Annals of Sri Lanka Department of Agriculture 2017. 19: 27 - 35

INFLUENCE OF COMPANION CROPS ON SUCKING PEST COMPLEX OF TOMATO

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ABSTRACT

Tomato is highly vulnerable crop for insect pest and diseases. Among the pest species of tomato identified in Sri Lanka, whiteflies, aphids and thrips are considered as important pests. These pests transmit virus diseases in addition to their direct damage. Therefore, commercially grown tomato crops are treated with large quantities of insecticides against these pests. Controlling these pests in organic farms or in home gardens has become a major problem. Therefore, development of non-chemical techniques to manage these pests has become very important. Growing companion crops along with tomato as the main crop has been practiced in other countries to manage the insect pest and diseases. Hence, this study was conducted from 2015 to 2016 at the Horticultural Crops Research and Development Institute, Gannoruwa, Sri Lanka with the objective of evaluating the efficacy of companion crops (okra, leeks, carrot, marigold and mint) on suppression of insect pest populations in tomato. The study revealed that okra, leeks and mint as companion crops reduced whitefly infestation in tomato. Even though carrot did not reduce whitefly population, it protected the tomato crop from virus disease infection. Mint showed a moderate effect in reducing virus infection in tomato while leeks and marigold did not show a significant effect. In addition, leeks, mint, carrot and okra contributed to yield increase in tomato compared to pure tomato stand. Based on overall results, cultivation of tomato along with okra, leeks, mint and carrot can be recommended to suppress the insect pest infestation and viral disease incidence in tomato.

Key words: Mixed cropping, Non-chemical pest control, Tomato, Virus vectors.

INTRODUCTION

Tomato is one of the most important vegetable crops grown in Sri Lanka. Tomato was cultivated in 6,568 ha in 2014 producing 79,553 t (Anon, 2016). Tomato crops are highly vulnerable to virus diseases transmitted by virus vectors viz. whitefly, aphids, thrips and leafhoppers. Chemical control is the only technique used by the farmers to control these pests in commercial cultivations. Therefore, commercial tomato crops receive high amount of insecticides. As tomato is consumed mostly raw, there is a possibility for the consumers exposed

to insecticide residues with the produce. Hence, it is very important to develop non-chemical pest control techniques for the control of sucking pest in tomato, especially for the organic and ecological farming.

Mixed- or inter-cropping of crops or cultivation of other plant species (non-crops) along with main crops is a common cultural practice in many countries. Among the potential advantages of this technique, effects on the population dynamics of pests that results in minimised crop damage can be highlighted (Perrin and Phillips, 1978). Many plant species have natural compounds such as allelo-chemicals which contribute in repelling or attracting pest or beneficial insects. Some plants are known to enhance growth rate of crops grown in companion with it and increase yield or quality of the crops by improving flavour of the fruits (Tringovska, 2015).

Pest controls, other than use of insecticides, rely on pest avoidance, exclusion and trapping. Mixed cropping of tomatoes reduces pest infestations (Perrin and Phillips, 1978) and trap plants can be used to attract pest insects away from tomato crop. Present study attempted to develop a non-chemical control technique, mainly for sucking pests using plants that contribute to reduce the infestations and protect the main crop tomato contributing to increase yield.

MATERIALS AND METHODS

Experiments were conducted from 2014 to 2016 at the research field of the Horticulture Research and Development Institute (HORDI), Gannoruwa. Tomato variety 'Thilina' was grown in 4 x 3.6 m plots. Each test companion crop was grown in two rows surrounding the tomato crop, at a distance of 50cm from the boarder rows of tomato in each plot. Five different companion crops (okra, carrot, marigold, leeks and mint) were tested for their effectiveness in reducing sucking pest infestation, virus disease infection and increasing yield of tomato. Experiments were conducted in randomized complete block design (RCBD) with 3 replicates. Crop was maintained free of pesticides and allowed for natural insect pest and disease infestation.

