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## Research Article

# Efficacy of organic mulches in controlling *Thrips tabaci* in arid and semi-arid onion fields

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## ABSTRACT

Onion thrips, *Thrips tabaci* L. is an economic pest of onion worldwide. To control this noxious pest, different controlling methods are introduced every day. The present research is also contributing in thrips control. Dried leaves of banana, sugarcane, and rice were used as mulching material on onion fields in two different climates, arid and semi-arid in the same season. Thrips populations were recorded weekly-basis from both areas. Overall, the results showed that mulching with banana leaves was effective in both arid and semi-arid areas followed by mulching with sugarcane and rice leaves. All treatments in semi-arid zone showed the lowest thrips population (banana leaves  $3.50 \pm 0.32$ , sugarcane leaves  $4.40 \pm 0.33$ , rice leaves  $5.53 \pm 0.39$  and control  $11.40 \pm 0.69$ ) as compared to arid zone (banana leaves  $8.23 \pm 0.61$ , sugarcane leaves  $9.93 \pm 0.59$ , rice leaves  $10.50 \pm 0.61$  and control  $18.77 \pm 1.01$ ). Banana leaves can hold more water and keep soil moist for a long time, as thrips prefer hot and dry climate so the moist field prevents thrips population. Using such plant residuals can help to control thrips, as it is burned in most of the fields and there are no further uses of these materials.

**Keywords:** Onion thrips; organic mulches; management; arid and semi-arid regions.



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## INTRODUCTION

*Thrips tabaci* (Lindeman, 1889) belongs to Thysanoptera order and Thripidae family, it is known as most destructive insect pest of onion (*Allium cepa* L.), it causes significant crop yield loss globally (Lewis, 1997). Owing to its Onion short generation time, parthenogenetic in nature, high reproductive rate and ability to develop resistance against insecticides, worsen the impact of this pest (Morse & Hoddl, 2006; Diaz-Montano et al., 2011). Both stages of thrips (nymph and adult) feed on leaf chlorophyll by punch-and-sucking, resulting in appurtenance of white and silver streaks. Hot and arid conditions favor its population development posing a substantial threat to induce economic loss to the crop (Alston & Drost 2008). Permanently feedings of thrips on onion, effect on plant growth and reduced bulb weight, it is also able to transmit several pathogens that further decrease yields (Gill et al. 2015). Moreover, *T. tabaci* has been identified as the main vector of Iris yellow spot virus, which can significantly reduce bulb size (Gent et al., 2004).

Chemical control is the foremost available option for its control under field conditions (Nault & Shelton 2010). Due to frequent and over-reliance on insecticides, it has been reported that thrips has evolved resistance against some insecticides in the carbamates, organophosphate and pyrethroid groups (Martin et al., 2003; MacIntyre-

Allen et al., 2005; Shelton et al., 2006; Herron et al., 2008). Moreover, irrational use of these insecticides in agricultural landscape has led to many environmental problems, including having a toxic effect on non-targets organisms (Jovanović et al., 2007). Keeping such problems in mind the researchers are diverting to the different eco-friendly methods for controlling such noxious pests around the world. Onion thrip losses can be minimized by combination of cultural practices and chemical controls, suppress its populations and reduce feeding damage by using resistant and tolerant varieties (Gill et al., 2015). In integrated pest management the cultural practices play an important role and have been included in pest control in several crops. The most common practice is the use of mulching to control soil moisture, maintain temperature, and improve crop health (Greer & Dole, 2003). Practice of mulching with organic material to the soil surface has been prevalent for a long time around the world. Mulching with organic material enhances soil fertility and contributes to plant nutrients as they decompose (Lackner and Besharati 2025). Mulching showed positive effects against many insect species in fields and greenhouses; for example, mulching with UV-reflective effect thrips population, it can disrupt their ability to land and recognize their host (Reitz et al., 2003). Crop debris such as banana leaves, sugarcane leaves and rice leaves are burned or discarded in the field in many areas where they grow, but there is no further proper usage. Infected they showed positive effect on plant growth and yield, mulching with dried leaves of banana enhance the plant growth and plant widest as compared to control in the field of tomato (Nisnisan, 2014).

