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Short Communication

An Alternative Rearing Method for the Onion Thrips, *Thrips tabaci* (Thysanoptera: Thripidae) using Garlic Cloves

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Abstract

An alternative rearing method for *Thrips tabaci* using garlic cloves (Ilocos white and X variety) is demonstrated. Firstly, thrips at the pupal stage were placed on sealed beakers containing garlic cloves. Biological parameters such as the total number on garlic cloves and paper towels, number per life stage and population increase of *T. tabaci* were recorded after 15 days. Secondly, the fecundity of virgin female adult thrips and the sex of its offspring when fed with Ilocos white garlic cloves were determined. Results of the first experiment showed that: 1) the total number of all life stages of *T. tabaci* was significantly higher in the Ilocos white cloves as compared to X cloves; 2) the number of prepupa and pupal stage of *T. tabaci* was significantly higher in the paper towel found in base location for both the Ilocos white and X variety; 3) the number of *T. tabaci* was significantly higher in the larval stage (L2) as compared to other life stages and 4) the population increase was significantly higher in the Ilocos white cloves as compared to X cloves 15 days after artificial infestation. Results of the second experiment showed that: 1) virgin females produced only female offspring; 2) daily fecundity of virgin, female adult *T. tabaci* on garlic cloves was 2.38 ± 1.50 and 3) total fecundity of virgin, female *T. tabaci* on garlic cloves was 35.64 ± 23.38. This information suggests that garlic cloves can be used as an alternative rearing medium for *T. tabaci* in the laboratory.

Keywords: Insect; Parthenogenesis; Population increase; Rearing techniques; Thelytoky

Introduction

The onion thrips *Thrips tabaci* Lindeman is an insect pest that belongs to the insect order Thysanoptera. It has specialized mouthparts that are used to punch through leaf tissues and siphon off plant contents leading to loss of chlorophyll and reduced photosynthetic efficiency (Boateng *et al*. 2014). In cultivated onions, smaller bulb sizes (30 – 50% reduction in bulb yield) could occur during thrips outbreaks (Nault and Shelton 2008). *Thrips tabaci* is also known as an insect vector of plant pathogens (Diaz-Montano *et al*. 2011), such as tomato spotted wilt virus or TSWV (Pittman 1927), Iris yellow spot virus or IYSV (Kritzman *et al*. 2001), *Alternaria porri* as well as *Pantoea ananatis* in onion (Thind and Jhooty 1982; Dutta *et al*. 2014). Thrips are minute and delicate insects that are difficult to handle and mass produce in the laboratory. Their body size, which on average is around 1 mm in length, presents difficulties in handling and observing thrips individuals during experiments. In studies that include evaluation procedures of control technologies (examples are insecticides and natural enemies screening) as well as transmission assays of plant pathogens in the laboratory, the development of practical and effective methodologies that enable the production of thrips in large numbers and uniform age has always been a challenge to researchers (Lewis 1973; Loomans and Murai 1997; Chatzivassiliou *et al*. 1999). The use of the bean jar method (Tedeschi *et al*. 2001), potted plants with or without covering (Edelson and Magaro 1988), boxes or containers (Guzmán *et al*. 1996), petri plates (Gulzar *et al.* 2021) and membrane method (Murai 2000; Murai and Loomans 2001) are known for maintaining the large number of thrips individuals under laboratory condition. Detached plant parts of host plant species like onion (Moraiet *et al*. 2017), leek (Chatzivassiliou *et al*. 1999) and cabbage (Gulzar *et al.* 2021) are also used as rearing medium for *T. tabaci* mass production. Another report described the use of plant pollen and germinated broad beans (Murai and Loomans 2001). However, most of these methods are laborious and time-consuming because the plant material such as detached leaves or plant parts easily dries up and therefore needs to be replaced with fresh ones frequently (every 2 to 4 days, for example). Thus, alternative rearing methods which are less laborious and simple to follow should be identified and investigated for *T. tabaci*. In the Philippines, harvested bulbs of local garlic or *Allium sativum* L. are usually stored for months by some farmers, and thus are a potential

