultraviolet plastic and dry land.*

I. INTRODUCTION

Pests are one of the groups of plant pests that often attack cultivated plants. One of the pests that are often found attacking cultivated plants is thrips [1]. Thrips is a group of polyphagous pests on many host plants [2], including tomato plants [3], which directly and indirectly cause losses. Directly, thrips sucks plant fluids, causing symptoms in the form of a silvery color on the underside of the leaves, which become curly or wrinkled, dry, and fall off [4;5;6]. Indirectly, thrips can be a vector of viruses that cause plant diseases, such as mosaic viruses and curly viruses [7;8;9], tomato spotted wilt virus, also known as TSWV (Tomato Spotted Wilt Virus) [10;11].The losses caused by thrips pest attacks lead farmers to take control measures using synthetic chemical pesticides. The application of synthetic chemical pesticides is often not following recommendations. It can have negative impacts such as resistance and resurgence in pests and diseases and degradation of agricultural ecosystems [12]. Thus, it is necessary to carry out more environmentally friendly control techniques such as implementing integrated pest management (IPM) techniques [13]. Control by technical culture as one of the IPM techniques is a preventive action carried out before pest and disease attacks [14]. Control by technical culture is carried out with the right cultivation techniques and good environmental management, so it can support optimal plant growth and reduce pest populations [15].

One way to suppress the presence of pests is to use ultraviolet (UV) plastic shade [16]. Witman [17] reported that the use of UV plastic shade was able to suppress the presence of aphids such as whitefly pests, thrips and aphids (*Myzuz pescisae* and *Aphis gossypii*) on pepper and tomato plants cultivated in semi-arid land. UV plastic shade has also been reported to reduce pest populations by disrupting the life cycle and behavior of pest insects [18] Other cultivation techniques that can be applied to control plant pests are the use of soil amendments such as biochar and manure, especially in dry land that has very low microbial availability and low nutrients [19]. [20] reported that the application of soil amendments such as biochar can improve the quality of soil chemical properties such as pH, C-organic content, nitrogen, phosphorus, potassium, cation exchange capacity (CEC), and C/N ratio. If the plant growth medium is good, it will have a positive impact on plant growth. Plants that are well-nourished in their nutrients will have stronger, healthier performance and can produce secondary metabolites so that they can repel pests [20].This study examined the use of UV plastic shade combined with soil amendments (chicken manure and biochar) to suppress thrips pests on tomato plants in dry land.

II. METHODS

Experimental Field

The experiment was conducted from May to September 2024 in a semi-arid area of Gumantar village, Kayangan subdistrict, North Lombok (8,253654 S, 116,285695 E), Indonesia. The soil ordo was Entisol with sandy loam texture and the altitude is 40 m above sea level. Climate type in the study area according to Oldeman classification is D type.

Chicken Manure and Biochar

The chicken manure used contained C-Organic 29.15%, N 1.15%, P205 4.44%, K2O2 2.58%, Ca 3.87%, Mg 1169.4 ppm, and Bo 182.38 ppm. The biochar used was seaweedbased biochar (REGEN^{TM}) produced by PT. Fajar Sulawesi Utama. The properties of biochar were as follows: pH 7.5, C-Organic 43.6%, C/N 29%, N 1.48%, P2O5 0.1%, K2O 2.66%, Total Fe 359 ppm, available Fe 157 ppm, and Zn 14 ppm.

Seedlings Preparation

Tomato seedlings were prepared by sowing the seeds in seedling trays with a medium in the form of a mixture of manure, husks and soil (1:1:1). The seedling proses was then maintained in accordance with tomato plant cultivation standards until the seedlings have four leaves when they were ready to be transferred to the plots.