Keeping this in view, the present research was aimed to use plant material such as dried leaves of banana, sugarcane and rice as mulching in onion fields in two different arid and semi-arid climates to see the impact of different plant leaves mulching against onion thrips. Most studies are investigated on straw mulches, but there is no evidence for banana, sugarcane and rice leaves. It was hoped that the result would help in controlling this harmful insect infestation.

## **MATERIALS AND METHODS**

### **Experiment**

The research was conducted at two different climates Larkana and Hyderabad. Larkana considered as arid zone an average altitude 51 meters (170 feet), latitude 27.559°N and longitude 68.212°E with the average annual rainfall is around 100 to 125 millimeters. And Hyderabad called semi-arid zone an average altitude 13 meters (43 feet), latitude 25.392°N and longitude 68.374°E, the average annual rainfall is 336.1 millimeters (13.23 inches).

### **Sowing and Experimental Design**

Onion seeds were sown in one-meter square beds and after 25 days of germination healthy and uniform plants were transplanted in a 2x3 meter bed with 10cm plant to plant and 15cm row to row space. The research was done in a randomized complete block design (RCBD) by performing four treatments viz. mulching with dried banana leaves, dried sugarcane leaves, dried rice leaves, and no mulch (control). Each treatment was replicated ten times following randomized block design. A layer of about 8-10cm of mulch material was applied after 5 days of transplanting and kept till the end of crop. Crop was irrigated by ground water with 4-5 days of interval and weeding was done by hoeing whenever weeds germinated. No insecticide application was applied throughout the growing season.

### **Mulching Material**

The mulching material such as dried leaves of banana, and sugarcane were collected from their growing fields in the Hyderabad district and dried leaves of rice were collected from the Larkana district where they were grown. All collected materials were used at both experimental places. All dried mulching material was not older than 6 months.

### **Data Recording**

Data recording was started after 10 days of transplanting and repeated every week till the end of crop. Fifty plants were selected and tagged in each plot from the inner rows. Each plant observed with magnified glass in the early morning when the thrips were inactive, and numbers of thrips were counted from each plant.

### **Data Analysis**

Paired t-test was used to compare the number of thrips in the treated and control plots. The mean numbers of adults were analyzed by One-way analysis of variance (ANOVA) and Tukey HSD post-hoc test ( $P < 0.05$ ). The percentage was subjected to an arcsine square-root transformation before ANOVA and Tukey's test. All statistical analysis was performed using SPSS statistics version 20, and figures were drawn using Sigma plot 10.0.

## **RESULTS AND DISCUSSION**

### **Weekly Effects of Treatments**

#### **Semi-arid Zone**

One-way ANOVA showed that using banana leaves for mulching had a significant difference compared to the control group ( $F = 3.84$ ;  $df = 3, 8$ ;  $P < 0.06$ ). However, there was no significant difference between the different treatments, and no difference was found between sugarcane and rice when compared to the control in the first week of observation (Figure 3). On the second week of observation all treatments showed significant difference with control ( $F = 6.49$ ;  $df = 3, 8$ ;  $P < 0.02$ ), but there was no difference between treatments (Figure 3). Banana leaves and sugarcane leaves showed significant difference with control at third ( $F = 6.09$ ;  $df = 3, 8$ ;  $P < 0.02$ ), fourth ( $F = 5.78$ ;  $df = 3, 8$ ;  $P < 0.02$ ) and fifth ( $F = 7.5$ ;  $df = 3, 8$ ;  $P < 0.01$ ) weeks of observation, but the mulching with rice leaves did not show any significant difference with control and other treatments (Figure 3). At the sixth week of observation, significant difference was observed between banana with control ( $F = 5.19$ ;  $df = 3, 8$ ;  $P < 0.03$ ), and sugarcane and rice leaves mulching did not show any significant difference with control and bananas leaves mulching (Figure 3). All treatment showed significant difference with control at seventh ( $F = 33.18$ ;  $df = 3, 8$ ;  $P < 0.00$ ), eighth ( $F = 18.82$ ;  $df = 3, 8$ ;  $P < 0.00$ ), ninth ( $F = 52.11$ ;  $df = 3, 8$ ;  $P < 0.00$ ) and tenth ( $F = 23.03$ ;  $df = 3, 8$ ;  $P < 0.00$ ) week of observation, but no significant differences were observed between treatment (Figure 3).