candidate as a rearing medium for *T. tabaci*. Although *T. tabaci* is known to feed and reproduce on young garlic leaves, very few studies have reported on the performance of *T. tabaci* on bulbs of garlic. Therefore, this paper aims to: 1) determine the biological parameters of *T. tabaci* when fed with garlic cloves and 2) demonstrate that garlic cloves can be used as an alternative rearing medium for *T. tabaci* in the laboratory.

Materials and Methods

Study Insect

Thrips tabaci was collected in a garlic farm site in Quinarayan, Narvacan, Ilocos Sur, Luzon Islands, Philippines. Infested garlic plants were placed inside resealable plastic bags and brought to the laboratory for processing. Thrips larvae feeding on garlic leaves were collected under the microscope using a fine, slightly moistened brush and transferred individually to healthy, clean garlic plants grown in pots. Cylindrical mylar cages were used to prevent the entry of other insects or arthropods on artificially-infested garlic plants. The adult stage of the field-collected thrips larvae as well as those from the culture were mounted in glass slides and used for taxonomic verification. *Thrips tabaci* was maintained for at least 15 generations on garlic plants in the laboratory (27ºC and under natural lighting) before using in experiments. The study was conducted in Room 106, National Crop Protection Center, University of the Philippines Los Baños from January until December 2019.

Biological parameters

Experiment 1: Untreated cloves of Ilocos white garlic variety (local variety bought in Sinait, Ilocos Sur) and X variety (imported variety bought in Los Baños, Laguna) were peeled and examined for the presence of other insects under the stereomicroscope. One replicate of each variety consisted of a glass beaker (Pyrex, 300 mL) containing 50 g of peeled, clean garlic cloves. Two pieces of paper towel (circular in shape) were also placed in between the cloves at the bottom, middle and upper locations inside the beaker. Fifteen pupae (near adult emergence) of *T. tabaci* from the progeny of the original female line were then placed inside each beaker. Two sheets of paper towel and organza cloth were used to tightly seal off the beaker with a rubber band. The experiment was conducted in a Completely Randomized Design (CRD) with seven replications in the laboratory (with 27ºC average temperature). The total number (on garlic cloves and paper towels), the average number per life stage, and the population increase of *T. tabaci* were recorded 15 days after infestation. Data were analysed using Analysis of Variance (ANOVA) with alpha = 0.05.

The time duration of 15 days was used because of two reasons: 1) approximately 1.5 generations of *T. tabaci* are completed within this period and 2) cloves without husks become dried after 15 days inside the beaker (Beltran, MJB, unpublished observation). During data gathering, circular paper towels from each beaker were removed first. The number and developmental stage of *T. tabaci* found on paper towels were counted. Ethanol (85%) was then poured inside the beaker to facilitate easy handling and counting of thrips individuals. All thrips individuals found in the beaker and paper towel were counted and recorded under the microscope.

Experiment 2: One larva (L2) from the stock culture was randomly selected, isolated in a glass test tube (8" x 1.2"), and provided with a young garlic leaf every other day until it reached the prepupal stage. The test tube was sealed off using a paper towel and organza cloth. After verifying the sex of the emerging adult, the female adult was provided with clean, uninfested garlic cloves (Ilocos white) to allow oviposition until it died. Sex determination of the adult stage of the progeny of this virgin, female adult was used as the basis to identify its mode of reproduction. In another setup, a total of 14 prepupae from the progeny of the original, virgin female adult was used to determine the average daily fecundity and total fecundity of *T. tabaci*. Prepupae were placed individually in a glass test tube and sealed with a paper towel and organza cloth using a rubber band. After verifying the sex of the emerging adult, one clove was provided daily to each female to allow oviposition for a period of 15 days. Each clove exposed to the female for 24 h was collected, sealed in another glass vial (2.2" x 1") and properly labeled. After five to six days, Ethanol (85%) was poured on each glass vial to facilitate easier handling and counting of thrips larvae emerging from the exposed clove. Fecundity was determined based on the larval stage (L1 to L2) because it is easier to count this stage than the eggs that are partially inserted in the cloves that have dried already.

