Pure Appl. Biol., 9(4): 2476-2481, December, 2020
http://dx.doi.org/10.19045/bspab.2020.90263

Research Article

Performance of various trap crops in the management of *Thrips tabaci* L. in onion crop

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Citation
Shahid Ali Chandio, Arfan Ahmed Gilal, Lubna Bashir Rajput, Muhammad Umar Brohi, Jam Ghulam Mustafa Sahto, Muneer Ahmed Bhatti and Attaullah Sheikh. Performance of various trap crops in the management of *Thrips tabaci* L. in onion crop. Pure and Applied Biology. Vol. 9, Issue 4, pp2476-2481.
http://dx.doi.org/10.19045/bspab.2020.90263

Received: 08/04/2020 Revised: 01/07/2020 Accepted: 06/07/2020 Online First: 28/07/2020

Abstract

Thrips tabaci L. is a polyphagous and severe pest that cause considerable losses to onions throughout the world. Therefore, studies were conducted on the performance of various trap crops in the management of onion thrips, *Thrips tabaci* by attracting them in an onion field. Four trap crops i.e., marigold, carrot, fennel and coriander along with control were used in the study. The individual trap crops were cultivated at an equal distance with twelve plants per replication. *Thrips tabaci* population was recorded from both trap crops and onion plants on weekly basis since the appearance of *T. tabaci* till harvesting of onions. At the time of harvesting, yield data was also recorded. Significant influence of the cultivation of trap crops was recorded on population of *T. tabaci* as comparatively more overall mean attraction of thrips was observed on marigold (11.61±0.40 thrips per plant), followed by fennel (8.51±0.30 thrips per plant), whereas, the minimum population was observed on carrot (5.77±0.25 thrips per plant). On onions, the lowest population was recorded in marigold treatment (4.50±0.11 thrips per plant), followed by fennel (4.80±0.14 thrips per plant), whereas, the maximum population (10.56±0.28 thrips per plant) was recorded on control treatment onions. The highest and lowest yield of onions was recorded in marigold and control treatments, respectively. Thus, based on the findings, marigold and fennel should be planted within onions to divert the population of *T. tabaci* from onions, thus, lowered the damage to onions.

Keywords: Attraction; Management; Onions; Thrips; Trap crops

Introduction

Onion (*Allium cepa* L.) is considered as one of the most important vegetable in many countries of the world, especially in the subcontinent where it seems to be an essential ingredient of the everyday cooking **[1]**. It is cultivated on large scale owing to its large-scale demand in Pakistan and is considered as one of the most important revenue earning crop of the country **[2]**. Accordingly, Pakistan is one of the ten largest onions producers of the world. Mostly, onion bulbs along with its fleshy leaves are used for many medicinal purposes owing to their large contents of phenolic compounds. Composition of these compounds vary depending upon the varieties and climatic conditions, whereas, production mainly depend on cultivars and cultivation practices **[3]**. In Pakistan, the major onion growing districts are Sanghar,

Nawabshah, Hyderabad, Dadu, Badin, Naushero. Feroze, Mirpurkhas, Shikarpur and Ghotki in Sindh; Dir and Swat in Khyber Pakhtunkhwa; Chaghi, Kalat, Kharan, Mastung, Nasirabad, Killa Khuzdar, Saifullah, Jaffarabad and Turbat in Balochistan; Kasur and Vehari in Punjab. However, Sindh province alone contributes about 50% onion production in the country [4].

Onions are attacked by many insect pests that cause damage at its various developing stages. Among pests includes thrips, borer, maggots, cutworm and leaf minors [5]. Onion thrips, *Thrips tabaci* (Thysanoptera: Thripidae) is considered as one of the severe and damaging insect pests of onions throughout the world [6]. Both adults and nymphs attack onion plant since its transplanting and could results in massive decline in the production [7]. Beside onions, *T. tabaci* also attack on many greenhouse, vegetable and field crops around the world [6]. It directly damages the host plants by feeding on them and indirectly by transmitting lethal plant viruses [8]. The population of thrips is found in all onion growing regions, but the warmer areas are more preferred by these insects as compared to colder regions [9]. *Thrips tabaci* can adjust according to the environmental conditions as in case of unavailability of food or after the crop is harvested, they can quickly migrate to the other crops [10]. Due to the attack of thrips, the onion yield could reduce more than 50%, but the losses may be severe when they transmit Iris yellow spot virus [11].