### Arid Zone

Results of one-way ANOVA showed that mulching with banana and sugarcane leaves has significant different with control ( $F = 7.19$ ;  $df = 3, 8$ ;  $P < 0.01$ ) at first week of observation. However, no significant difference was observed between treatments (Figure 4). We observed significant difference between control and treatment on the second ( $F = 18.19$ ;  $df = 3, 8$ ;  $P < 0.01$ ), third ( $F = 14.15$ ;  $df = 3, 8$ ;  $P < 0.01$ ), fourth ( $F = 12.23$ ;  $df = 3, 8$ ;  $P < 0.01$ ), fifth ( $F = 12.91$ ;  $df = 3, 8$ ;  $P < 0.01$ ), sixth ( $F = 18.94$ ;  $df = 3, 8$ ;  $P < 0.01$ ), seventh ( $F = 9.77$ ;  $df = 3, 8$ ;  $P < 0.01$ ), eighth ( $F = 22.65$ ;  $df = 3, 8$ ;  $P < 0.00$ ), ninth ( $F = 20.11$ ;  $df = 3, 8$ ;  $P < 0.00$ ) and tenth ( $F = 23.97$ ;  $df = 3, 8$ ;  $P < 0.00$ ) weeks of observation, whereas, there are no significant difference was observed between treatments (Figure 4).