Results

First, the total number of all life stages of *T. tabaci* was significantly higher in the Ilocos white cloves as compared to the X cloves (Table 1; Figs. 1 and 2). The life stages considered in this comparison consisted of the larval stages 1 (L1) and 2 (L2), prepupal stage (P1), pupal stage (P2) and female adult (A). *Thrips tabaci* individuals at the egg stage were not included and no male adult individuals were found. Second, the number of prepupa and pupal stage of *T. tabaci* was significantly higher in the paper towel found in the base location as compared to other locations for both the Ilocos white and X variety (Table 2 and 3). Third, the number of *T. tabaci* is significantly higher in larval stage 2 (L2) as compared to the other life stages (Table 4). This is followed by pupal (P2) stage. No difference was found in the two-way interaction between the garlic variety and the life stage of *T. tabaci*. Fourth, the population increase is significantly higher

Table 1: Number of specimens recorded in every life stage and total number of specimens in all life stages of *T. tabaci* fed with Ilocos white and X varieties in the laboratory

Variety	L1	L2	P1	P2	A	Total number
Ilocos white	65.714	166.714	59.571	149.571	66.857	508.429
X	68.571	135.571	41.286	62.714	18.571	326.714

Table 2: Number of *T. tabaci* (P1 and P2) on paper towels placed in different locations inside the glass beaker for the Ilocos white variety

Location	Total average number (P1, P2)
Base	76.071[a]
Middle	22.500[b]
Upper	6.000[b]

*Means within the same column followed by a different letter are significantly different from each other ($P < 0.05$, LSD)

Table 3: Number of *T. tabaci* (P1 and P2) on paper towels placed in different locations inside the glass beaker for the X variety

Location	Total average number (P1, P2)
Base	43.425[a]
Middle	8.500[b]
Upper	2.047[b]

*Means within the same column followed by a different letter are significantly different from each other ($P < 0.05$, LSD)

Table 4: Average number of *T. tabaci* per life stage using garlic cloves as rearing medium 15 days after the date of artificial infestation in the laboratory

Life stage	Average number (Ilocos white, X variety)
L1	67.143[c]
L2	151.143[a]
P1	50.429[c]
P2	106.143[b]
A	42.714[c]

*Means within the same column followed by a different letter are significantly different from each other ($P < 0.05$, LSD)

Table 5: Total number and increase in the number of *Thrips tabaci* from day 0 to day 15 on cloves of Ilocos white and X variety after 15 days

Variety	Replicates	Average number		Average population increase (day 15-day 0)
		Day 0	Day 15	
Ilocos white	7	15.000	508.429	493.429[a]
X	7	15.000	326.714	311.714[b]

*Means within the same column followed by a different letter are significantly different from each other ($P < 0.05$, LSD)

Table 6: Daily and total fecundity of virgin- *Thrips tabaci* on Ilocos white garlic cloves in 15 days

Variety	Replicates	Daily fecundity	Total fecundity
Ilocos white	14	2.38 ± 1.500	35.640 ± 23.380

in the Ilocos white cloves as compared to the X cloves 15 days after artificial infestation (Table 5). Fifth, the progeny of virgin, female adults of *T. tabaci* were all females. And six, the daily fecundity and total fecundity of virgin, female adults (N = 14) on garlic cloves (Ilocos white) were 2.38 ± 1.50 and 35.64 ± 23.38, respectively (Table 6).