Mostly, *T. tabaci* is controlled by using synthetic insecticides because they kill them immediately as they come in contact with the chemicals [12]. However, indiscriminate and uncaring use of these chemicals led to several serious problems for growers, their health and animals like toxic effects on non-target animal and insect species, resistance development in target pest due to the improper applications [13]. Due to such problems, researchers and growers have developed and adopted other control methods like trap cropping to manage the populations of noxious pests including *T. tabaci* [14]. Trap cropping is the safest to the environment and reliable method for monitoring and managing noxious pests of crops [15]. These are the plants cultivated along with main crop either to divert the attraction of pest from main crop to trap crop or to repel the pest. Some of the crops that are used on wide scale as trap crops against insects' pests include marigold, fennel, coriander, carrot, tobacco, millet, okra, etc. [16]. The attraction of pest towards trap crop is based on the plantation time along with spacing of trap crop and the main crop [17]. Mainly the trap crops cultivated in onions disturb the ovipositional sites and shelter locations of *T. tabaci* as they could not find appropriate place accordingly. As a result, plants grow healthy and become tolerant to pest outbreaks and diseases transmission [18]. Beside pest control, trap cropping also improve the soil fertility and preserve natural predatory fauna that could help in reducing the pests and weeds [19]. Thus, trap cropping is advanced method of insect pest management that is implemented throughout the world [20]. Therefore, considering the potential of traps crops, this study was conducted to evaluate the impact of different trap crops against *T. taabci* in onion under field conditions.

Materials and methods

Study site and cultivation of onions

The field of Entomology Section, Agriculture Research Institute, Tandojam was used for this study that was carried out during 2017-18. The nursery of Phulkara onion variety was collected from Onion Research Station, Directorate of Sindh Horticulture Research Institute, Mirpurkhas. The recommended dose i.e., 2 kg / acre of the onion nursery was used for the transplanting that was cultivated by keeping row to row and plant to plant distance at 30 cm and 20 cm, respectively. All the standard agronomic practices as recommended were followed during the experiment.

Cultivation of trap crops

Marigold (*Calendula officinalis*), carrot (*Daucus carota* subsp. *sativus*), fennel (*Foeniculum vulgare*) and coriander (*Coriandrum sativum*) were used as trap crops along with control (onions without trap crop). The individual trap crops were cultivated at an equal distance managing

four plants of the respective trap crops in a row, and twelve crops per replication.

Experimental design, data collection and analysis

The experiment was arranged in a Randomized Complete Block Design (RCBD) whereas, three replications were maintained for each treatment. The size of each replication plot was 9x10 feet and distance between two replications was maintained at 12 cm. The observations on the population of *T. tabaci* was recorded from both onions and trap crop to determine the relative attractiveness of trap crops for *T. tabaci* and their subsequent impact on population reduction on onions. Thus, observations of *T. tabaci* population was recorded from randomly selected ten onions plants and four plants of the respective trap crop from a replicated plot. The observations were taken on weekly basis since the appearance of *T. tabaci* till harvesting of onions. At the time of harvesting, yield data was obtained by harvesting the entire plots. The collected data was analysed using Analysis of Variance (ANOVA) and the Least Square Difference (LSD) was used at 5% probability level to separate means with significant difference. All the analysis was made using STATISTIX 8.1 computer software.

Results

Results given in (Table 1) shows the population of *T. tabaci* attracted to different trap crops i.e., marigold, fennel, coriander and carrot. *Thrips tabaci* was recorded since the transplanting of onions and the same showed a gradual rise till its maximum vegetative growth and then, declined towards the maturity of crop. According to results, the maximum attractiveness of *T. tabaci* recorded on marigold, fennel, coriander and carrot was 18.50±0.93 thrips per plant, 13.83±1.00 thrips per plant, 12.42±0.72 thrips per plant and 10.25±0.45 thrips per plant, respectively. Moreover, overall results showed a significant impact ($F = 1.93$, $P < 0.0017$) of trap crops to attract population of *T. tabaci* as overall, the highest population of *T. tabaci* was recorded on marigold (11.62±1.25 thrips per plant), followed by fennel (8.51±0.92 thrips per plant). The minimum population was observed on carrot (5.77±0.76 thrips per plant), followed coriander (7.31±0.86 thrips per plant) (Table 1).

