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Population Trend of Onion Thrips and Its Botanical Approach to Sustainable Management

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ABSTRACT

This research is about onion (*Allium cepa* L.) which is an important commonly grown vegetable in kitchen gardens and for commercial purposes throughout the globe its crucial. Plant phytochemicals are playing an important role in pest management, and when combined with synthetic pesticides, they increase toxicity due to a synergistic effect. The current study compares effectiveness of *Lantana camera* leaf extract and its combination with diamethoate 30EC against onion thrips were compared. It has resulted that thrips colonization began on the 9th SMW and peaked on the 15th SMW. Thrips colonization was maximum at high temperature and low rainfall but relative humidity depleting the thrip population. All treatments were found to be significantly more effective than the control against thrips. *Lantana camera* leaves extracts at 50 g L-1 as the sole and in combination with dimethoate 30EC between 150 and 250 mL ha^{-1} were found to be a promising combination.

Keywords: *Thrips tabci*, *Lantana camera*, Sustainability, Management, Population dynamics.

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INTRODUCTION

Onion is a valuable cash crop grown primarily by smallholder farmers under irrigation, with the total area covered increasing over time [1, 2]. A poor cropping system, a scarcity of resistant varieties, disease and insect pests, and other constraints have all contributed to lower bulb production [3]. *Thrips tabaci* was one of the most common pest [4], causing 10-60% economic loss in onions depending on various factors [5] and up to 100% in some crops [6, 7]. T. tabaci is a cosmopolitan and polyphagous pest with nymphs and adults found between leaf sheaths that attack over 391 plant species belongs to different 64 families [8]. They both extensively scrape the leaves, sucking the cell sap and leaving silver patches and streaks that eventually dry the leaves [9, 10]. To compensate for this loss, farmers depend entirely on synthetic pesticide formulations, but their indiscriminate use has an impact on crop costs, and human and environmental health [11, 12]. Furthermore, sucking pests such as thrips rapidly developed insecticide resistance and became ineffective [13]. As a result, botanical derivatives offer an alternative option to overcome the resistance problem.

Plants and plant products have been used in agriculture in China, Egypt, Greece, and India since ancient times [14]. Furthermore, plant extracts are becoming more popular as organic products and could be used as an alternative pest management strategy [15]. Many plant extracts have been investigated for their toxic, antifeedant, ovicidal, and repellent properties [16-20]. *Lantana camera* is a tropical ornamental weed that grows as an erect shrub. Due to the presence of secondary metabolites [21, 22], it has the potential to manage stored grain pests [23], lepidopteran pests [24], and sucking pests [25, 26]. There is very little information available on L. camera extract against onion thrips, so the current study focused on learning about thrips population buildup on onions and evaluating L. camera leaf extract against onion thrips.

MATERIALS AND METHODS

A separate field experiment was conducted to better understand the onion thrips trend and its management during the rabi season. A three-leaf stage of Punjab Naroya onion seedling was transplanted in 15 x 15 cm spacing in 216 m^2 areas. A transplanted area was kept completely chemical free to allow natural population build-up. To evaluate L. camera leaf extract, onion seedlings were transplanted in a 3x3 m^2 area. This experiment used a Randomized Block Design (RBD), with seven treatments, including a control, replicated three times. The treatments were *Lantana camera* leaf extract @ 50 g L^{-1} (lower dose), 100 g L^{-1} (standard dose), and 150 g L^{-1} (higher dose). Recommended pesticides like Dimethoate 30% EC @ 250 mL ha^{-1} were used in combination with each dose of leaf extract to compare with the absolute check. A recommended package of practices was adapted for uniform growth of the onion crop. Both nymph and adult of the thrips population were counted after every three-day interval from randomly selected 10 plants with the help of a hand lens.

Thrips count data was normalized using square root transformation, and the same data was used in various statistical analyses based on the objectives. An analysis of variance (ANOVA) based on Turkey's test was used to compare treatments. A correlation model developed between thrips populations and environmental factors. All the statistical analysis was performed in SPSS (version 22).

RESULTS AND DISCUSSION

Population dynamics and its relation with environmental factors

The population of Thrips tabaci appeared in the 9th standard meteorological week (SMW) and remained until crop maturity (16th SMW). The average population per five plants ranged from 0.28 to 57.87 thrips. The thrips population grew exponentially, reaching a peak at the 15th SMW (57.87 thrips/five plants) and then gradually declining with crop maturity **(Figure 1)**. Temperature and rainfall were clearly shown to positively influence the population of T. tabaci ($r=0.403$ and $r=0.485$) respectively, whereas humidity ($p=0.001$) significantly inhabited the population **(Figure 1)**.