Visual counts on the numbers of aphids, whiteflies and leafhoppers on 10 randomly selected leaves per plot, (two tender leaves each from five randomly selected tomato plants of the middle rows in each plot) were collected at weekly intervals. The plants were approached with minimal disturbance and the underside and upper side of the leaves were visually observed for these pest counts. Samples of 10 randomly selected tender leaves per plot were collected in polythene bags and were observed under a binocular dissecting microscope in the laboratory for thrip counts. Number of virus infected plants and total number of plants per plot were counted. Yield was recorded at each harvest. Data on overall average numbers of insect populations throughout the season were transformed to log values and were analysed by co-variance analysis using SAS version 9.1.3, considering initial pest counts as the co-variate. Data on the percentage of damaged plants due to virus diseases and the total yield were analysed using analysis of variance procedure.

RESULTS AND DISCUSSION

Sucking pest infestation in tomato

Among the four sucking pest species, whiteflies and thrips were observed during the study period. Both pest populations were higher during the 2014/15 *Maha* season than in the 2015 *Yala*. Aphid and leafhopper populations during both seasons were very low (< 0.02 aphids per leaf and < 0.001 leafhoppers/leaf). When comparing the overall mean of the whitefly population in tomato plants throughout the season, considering the initial infestations as the co-variate, there was a significant reduction of whitefly infestation in all the treatments compared with the tomato pure-stand. Results indicated that mint and leeks when grown surrounding the tomato crop, significantly reduced the whitefly population in tomato (C.V. = 3.25, P = 0.01) (Figure 1 and Figure 2).

2014/15 *Maha* - whitefly

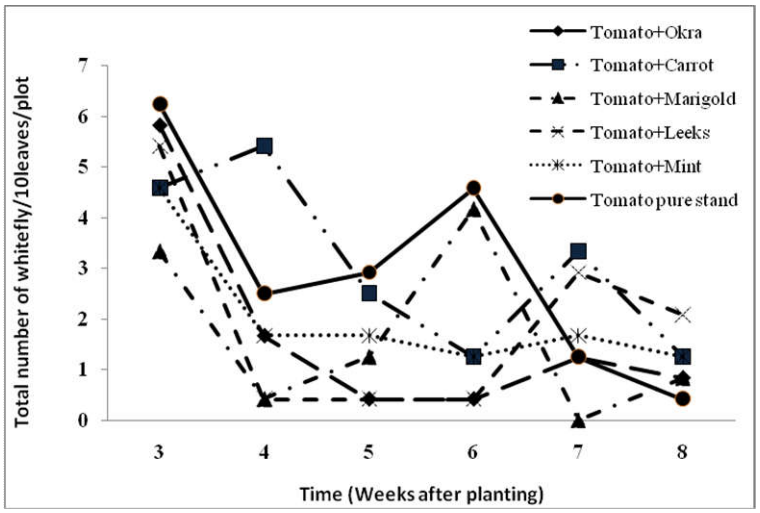

Figure 1. Mean abundance of whiteflies in tomato crops cultivated along with different companion crops during 2014/15 *Maha* seasons at HORDI Research fields, Gannoruwa

2015 *Yala* - white fly

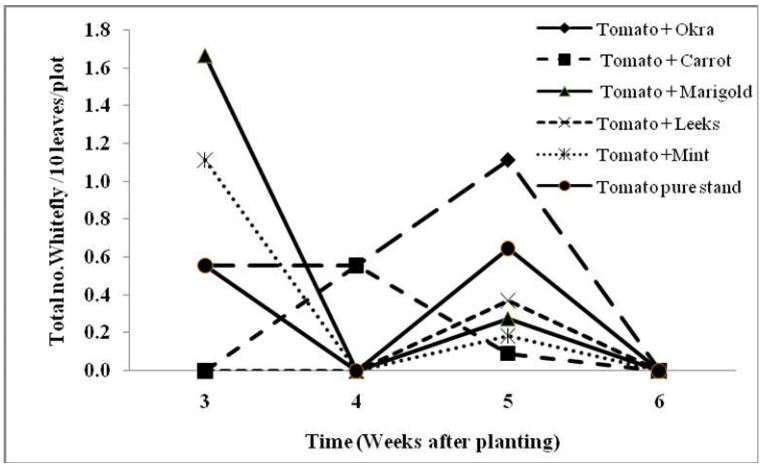

Figure 2. Mean abundance of whiteflies in tomato crops cultivated along with different companion crops during 2015 *Yala* seasons at HORDI Research fields, Gannoruwa.