Experimental Design and Treatments

The experiment was carried out using a randomized block design. The treatments tested were three soil amendment treatments: without soil amendment (I0), the use of chicken manure (I1), and the use of biochar (S2), and two treatments of shade: without shade (S0) and the use of UV plastic (S1). The experiment was set up with three replications so that there were 18 treatment plots divided into three blocks. Each plot was made with dimensions of 600 cm × 100 cm × 75 cm with a distance between plots in blocks of 50 cm and a distance between blocks of 75 cm. The plots then were sprinkled with Pak Tani's NPK fertilizer (16-16-16) as basic fertilizer at a dose of 760 kg ha^{-1} (456 g plot^{-1})Then according to the treatments, the chicken manure and biochar were applied 6 kg plot^{-1} (10 ton ha^{-1}) each and sprinkled evenly on the soil surface, then mixed thoroughly with the plow layer soil (~20 cm) by manual stirring, so that the color of the soil was uniform in all treated plots. Likewise, for shade treatment plots, shades with UV-plastic 2 mm supported by a curved bamboo frame shape with a central height of 1.5 m and at the edge of the plot, 1.2 m, and at the end of the plastic, 0.3 m from the surface of the plot, were installed. All plots were then covered by plastic mulch. In each plot, tomato seeds were planted with a spacing of 60 cm × 60 cm, so there were rows of 10 plants in one plot. Furthermore, the plants were maintained according to planting standards.

Data Collection and Analysis

The parameters observed included the population of thrips pest imago on old and young leaves, first instar larvae of thrips pests on old and young leaves, second instar larvae of thrips pests on old and young leaves, and the intensity of thrips pest attacks. In addition, there were also supporting parameters observed, including the number of leaves, natural enemy population, leaf chlorophyll content, percentage of sunlight absorbed by UV plastic shade, and air temperature and humidity. The data collected were analyzed using Analysis of Variance and, where necessary, followed by Least Significant Difference and Duncan's Multiple Range Test (DMRT) at a 5% significance level.

III. RESULT AND DISCUSSION

Overview of the experimental conditions

Environmental conditions such as temperature and humidity, sunlight intensity, and sunlight intensity were quite optimal for plant growth and the development of thrips pests. Providing UV plastic shade and soil amendment created a microclimate beneficial for plants. In plants shaded by UV plastic, the air temperature ranged between 27.7 - 34.2 °C, with air humidity around 58%. While in treatments not shaded by UV plastic, the air temperature ranged between 25.3 - 34 °C, with an average air humidity during the experiment of 68.3%. The sunlight intensity recorded outside and inside the UV plastic shade reached 130 kilolux and 84 kilolux, respectively. In general, tomato plants planted in the experimental location had good growth, with the best results observed in the biochar treatment shaded with UV plastic. Thrips pests began to be found 4 weeks after planting (WAP) on unshaded plants, and a few days later. They continued to exist until the end of the harvest. During the experiment, several other insects were also found besides thrips pests, namely bees (pollinators), Liriomyza sp (leafminer pests), Helicoverpa (fruit caterpillars) and spiders (predators) from the arachnid class (not insects).

Effect of Treatment on Thrips Pest Imago

The UV plastic shade treatment significantly affected the presence of thrips imago, while the soil amendment treatment did not significantly affect the presence of thrips imago on either old or young leaves. The lowest average population of thrips imago was found on young leaves of plants shaded by UV plastic (Table 1).

Table 1. The Average Thrips Pest Imago Population (per plant) on Old and Young Leaves

Treatments	Population (Numbers of imago) *)	
	Old leaves	Young leaves
Shade		
Without shade	196.0b	104.3b
With Shade	56.0a	38.6a
LSD 5%	*42.6*	*47.5*
Soil amendment		
Without	126.5	83.3
Chicken manure	136.0	70.1
Biochar	115.5	60.9

*) Numbers followed by the same letter in the same column and treatment indicate values that are not significantly different.

This is in line with the research result [24], which reported that aphids (thrips, whiteflies, and aphids) were found less on plants shaded by UV plastic. This may be because UV plastic shade can filter direct sunlight, especially UV rays [25]. In addition, UV plastic shade can also be a physical barrier, such as affecting the vision of pests so that pests have more difficulty finding their host plants [26]. UV plastic shade can also protect plants from physical damage due to wind, which can be a big opportunity for pests to attack plants [27].

Effect of Treatment on Thrips Pest Larvae

The UV plastic shade treatment significantly affected all parameters of thrips larvae, while soil amendment application significantly affected the presence of first instar larvae, but did not significantly affect the presence of second instar larvae. The UV plastic shade treatment significantly reduced the population of first instar larvae with the lowest population observed on young leaves of plants shaded by UV plastic (Table 2). The lowest average population of second instar larvae was found on young leaves of plants shaded by UV plastic, which was around 40.31.