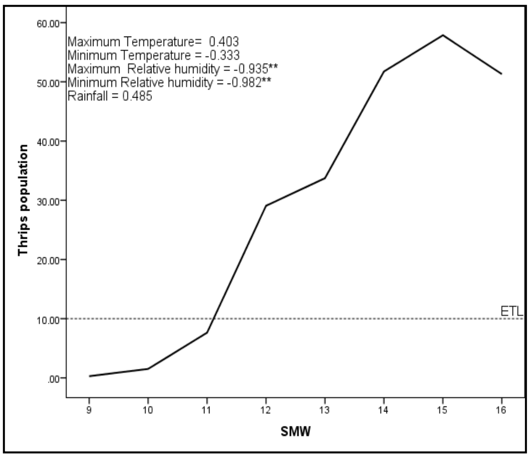

Figure 1. Population dynamics of *Thrips tabaci* and its relation with abiotic factors. (Dotted line on Y axis indicate economic threshold level)

Bio-efficacy of lantana camera and its combination with Diamethoate

The economic threshold level was set as 10 thrips per plant and pesticides were applied when the thrips population was well colonized on crops **(Figure 2)**. All the treatments were performed significantly better at three days after treatments (DAT) ($F_{7, 2}=11.73$, $P<0.05$), 5 DAT ($F_{7, 2}=19.06$, $P<0.05$), 7DAT ($F_{7, 2}=40.54$, $P<0.05$) and 15 DAT ($F_{7, 2}=54.03$, $P<0.05$) than control **(Table 1)**. *Lantana camera* leaf extract @ 50 g L^{-1} reduced 32.46% thrips population at 3DAT, 5DAT (52.10 percent), 7DAT (65.93 percent), and 15 DAT (72.55 percent) when compared to higher doses **(Figure 2)**. However, the L. camera leaf extract @ 50 g L^{-1} in combination with Dimethoate 30% EC @ 250 mL ha^{-1} was economically minimizing 40.51%, 37.35%, 56.32% and 66.21% of thrips population at 3DAT, 5DAT, 7DAT and 15DAT respectively **(Figure 2)**. However, among the all treatments, the sole application of Diamethoate 30% EC @ 250 mL ha^{-1} was found highly superior to the other treatments against onion thrips.

Table 1. Effect of *Lantenna camera* leaf extract and its combination with Dimethoate spray against thrips population

		Post-treatment thrip population (number)			
		DAT3	DAT5	DAT7	DAT15
T_1	49.9	33.7^{b}	23.9^{bc}	17.0^{b}	13.7^{b}
T_2	44.0	39.5^{b}	31.6^{b}	24.3^{b}	17.9^{b}
T_3	51.3	37.9^{b}	29.6^{bc}	22.5^{b}	16.5^{b}
T_4	50.6	30.1^{b}	31.7^{b}	22.1^{b}	17.1^{b}
T_5	40.7	29.3^{b}	31.7^{b}	21.3^{b}	14.5^{b}
T_6	44.7	29.6^{b}	24.5^{bc}	19.0^{b}	13.5^{b}
T_7	41.5	26.5^{b}	20.6^{c}	18.3^{b}	11.9^{b}
T_8	48.9	59.3^{a}	62.7^{a}	51.6^{a}	51.3^{a}
SEm (±)	3.216	3.377	2.863	1.761	1.765
P value	NS	10.243*	8.684*	5.340*	5.353*

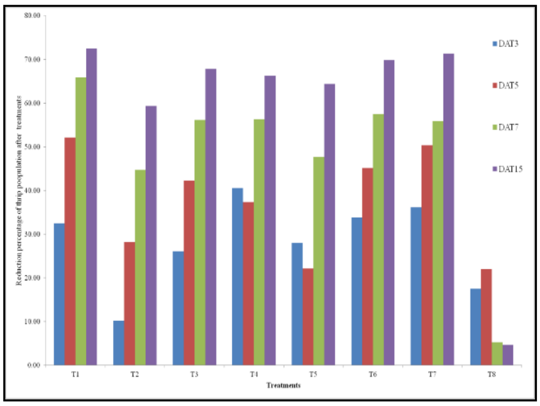

Figure 2. Reduction percentage of thrips population after treatment (T_1= *Lantana camera* leaf extract @ 50 g L^{-1}, T_2= *Lantana camera* leaf extract @ 100 g L^{-1}, T_3= *Lantana camera* leaf extract @ 150 g L^{-1}, T_4= *Lantana camera* leaf extract @ 50 g L^{-1}+ Dimethoate 30% EC @ 250 ml/ha, T_5= *Lantana camera* leaf extract @ 100 g L^{-1}+ Dimethoate 30% EC @ 250 mL ha^{-1}, T_6= *Lantana camera* leaf extract @ 150 g L^{-1}+ Dimethoate 30% EC @ 250 mL ha^{-1}, T_7= Dimethoate 30% EC @ 250 mL ha^{-1}, T_8= Control). DAT= days after treatments, [a]Different letter(s) showed significant differences between treatments (Turkey's p≤0.05).