Thrips infestation in tomato was significantly reduced (C.V.=2.17, P=0.05) until 7WAP in plots of tomato with mint, okra and carrot during 2014/15 *Maha* (Figure 3). Thrips infestation was not observed during 2015 *Yala* except in tomato pure stand at 3wap.

Uvah and Coaker (1984) reported that mixed cropping carrots with onions reduced attacks by *Thrips tabaci* Lind on onions, compared with those on onions

in monoculture. In the present study carrot, mint and okra showed positive effect on reducing thrips infestation in tomato during *Maha* season.

Effect of companion crops on the infestation of tomato by virus diseases

Mean of the percentage of virus infected plants was the highest in the tomato pure stand during *Maha* when the whitefly and thrips populations were high but there was no significant difference in virus incidence among treatments when the pest populations were low during *Yala* (Table 1).

Mean percentage of virus incidence was significantly lower in tomato crops grown in combination with carrot and okra compared to the tomato pure stand (Table 1). Although the whitefly populations were high in tomato crops grown along with carrot or okra during *Maha* season, low thrips population may have contributed for the reduction of virus incidence observed in these crop combinations. Or else this may probably be due to either the volatiles of carrot in combination with tomato that may act as a feeding or oviposition deterrent for whiteflies that infested the crop. It is also possible that the allelo-chemicals in carrot may confuse and prevent the insects from feeding or oviposition, which will in turn reduce infection of the virus. Further investigations are required to study this phenomenon.

2014/15 *Maha* - thrips

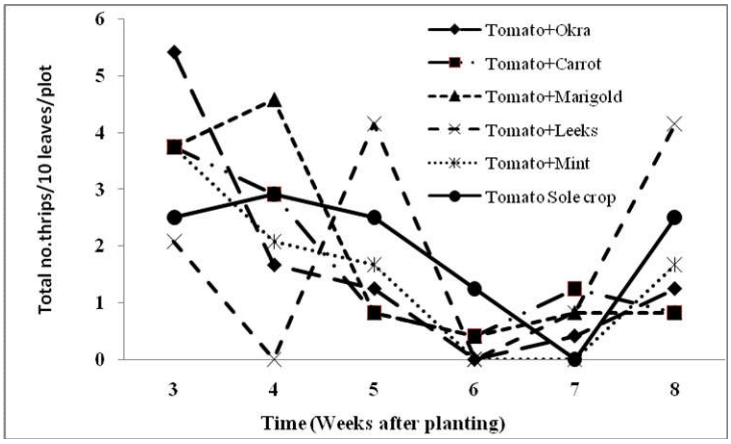

Figure 3. Mean abundance of thrips in tomato crops cultivated along with different companion crops during 2014/15 *Maha* season at HORDI Research fields, Gannoruwa.

Table 1. Effect of companion crops on the virus disease incidence in tomato during 2014/15 *Maha* and 2015 *Yala* season at Gannoruwa.

Treatment	Mean percentage of virus incidence	
	2014/15 *Maha*	2015 *Yala*
Tomato with Okra	28.11 c	5.18
Tomato with Carrot	30.39 bc	6.67
Tomato with Mint	41.61 abc	3.33
Tomato with Leeks	50.74 abc	16.67
Tomato with Marigold	53.59 ab	8.51
Tomato pure stand	55.51 a	6.78
C.V.%	7.03	N.S.

Note: Mean values in a column followed by the same letter are not significantly different at P=0.05.