The results on relative population of *T. tabaci* on onions grown with different trap crops showed a highly significant ($F = 2.03$, $P < 0.0001$) difference in population of *T. tabaci* due to the influence of traps crops i.e., marigold, fennel, coriander, carrot and control (Table 2). It has been observed that although initial population recorded on various trap crop treatments showed not much difference, but afterwards, a prominent influence of trap crops was observed on the population fluctuation of *T. tabaci* in various treatments. Accordingly, the maximum population of *T. tabaci* on onions grown with different trap crops i.e., marigold, fennel, coriander, carrot and control was 6.83±0.37 thrips per plant, 7.33±0.43 thrips per plant, 8.00±0.56 thrips per plant, 8.63±0.61 thrips per plant and 14.30±1.16 thrips per plant, respectively. In continuation of the above results, overall, minimum thrips population (4.50±0.35 thrips per plant) was recorded onions grown with marigold, whereas, the control plots suffered the highest (10.56±0.78 thrips per plant) population.

Impact of various trap crop on the yield of onions

In continuation of the efficacy of different trap crops in the management of onion thrips, a significant difference ($F = 7.79$, $P < 0.05$) was also recorded in the yield of onions in individual treatments (Table 3). The results indicated that significantly the highest yield of onions (80.33±2.40 maunds / acre) was recorded in marigold treatment, followed by fennel (77.33±2.33 maunds / acre), coriander (73.00±1.73 maunds / acre) and carrot (69±2.08 maunds / acre) treatments. Moreover, the lowest yield of onions was recorded in control (64.67±2.60 maunds / acre).

Table 1. Weekly mean population of *Thrips tabaci* on various trap crops grown in onion

Dates	Marigold	Fennel	Coriander	Carrot
06/11/2017	4.67±0.67	3.75±0.49	3.08±0.29	2.00±0.28
13/11/2017	6.17±0.61	4.75±0.45	4.00±0.44	2.42±0.34
20/11/2017	8.50±0.51	5.83±0.41	4.75±0.30	3.75±0.28
27/11/2017	8.75±0.37	6.83±0.51	5.50±0.65	4.25±0.35
04/12/2017	8.92±0.45	6.42±0.53	5.83±0.53	4.33±0.41
11/12/2017	13.42±0.82	9.75±0.58	8.58±0.38	7.42±0.70
18/12/2017	16.50±0.61	13.83±1.00	11.25±0.43	8.75±0.35
25/12/2017	18.50±0.93	11.92±0.43	10.75±0.71	10.25±0.45
01/01/2018	16.17±1.19	12.25±0.77	12.42±0.72	8.17±0.8
08/01/2018	14.00±1.01	10.33±0.56	8.00±0.48	7.17±0.53
15/01/2018	12.67±0.87	9.08±0.66	7.50±0.40	6.58±0.38
22/01/2018	11.17±0.4	7.42±0.45	6.08±0.54	4.17±0.39
Overall Mean	**11.62±1.25a**	**8.51±0.92b**	**7.31±0.86c**	**5.77±0.76d**

*Means followed by same letters in final row are not significantly different (LSD, P <0.05)

Table 2. Weekly mean weekly population of *Thrips tabaci* on onions grown with various trap crops