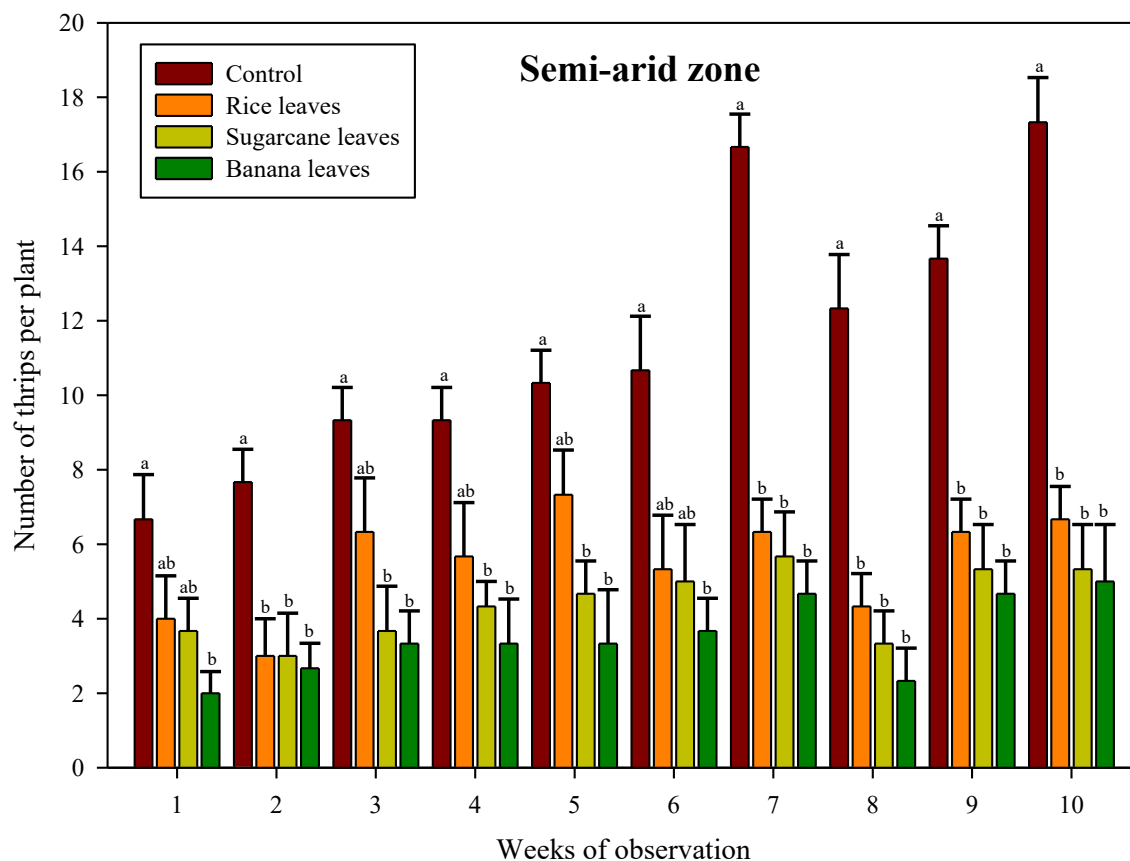


Figure 1. Banana, sugarcane, and rice leaves were mulched in a semi-arid zone. The data are the mean of ten repeated experiments. The means were compared using one-way ANOVA, followed by a Tukey HSD post-hoc test ( $P < 0.05$ ). Means with the same letter in the same week are not significantly different.

### Comparison Between Zone and Treatments

Different plant mulches showed effect against thrips population when compared both semi-arid and arid zone. Significant differences were observed at mulching with banana leaves ( $F = 46.76$ ;  $df = 1, 58$ ;  $P < 0.00$ ), sugarcane

leaves ( $F = 65.76$ ;  $df = 1, 58$ ;  $P < 0.00$ ), rice leaves ( $F = 46.96$ ;  $df = 1, 58$ ;  $P < 0.00$ ) and control ( $F = 36.08$ ;  $df = 1, 58$ ;  $P < 0.00$ ) when treatments of both zone compared between each other (Fig. 1). Overall the season, all treatments in semi-arid zone showed lowest thrip population (banana leaves  $3.50 \pm 0.32$ , sugarcane leaves  $4.40 \pm 0.33$ , rice leaves  $5.53 \pm 0.39$  and control  $11.40 \pm 0.69$ ) as compared to arid zone (banana leaves  $8.23 \pm 0.61$ , sugarcane leaves  $9.93 \pm$

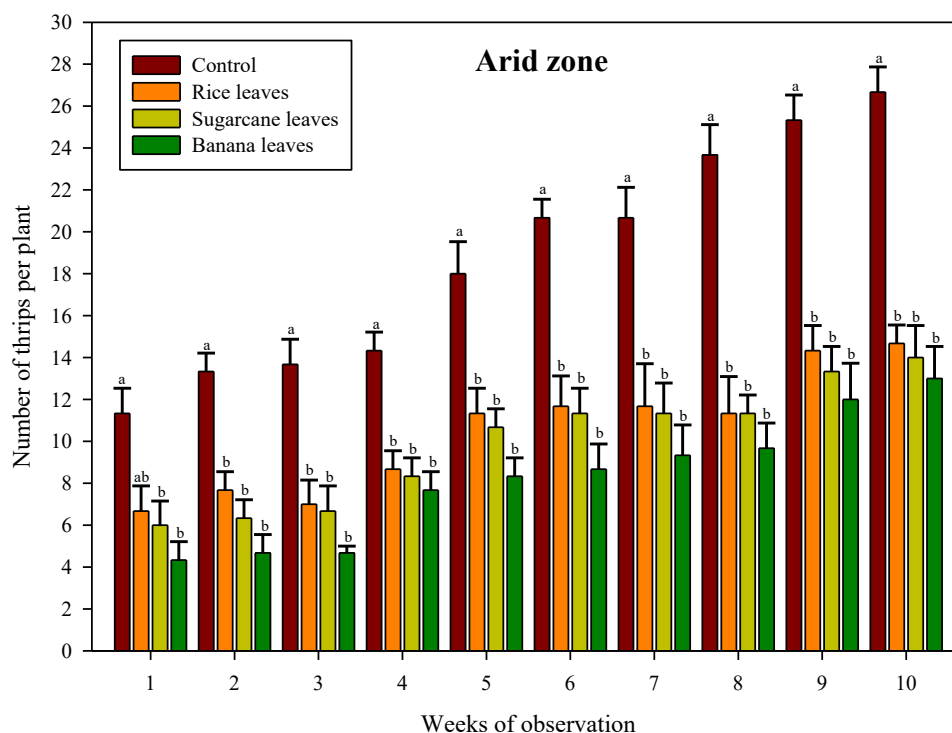


Figure 2. Banana, sugarcane, and rice leaves were mulched in an arid zone. The data are the mean of ten repeated experiments. The means were compared using one-way ANOVA, followed by a Tukey HSD post-hoc test ( $P < 0.05$ ). Means with the same letter in the same week are not significantly different.