Effect of companion crops on the yield of tomato:

Tomato crop that grown in combination with leeks produced the highest yield during both seasons giving 71.45% and 19.73% yield increase in *Maha* and *Yala* seasons respectively. This must be due to low whitefly infestation in tomato crops grown with leeks. Low yield increase over tomato pure stand obtained during *Yala* would have been due to low damage occurred to tomato by virus diseases in that season which did not affected the yield. Tomato with carrot, okra or mint gave contrasting results during the two seasons. Tomato with mint gave the highest yield in *Yala* when thrips population was low giving a yield increase of 38.48% over tomato pure stand. Tomato with carrot or okra gave equally high yields (yield increase of 49.61% and 50.85%, respectively) in *Maha* even though the whitefly and thrips populations were high (Table 2).

Table 2. Yield of tomato crop when grown in combination with companion crops during 2014/15 *Maha* and 2015 *Yala* at Gannoruwa.

Treatment	2014/15 *Maha*		2015 *Yala*	
	Total yield *(t/ha)	Percentage yield increase	Total yield **(t/ha)	Percentage yield increase
Tomato with Leeks	4.437 a	71.45	21.88 ab	19.73
Tomato with Okra	3.904ab	50.85	17.73 bc	-
Tomato with Aarrot	3.872ab	49.61	16.96 bc	-
Tomato pure stand	2.588b	-	18.27 bc	-
Tomato with Mint	2.540 b	-	25.30 a	38.48
Tomato with Marigold	1.531 bc	-	11.28 c	-
C.V.%	42.82		21.23	

Note: Mean values in a column followed by the same letter are not significantly different at P=0.05; * Yield of 3 picks ; ** yield of 6 picks.

Although the whitefly population was higher in tomato in combination with carrot, the virus infection in that treatment was lower than in the other treatments. The higher yield of tomato in combination with carrot therefore, probably due to the low virus infection. This suggests that leeks, okra and carrot have a positive effect on protecting tomato crop from virus disease infection and help in increase of tomato yields. In addition to that farmers get an extra income from the yields of these crops. When considering the prices of these vegetables, carrot and leeks will provide more profit to the farmer than okra. Other than protection to tomato from virus disease infection, these companion crops will benefit the farmer by reducing the risk in loss of income from tomato monocrop due to heavy price reductions that is usually faced by Sri Lankan farmers by extra production of tomato in certain seasons.

Results of a similar experiment conducted in Sri Lanka showed that mixed cropping of bean with leeks significantly reduced adult bean fly, *Ophiomyia phaseoli* settling, emergence and death of bean plants compared with a mono crop during two dry season field experiments. Bean yield per row was approx. 150% higher for the mixed crop (Bandara *et al*., 2009). They further reported that whole leeks plant were repellent and prevented attraction of bean fly to the host plant, beans. Beans that had been exposed to volatiles from living leek plants for 7 days became repellent to the fly.

The lowest yield of tomato was obtained when tomato was grown in combination with marigold during both seasons. In the present study, marigold was grown surrounding the plots with a distance of 50cm and it was grown healthier and taller than tomato crop probably by absorbing nutrients supplied to the main crop tomato. Hence it created mutual shading to tomatoes and that may have affected the yield of tomato. A thorough understanding of the nature, physiology and ecology of the insect- plant interactions in tomato under mixed cropping system is very important and require more research efforts in the future. According to Dahanayake *et al*. (2015), mixed cropping legumes with curry chilli or tomato or okra are more beneficial for legume as well as vegetable crop.

CONCLUSION

Leeks, okra, mint and carrot grown along with tomato as companion crops will contribute to reduce virus disease infection and to increase yields in tomato.

ACKNOWLEDGEMENTS

Authors gratefully acknowledge the Director, Horticulture Research and Development Institute for the continuous support provided throughout the period of study. Invaluable contribution of Mr.Ranjith Padmasiri, RSA in conducting the field trials is highly appreciated.

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