Dates	Marigold	Fennel	Coriander	Carrot	Control
06/11/2017	2.53±0.21	3.00±0.27	3.37±00.27	3.63±00.34	6.70±00.54
13/11/2017	3.37±0.29	3.70±0.27	3.83±0.37	4.07±0.37	7.00±0.57
20/11/2017	3.77±0.36	4.00±0.37	4.17±0.40	4.57±0.38	8.60±0.79
27/11/2017	3.90±0.26	4.13±0.40	4.47±0.39	4.83±0.44	9.63±0.92
04/12/2017	4.10±0.35	4.27±0.42	4.50±0.41	5.07±0.41	11.30±0.86
11/12/2017	4.60±0.34	4.80±0.49	4.80±0.33	5.90±0.32	12.87±1.09
18/12/2017	5.10±0.36	5.67±0.52	5.77±0.39	7.27±0.44	13.43±0.93
25/12/2017	6.13±0.48	6.37±0.71	6.90±0.58	8.63±0.61	14.30±1.16
01/01/2018	6.83±0.37	7.33±0.43	6.70±0.43	8.07±1.03	13.37±1.00
08/01/2018	5.33±0.30	5.63±0.35	8.00±0.56	6.83±0.28	12.30±0.91
15/01/2018	4.70±0.31	4.80±0.33	5.00±0.41	5.47±0.29	9.60±0.85
22/01/2018	3.63±0.29	3.87±0.38	4.13±0.27	4.67±0.35	7.63±0.63
Overall Mean	**4.50±0.25d**	**4.80±0.36cd**	**5.14±0.41C**	**5.75±0.46b**	**10.56±0.78a**

*Means followed by same letters in final row are not significantly different (LSD, P < 0.05)

Table 3. Effect of different trap crops on the yield of onion

Treatments	yield (Maunds /acre)
Fennel	77.33±2.33ab
Marigold	80.33±2.40a
Coriander	73.00±1.73b
Carrot	69.00±2.08c
Control	64.67±2.60c

*Means followed by same letters are not significantly different (LSD, P < 0.05)

Discussion

Study results indicated that the population of *T. tabaci* was observed onions since the transplanting of onions and the same fluctuated throughout the study duration. Moreover, significant influence of the cultivation of trap crops was recorded on the population of *T. tabaci* as comparatively more attraction of thrips was observed on marigold, followed by fennel, whereas, the minimum population was observed on carrot. As a result of the attraction of *T. tabaci* on trap crops, its population on onions showed significant decline in the

respective treatments. Thus, the lowest population of thrips on onions was recorded in marigold treatments, whereas, the control treatment onions suffered the maximum population of *T. tabaci*. Many previous studies also confirmed the significant role of different trap plants in the management of *T. tabaci* because trap cropping is considered as one of the safest and reliable method for monitoring and management of noxious pests in many agricultural and horticultural crops **[15]**. These are the crops grown alongside the main crop to divert the population of dangerous insect pests from main crops towards them or repel them away, hence, reduce the yield losses **[16]**. The marigold, fennel, coriander, carrot, tobacco, millet and okra are some of the widely used trap crops against insect pests **[17]**, however, the level of attractiveness of pests can be influence by many factors and includes plantation time, spacing of trap crop with the main crop and environmental factors [18]. It has been observed that the cultivation of these plant alters the behaviour of insects by reducing appropriate egg laying site and shelter leading to healthy plant growth and lower risks of pest outbreak and diseases transmission **[19-21]**. Besides the role of trap crops in managing the pest populations, they also improve the soil fertility and preserve natural predatory fauna that could help in reducing the pests and weeds **[19]**. Thus, trap cropping is an advanced method of insect pest management that is implemented throughout the world. Another study also highlighted the role of cucurbits, crucifers, carrot, chrysanthemum and carnation as effective trap crops for the management of *T. tabaci* in onions when they are planted at small patches or strips in onion field **[6]**. The said study also observed the same harvesting yield from both plots (insecticide treated and intercropped plots) and the same supported the findings of this study as comparatively higher yields of onion was recorded from trap crops treatments than control plots.

Conclusion

All the trap crops showed potential to attract *T. tabaci*, with maximum attraction recorded on marigold, followed by fennel carrot and coriander. Accordingly, the highest and lowest yield of onion was recorded in marigold and control, respectively. Considering the above facts, it is clear that trap crops have significant impact to divert populations of *T. tabaci* towards them, especially marigold and fennel. Thus, cultivation trap crop especially marigold and carrot could be a helpful tool in reducing the population of thrips on onions by diverting their populations, hence, lower the yield losses of onions.

Authors' contributions

Conceived and designed the experiments: AA Ahmed & L Bashir, Performed the experiments: SA Chandio, Analyzed the data: JGM Sahito, Contributed reagents/ materials/ analysis tools: MU Brohi & MA Bhatti & A Sheikh, Wrote the paper: MU Brohi & AA Gilal.

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