Table 2. Average Population of First and Second Instar Larvae of Thrips Pests (per Plant) on Old and Young Leaves

Treatments	Population of First Larva Instar (larva) *)		Population of Second Larva Instar (larva) *)	
	Old leaves	Young leaves	Old leaves	Young leaves
Shade				
Without	312.0b	126.6b	181.7b	110.7b
With shade	80.2a	53.4a	54.0a	40.3a
LSD 5%	*30.8*	*10.9*	*26.2*	*44.0*
Soil amendment				
Without	195.0ab	83.7a	115.6	86.2
Chicken manure	213.1b	99.4c	129.8	74.2
Biochar	180.1a	86.8b	108.2	66.1
LSD 5%	*30.8*	*10.9*	-	-

*) Numbers followed by the same letter in the same column and treatment indicate values that are not significantly different.

Fewer first and second instar larvae in the treatment with UV plastic shade may be related to thrips pest imago. The lowest population of thrips pest imago was found in the treatment given UV plastic shade

(Table 1). This shows a positive correlation between the number of imago and the presence of first and second instar larvae of thrips pests. This indicates that the high and low first and second instar larvae populations are influenced by the presence of imago and the number of eggs laid [28]. However, in this study, the number of eggs in each treatment could not be observed because thrips pests lay their eggs in plant tissue [29;30] On old tomato leaves, first and second instar larvae of thrips pests tend to be more numerous than on young leaves in shade and soil amendment treatments. This is thought to be caused by more imago on old leaves. The imago lays its eggs on old leaves so that the first instar larvae are immediately on the old leaves when they hatch. The attraction of thrips pest imago to old leaves is due to the availability of nutrients, and old leaves have a thinner texture, so that not only are they more easily attacked by thrips pests, but thrips pests also find it easier to lay their eggs into the tissue of old leaves [31]. The soil amendment treatment significantly increased the population of first-instar larvae on young leaves compared to the treatment without soil amendment (Table 2). However, the soil amendment treatment did not significantly affect the presence of second-instar larvae, which may have occurred because the soil amendment did not directly impact the presence of thrips larvae.

Effect of Treatment on Thrips Pest Attack Intensity

The shade treatment significantly reduced the intensity of thrips attacks. The average attack intensity found in all treatments was classified as a light attack intensity category (<25%). This is closely related to the presence of thrips on tomato plants. If the thrips population is high, it can cause higher damage, and vice versa [32;30]. The thrips population in the treatment given UV plastic shade was lower than in the treatment without shade, resulting in low attack intensity (Table 2).

Table 3. Average Intensity of Thrips Pest Attacks

Treatments	Intensity of Thrips Pest Attacks (%)*)
Shade	
Without	22.60b
With shade	7.84a
LSD 5%	*3.61*
Soil amendment	
Without	15.12
Chicken manure	15.54
Biochar	15.00

*) Numbers followed by the same letter in the same column and treatment indicate values that are not significantly different.

The intensity of the attack can be influenced by the feeding behavior (level of ferocity) of thrips pests on tomato plants [30], which can be influenced by environmental factors such as light intensity [29]. In the UV plastic shade treatment, the light intensity was lower at around 84 kilolux, while in the treatment without UV plastic shade, the light intensity was around 130 kilolux, which is the preferred light intensity because thrips pests have more freedom to find food [30]. In addition, the use of UV plastic shade can filter sunlight, especially UV rays, which are less beneficial for plants, so that plants become healthier and stronger because they are protected from stress and are more resistant to pest attacks. This causes the intensity of attacks in the shaded treatment to be less when compared to the treatment without shade. In addition, the intensity of attacks caused by thrips pests can be influenced by plant resistance. Plants with good and healthy growth tend to be more resistant to pest attacks [31]. In this study, the best growth of tomato plants was in the treatment given UV plastic shade and biochar soil amendment (Figure 1). Plants that grow well have a higher level of resistance [32].


Fig 1. Tomato plants treated with UV Plastic Shade and Soil Amendment (Biochar) (left); Tomato plants not treated with UV Plastic Shade and Soil Amendment (right).

The intensity of attacks on plants treated with chicken manure tends to be higher than those not given soil amendment (Table 3). This condition may occur because chicken manure treatment can change the chemical composition of plants, increasing the levels of amino acids and sugars in plant tissue so that thrips pests prefer it [33].