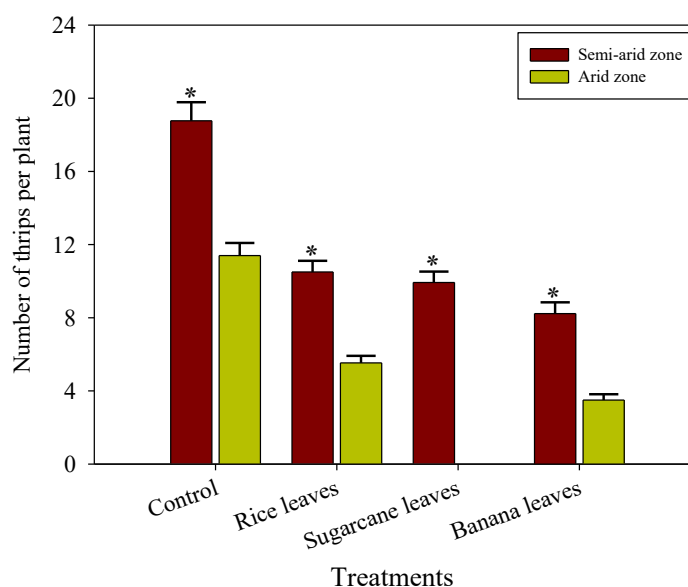


Figure 3. Comparison of banana, sugarcane, and rice leaf mulching at arid and semi-arid zone. Data are the mean of ten replications. The means were analyzed using one-way ANOVA, followed by a Tukey HSD post-hoc test ( $P < 0.05$ ); means topped by the same letter are not significantly different.

0.59, rice leaves  $10.50 \pm 0.61$  and control  $18.77 \pm 1.01$ ). Significant difference was observed between treatments at semi-arid zone ( $F = 59.96$ ;  $df = 3, 116$ ;  $P < 0.00$ ) and arid zone ( $F = 41.60$ ;  $df = 3, 116$ ;  $P < 0.00$ ) when treatments in

both zones were compared with each other (Figure. 2).

Our results showed that mulching with crop residuals is better than no-mulch in both semi-arid and arid areas in many weeks. Mulching with crop residuals maintain soil temperature, develop moisture in soil surface, which significantly decreased the thrip population as compared with control in both semi-arid and arid areas. Comparable results for mulching effect on soil temperature and crop ecosystem were found by Ni et al. (2016) Different organic mulches have effects on soil physical properties and plant growth, the mulching with round gravel and wood chips help in improve the soil environment and plant and nurseries growth of 'Rixianggui'. Several different types of organic mulches such as sunn hemp mulch, cowpea mulch, pine bark nuggets and sorghum-sudan grass mulch can reduce plant-feeders such as thrips, aphids and whiteflies around snapdragon plants as compared to control plot (Gill and McSorley, 2011). Thrips population can be disturbed on tomatoes and peppers by using UV-reflective mulches; the UV-reflective mulches disturb the ability of host recognize and landing on their hosts, resulting the low population were observed (Staviskyet al., 2002; Reitz et al., 2003). Organic mulching such as wheat straw can reduce the aphid infestation and effect their population in the Organic mulching with straw reduce thrips population in onion field and gives significant results when compared with no mulching (Larentzakiet al. 2008, Schwartz et al. 2009). Organic mulch not only decreases thrips population by increasing soil moisture and plant ecosystem. But it also helps to develop and promote populations of bio-control agents (Lu, 1990).