Fig. 1: Proportion of different life stages of *T. tabaci* in Ilocos white cloves 15 days after artificial infestation (clockwise: life stage with largest to smallest proportion)

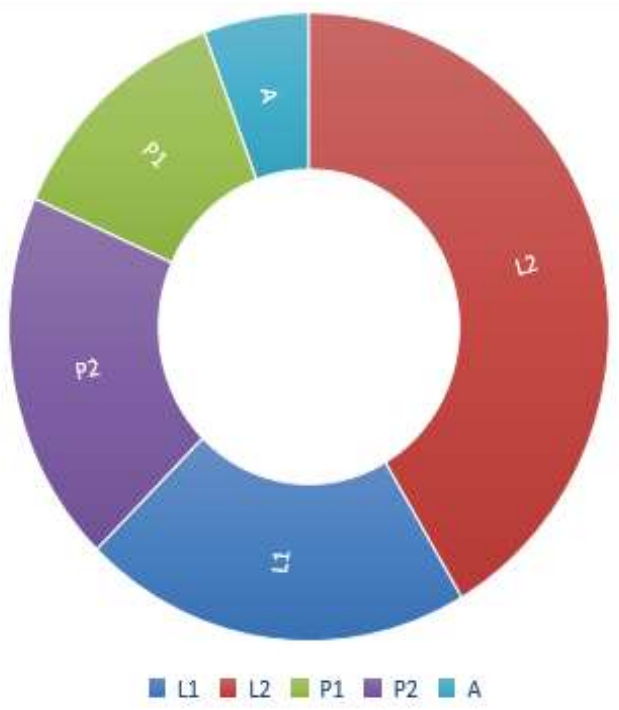

Fig. 2: Proportion of different life stages of *T. tabaci* in X variety cloves 15 days after artificial infestation (clockwise: life stage with largest to smallest proportion)

Discussion

Results suggest that Ilocos white is more suitable as a medium for the development and reproduction of *T. tabaci* as compared to the X variety. The local variety then appeared to be more promising as an alternative rearing host plant than the imported one. Moreover, the population increase in terms of numbers from 15 individuals to 508.429 individuals indicates that the increase was almost 33 times higher than the original number for a rearing medium of garlic cloves that weighs 50 grams. Another point is that the base location is the most preferred location for *T. tabaci* pupation. Thrips larvae that are about to enter the prepupal stage crawled into crevices, such as in the folds of the paper towel found in the bottom of the beaker. This behaviour, which is widely known in several thrips species, facilitated the easy collection of the prepupa and pupal individuals which concentrated in the paper towel. Another advantage of using garlic cloves as a rearing medium for *T. tabaci* is the production of a large number of the active feeding stage of the pest, which is the larval stage (L2). In the literature, daily and total fecundity of *T. tabaci* on leaves of garlic are 3.1 ± 0.11 and 58 ± 3.09, respectively (Basri *et al.* 2019). On the other hand, pupa (P2) can be collected in advance from the cultur if the target stage for use in experiments is the adult stage. However, not a single male individual was collected in the offspring. This suggests that this *T. tabaci* population is reproducing *via* thelytoky – an asexual mode of reproduction where unfertilized eggs develop into females. Thelytoky is known as the most common mode of reproduction in this species (Kendall and Capinera 1990).

Conclusion

This study has shown that garlic cloves could be used as an alternative rearing medium for the onion thrips *Thrips tabaci*. A local variety, Ilocos white cloves, was shown to have a greater potential as a rearing host than the imported, designated as X variety. Biological parameters such as the total number on garlic cloves and on paper towels, the number per life stage, as well as population increase in number of *T. tabaci* supported this conclusion. On the other hand, the fecundity of *T. tabaci* when fed with garlic cloves is somewhat close in value when compared to the fecundity of *T. tabaci* when fed with garlic leaves.

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Author Contributions

The author identified the research problem, designed and conducted the experiment. Preparation of manuscript for publication was done solely by the author.

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Conflict of Interest

The author declares that there is no conflict of interest.