Effect of Treatment Interaction on Observed Parameters

The interaction between the shade factor and the soil amendment factor significantly affected the population of first-instar larvae of thrips pests on young leaves. The average population of first-instar larvae on young leaves is presented in Fig. 2.

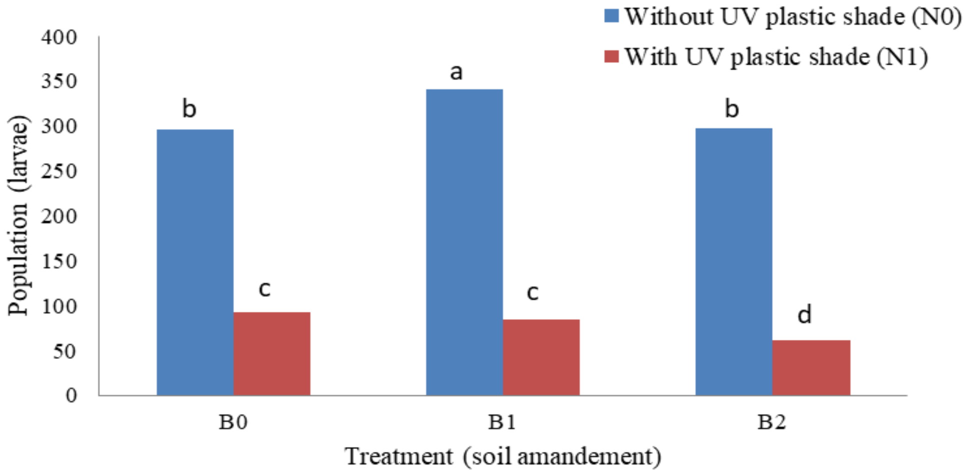

Fig 2. Average population of first instar larvae on young leaves. Without UV plastic shade and without soil amendment (N0B0), without UV plastic shade and with chicken manure (N0B1), without UV plastic shade and biochar (N0B2), with UV plastic shade and without soil amendment (N1B0), with UV plastic shade and with chicken manure (N1B1), with UV plastic shade and with biochar (N1B2). The same letter on each bar indicates values that are not significantly different (DMRT 5%).

Figure 2 shows that the treatment without shade showed a significantly higher average population when compared to the UV plastic shade treatment for all types of soil amendments. In the treatment without shade with soil amendment (chicken manure), the population of first instar larvae significantly increased. Meanwhile, the treatment without shade, with biochar treatment, and without soil amendment did not show a significant difference. This occurs because thrips pests prefer high light and high nitrogen content [34]. Chicken manure treatment is thought to increase nitrogen content in leaves, so it is preferred by thrips pests [35;36;37]. On the other hand, in the shade treatment, the treatment of soil amendments, both chicken manure and biochar, tended to decrease the population, although not significantly different from without soil amendment. A significant decrease in population was observed in the combination of UV plastic shade and soil amendment (biochar) showing the lowest average population of first instar larvae.

This shows that UV plastic shade can protect plants from excessive UV radiation that can damage plants and make them more resistant to pest attacks [38]. [39] reported that biochar treatment was able to reduce pest populations indirectly by improving plant vigor so that pests did not easily attack them, did not easily attack them, did not easily attack them, did not easily attack them, and did not easily attack them. In addition, the use of biochar has been reported to be a repellent against insects such as aphids, leafhoppers, and fruit flies [40]. This repellent effect is caused by volatile chemical compounds released by biochar and changes in the soil environment that are not liked by insect pests. Several researchers have also reported that biochar can interfere with developing and reproducing herbivorous leaf-sucking insects such as mites, aphids and leafhoppers [41;42]. This mechanism occurs by increasing the absorption of Si (silicon), which can improve physical and chemical resistance through increased production of defense enzymes or the release of plant volatile substances that respond to anti-herbivore defenses [43].

IV. CONCLUSION

There was an interaction between soil amendment and UV plastic shade on the presence of first instar larvae of thrips pests on young leaves of tomato plants. UV plastic shade treatment combined with biochar soil amendment treatment can suppress the presence of thrips pests. UV plastic shade treatment can suppress the population of imago, first instar larvae, second instar larvae, and the intensity of thrips pest attacks on old and young leaves of tomato plants. Chicken manure and biochar treatments can suppress the population of first instar larvae on old and young leaves.

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