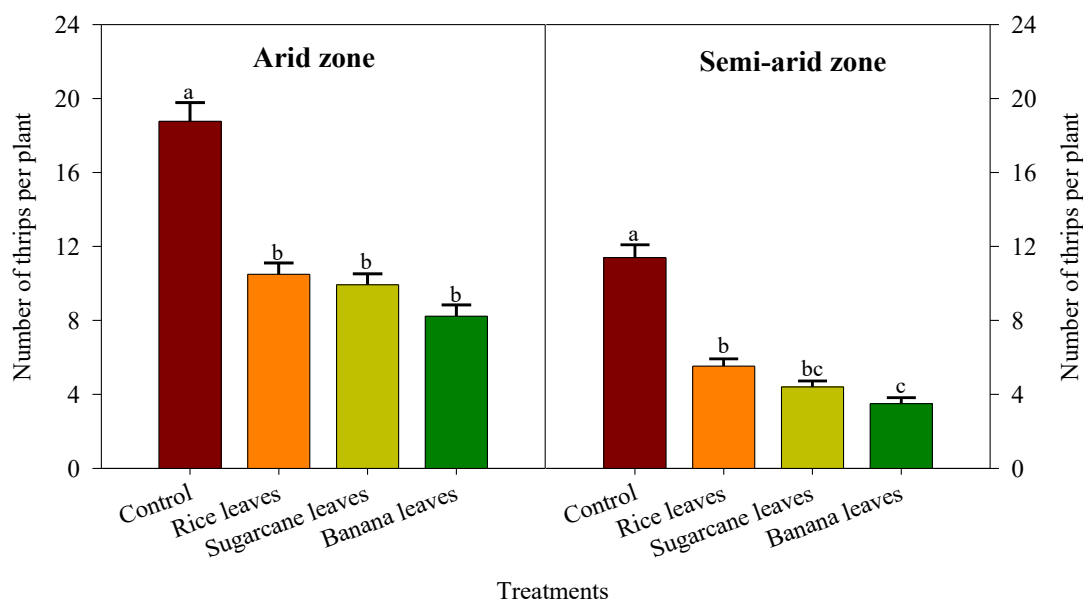


Figure 4. Comparison of mulching treatments using banana, sugarcane, and rice leaf at arid and semi-arid zone. Data are the mean of ten replications. The means were analyzed using one-way ANOVA, followed by a Tukey HSD post-hoc test ( $P < 0.05$ ); means topped by the same letter are not significantly different.

Our results showed that using banana leaves as mulch had the lowest thrips population in both areas. This was significantly different from the control and other treatments in both areas throughout the whole growing season. It can be hypothesis the banana leaves are wider then sugarcane and rice, banana leaves can hold water themselves and slow the evaporation process which can maintain moisture in the soil. Mulching with banana and papaya leaves in standing crop i.e. tomato (*Lycopersicon esculentum*) are one of the more practical, least expensive, safest and enhance the soil condition (Nisnisan, 2014). Mulches have many benefits including weed suppression, conserving soil moisture, increasing soil temperature, and reducing soil erosion. Some synthetic mulches also may repel insects (Gill et al., 2015).

## CONCLUSION

It has been concluding that using banana leaves as mulches more effective at reducing thrips population in the onion field. However, mulching with sugarcane and rice leaves also gives positive results in account of thrips control.

## AUTHOR'S CONTRIBUTION

Tufail Ahmed Wagan, Javeed Shabbir Dar, Zulfiqar Ali Abbasi, Shahjahan Rajput, Hakan Bozdoğan

Conduct experiment and record data by Tufail Ahmed Wagan and Zulfiqar Ali Abbasi Methodology and Writing draft: Tufail Ahmed Wagan and Javeed Shabbir Dar. Analysis: Shahjahan Rajput Reviewing: Hakan Bozdoğan and Zulfiqar Ali Abbasi. Correspondence: Tufail Ahmed Wagan. All authors have proofread and approved the final version of the manuscript.

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## AVAILABILITY OF DATA AND MATERIAL

All data produced throughout this research is presented in this published article as figures.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

## CONSENT FOR PUBLICATION

This study does not include any personal data from individuals in any capacity. All authors have consented to its publication.

## CONFLICT OF INTERESTS

All authors attest to the validity of manuscript contents and agree for submission.

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