Data Availability

The data is available with the author.

Ethics Approvals

Not applicable in this paper.

References

Basri R, MS Ansari, MA Moraiet, M Muslim (2019). Influence of host plants on biological parameters of *Thrips tabaci*. *Ann Plant Prot Sci* 27:31–36

Boateng CO, HF Schwartz, MJ Havey, K Otto (2014). Evaluation of onion germplasm for resistance to Iris Yellow Spot Virus (Iris yellow spot virus) and onion thrips, *Thrips tabaci*. *S W Entomol* 39:237–260

Chatzivassiliou EK, D Peters, NI Katis (1999). Transmission of tomato spotted wilt tospovirus by *Thrips tabaci* populations originating from leek. *Plant Pathol* 48:700–706

Diaz-Montano J, M Fuchs, BA Nault, J Fail, AM Shelton (2011). Onion thrips (Thysanoptera: Thripidae): A global pest of increasing concern in onion. *J Econ Entomol* 104:1–13

Dutta B, AK Barman, R Srinivasan, U Avci, DE Ullman, DB Langston, RD Gitaitis (2014). Transmission of *Pantoea ananatis* and *Pantoea agglomerans*, causal agents of center rot of onion (*Allium cepa* L.), by onion thrips (*Thrips tabaci* Lindeman) through feces. *Phytopathology* 104:812–819

Edelson JV, JJ Magaro (1988). Development of onion thrips, *Thrips tabaci* Lindeman, as a function of temperature. *S W Entomol* 13:171–176

Gulzar S, W Wakil, DI Shapiro-Ilan (2021). Combined effect of entomopathogens against *Thrips tabaci* Lindeman (Thysanoptera: Thripidae): Laboratory, greenhouse and field trials. *Insects* 12:456–472

Guzmán SP, P Salazar, PA Trochez, JDL Cruz (1996). Life cycle, habits and behaviour of *Thrips tabaci* Lindeman in onions (*Allium* cepa). *Rev Colomb Entomol* 22:93–98

Kendall DM, JL Capinera (1990). Geographic and temporal variation in the sex ratio of onion thrips. *S W Entomol* 15:80–88

Kritzman A, M Lampel, B Raccah, A Gera (2001). Distribution and transmission of Iris yellow spot virus. *Plant Dis* 85:838–842

Lewis T (1973). *Thrips: Their Biology, Ecology and Economic Importance*. Academic, London, United Kingdom

Loomans AJM, T Murai (1997). Culturing thrips and parasitoids. *In*: *Thrips as Crop Pests*, pp:477–503. Lewis T (Ed). CAB International, Wallingford and New York

Moraiet MA, MS Ansari, R Bastri (2017). Biological parameters of onion thrips, *Thrips tabaci* Lindemann on onion cultivars. *J Plant Prot Res* 57:120–128

Murai T (2000). Effect of temperature on development and reproduction of the onion thrips, *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), on pollen and honey solution. *Appl Entomol Zool* 35:499–504

Murai T, AJM Loomans (2001). Evaluation of an improved method for mass-rearing of thrips and a thrips parasitoid. *Entomol Exp Appl* 101:281–289

Nault BA, AM Shelton (2008). Insecticide efficacy and timing of sprays for onion thrips control. *In*: *Proceedings, 2008 Empire State Fruit and Vegetable Expo*, pp:52–56. 12–14 February 2008. New York, USA

Pittman HA (1927). Spotted wilt of tomatoes. *J Aust Counc Sci Indust Res* 1:74–77

Tedeschi RM, CG Mason, P Roggero, L Tavella (2001). Transmissibility of four tospoviruses by a thelytokous population of *Thrips tabaci* from Liguria, northwestern Italy. *Phytoparasitica* 29:37–45

Thind TS, JS Jhooty (1982). Association of thrips with purple blotch infection on onions plants caused by *Alternaria porri*. *Ind Phytopathol* 35:696–698