Onion thrips, *Thrips tabaci* is a serious and regular pest of onion distributed throughout the world. The immature stage of thrips causes direct damage by lacerating the tissue and sucking the cell sap, whereas the adult stage causes indirect damage by transmitting the Iris yellow spot virus, which reduces both qualitative and quantitative loss [27]. This species are colonized in a wide variety of crops and weeds but predominantly preferred to onion [28, 29]. Our general result, a thrips population has appeared at the 9th SMW approximately fifty days of transplanting of onion seedlings and maximum colonization at the 15th SMW. This finding is consistent with Raut and coauthor [29], who reported that the thrips population appeared at the 9th SMW even though the seedlings were transplanted at different times, with two identical picks (12th and 15th SMW) observed in Jalandhar, Punjab. Crop season, host, geographical location, varieties, morphological and biochemical parameters, and climatic conditions all influence thrips population colonization. Furthermore, climatic factors play an important role in the development of thrips. Our findings indicated that thrips populations increased with maximum temperature and decreased with minimum temperature and relative humidity. The current findings are supported by Raut *et al.*, [29], who reported hot and humid climatic conditions favorable for linear growth. Parthenogenesis and sexual reproduction are the main factors for rapid development in a short time in this species [30]. Because of morphological differences in the crops, there was a significant difference in the development of the immature stage of thrips on cabbage, garlic, and onion cultivars [31]. *Lantana camara* is a well-known ornamental weed used to treat a variety of diseases and in various folk medicinal preparations [32, 33]. As major phytochemical functional groups, L. camara Linn contains essential oils, phenolic, flavonoids, carbohydrates, proteins, alkaloids, glycosides, iridoid glycosides, phenyl ethanoid, oligosaccharides, quinine, saponins, steroids, triterpenes, sesquiterpenoids, and tannin [34-37]. As a result, the presence of these phyto-chemicals demonstrates significant biological activities such as antipyretic, antimicrobial, antimutagenic, antibacterial, fungicidal, insecticidal, and nematicidal properties [38, 39]. These plants have insecticidal properties due to the presence of dodecanol, 1-eicosano, piperidine, and ethoxy [40], while lantanilic acids, camaric acid, and oleanolic secondary metabolites are responsible for nematicides

[41]. Furthermore, oleanonic acid, lantadene A, and oleanolic acid are toxic to aquatic arthropods but not to herbivorous arthropods [42]. Recently many researchers focused on identifying promising secondary metabolites in L. camera and studied its toxicity impact on various herbivores. Extract of L. camera had a significant impact on lepidoptera pest, sucking and stored grain pest [43-45]. Plant extracts are widely used in the pest management program in economic crops because of ecofriendly, did not develop resistance to a pest, have no phytotoxic effect, and are easily available in local areas. Therefore, we used L. camera in our study and it resulted in leaf extract 50 g L^{-1} having a significantly higher percentage in decline thrips population than other those with higher concentration. Several botanicals also have been evaluated against the T. tabaci in onion growing areas. The L. camera leaf extract has potential to decline the T. tabaci population when extracted in cow urine [46, 47]. Bio-pesticides are compatible with synthetic pesticides which increase the efficacy against the pest in a sustainable manner. In the field, the application of L. camera leaf extracts with diamethoate. Our results show that the combination of botanical and synthetic insecticides i.e., *L. camera* leaf extract @ 50 g L^{-1}, 100 g L^{-1} and 150 g L^{-1} with Dimethoate 30% EC @ 250 mL ha^{-1} against the population of thrips and results revealed that the effective control thrips population as compared to the control (untreated). Dimethoate is a widely used organophosphate insecticide and acaricide. It was patented and introduced in the 1950s by American Cyanamid. Dimethoate is an acetylcholinesterase inhibitor that disables cholinesterase, an enzyme essential for central nervous system function. It acts both by contact and through ingestion. It is readily absorbed and distributed throughout plant tissues, and is degraded relatively rapidly [48]. Our results in agreements that application of diamethoate 30% EC @ 250 mL ha^{-1} against thrips population found satisfactory results [49, 50].

CONCLUSION

From the present investigation, it can be concluded that *Lantana camera* leaf extract could be used in onion fields to manage *Thrips tabaci* sustainably. Thus, it offers more effective and diverse control options, as well as environmentally sound and cost-effective solutions.

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