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EVALUATION OF DIFFERENT MANAGEMENT OPTIONS AGAINST WHITEFLY, *BEMISIA TABACI* FOR SUPPRESSING TOMATO LEAF CURL VIRUS

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Abstract

Whitefly, *Bemisia tabaci*, is a seirous insect pest of tomato and a vector of tomato leaf curl virus (ToLCV). Five management approaches were evaluated against whitefly to suppress ToLCV during Rabi 2021-22 in the research field of BARI, Gazipur. Two management packages i.e., T_3 (Seed treatment with Fortenza 60 FS @ 2.5 ml kg^{-1} seed + Alternate spraying of Fizimite 10% @ 1 ml l^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and 2 sprays with Tundra 20 SP at 10 days interval) and T_4 (Seedbed netting with 60 mesh nylon net + Alternate spraying of Fizimite 10% @ 1 ml l^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and 2 sprays with Tundra 20 SP at 10 days interval) offered satisfactory effectiveness considering reduced infestation of whitefly and ToLCV infection, higher yield and marginal benefit cost ratio (MBCR).

Keywords: Whitefly, tomato, leaf curl virus, management.

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most popular and widely grown vegetables crop of both tropics and subtropics of the world, belonging to the family Solanaceae. Tomato fruit is considered to be fairly high in vitamins A and C, having high cash value with potential for value-added processing. Tomato is infested by several insect pests, viz., whitefly, fruit borer and leaf miner. Whitefly is one of the most devastating sucking pests of tomato. This pest not only sucks the plant sap but it also transmits the tomato leaf curl virus (ToLCV) disease in tomato. The whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), is one of the most serious pests found in protected horticulture because of its broad host range, high reproductive rate, and short life cycle (Oliveira *et al*., 2001).

The management of whitefly and ToLCV in tomato should focus on several areas. These encompass the exploration of eco-friendly alternatives like biorational

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insecticides, the development of effective strategies for managing resistance, the incorporation of precision agriculture technologies to reduce insecticide usage and the investigation of biocontrol agents and cultural practices that can contribute to whitefly control. Protection of the crop from ToLCV during the first 5 or 6 weeks after transplanting is crucial to reduce yield losses (Sakia and Muniyappan, 1989). Seed treatment or seed bed netting can be helpful in protecting whitefly for first week leading to reduction in ToLCV infection at initial stages of the crop. The development of insecticide resistance has contributed to the need for alternatives to insecticides to manage *B. tabaci* and ToLCV in tomato growing regions. Intensive use of neonicotinoid insecticides to manage *B. tabaci* has led to the development of tolerance to certain neonicotinoids among some populations of whitefly in Florida (Schuster *et al*., 2008).

Presently, the farmers are totally dependent on the use of traditional insecticides to control whitefly but they are not getting desired result. So, developing alternatives to traditional toxic chemical pesticides is of paramount importance. Therefore, this study has been designed to develop sustainable management package for tomato whitefly as well as whitefly transmitted tomato leaf curl virus disease.

Materials and Methods

The experiment was conducted in the research field of BARI, Gazipur during Rabi 2021-22. The experiment was laid out in RCBD having 3 replications. Seeds of 'BARI Hybrid tomato-5' variety was sown in a plot of 4.8m x 2.5m. Weeding and other intercultural operations were done as and when necessary to raise a good crop. Treatment applications were started as soon as the infestation were noticed. Non target pests were controlled with spraying emamectin benzoate (Proclaim 5SG) @ 1 g/litre of water. The treatments were assigned as follows:

T_1 = Seed treatment with cyantraniliprole (Fortenza 60 FS) @ 2.5 ml/kg seed + Spraying Sodium lauryl ether sulphate (Fizimite 10%) @ 1ml/L of water. Altogether 5 sprays were done at 10 days interval

T_2 = Seedbed netting with 60 mesh nylon net + Spraying Sodium lauryl ether sulphate (Fizimite 10%) @ 1ml/L of water. Altogether 5 sprays were done at 10 days interval

T_3 = Seed treatment with cyantraniliprole (Fortenza 60 FS) @ 2.5 ml/Kg seed + Alternate spraying of Sodium lauryl ether sulphate (Fizimite 10%) @1 ml/L of water and Acetamiprid (Tundra 20 SP) @ 1 g/L of water. Altogether 5 sprays were done, 3 sprays with Fizimite 10% and 2 sprays with Tundra 20 SP at 10 days interval.

T_4 = Seedbed netting with 60 mesh nylon net + Alternate spraying of Sodium lauryl ether sulphate (Fizimite 10%) @1ml/L of water and Acetamiprid (Tundra 20 SP) @ 1g/L of water. Altogether 5 sprays were done, 3 sprays with Fizimite 10% and 2 sprays with Tundra 20 SP at 10 days interval.

T_5= Farmers' practice: Spraying with Imidacloprid (Imitaf 20 SL) @ 0.5 ml/litre of water (altogether 10 sprays were done at 7 days interval); and

T_6= Untreated control.

Whitefly population and virus infected plants were recorded at weekly interval. The fruit yield was obtained from each plot was converted into per hectare. The data collected was subjected to statistical analysis after necessary transformation using R software and treatment means were separated using Duncan's Multiple Range test DMRT ($P \leq 0.05$).

Results and Discusion

Effectiveness of different management packages against whitefly population, ToLCV infection and yield of tomato

Results of field studies on effectiveness of different management packages against whitefly population, ToLCV infection and yield of tomato are presented in Table 1. The results indicated that T_4 (Seedbed netting with 60 mesh nylon net + Alternate spraying of Fizimite 10% @ 1 ml l^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and Two sprays with Tundra 20 SP at 10 days interval) recorded the lowest whitefly population (2.98/5 leaves) which was followed by T_3 (Seed treatment with Fortenza 60 FS @ 2.5 ml kg^{-1} seed + Alternate spraying of Fizimite 10% @ 1 ml l^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and Two sprays with Tundra 20 SP at 10 days interval). Similarly, highest reduction (85.62%) of whitefly population over control was recorded from T_4. The control plots recorded the highest whitefly population (20.72/5 leaves). Table 1 also indicated that T_4 recorded the lowest ToLCV infected plants (6.02%) which is statistically at par with T_3. The control plots recorded the highest ToLCV infected plants (38.04%). Similarly, the highest reduction (84.21%) of ToLCV infected plants over control was recorded from T_4. Significantly the highest yield was also obtained from T_4 (51.15 t/ha) which was statistically at par with T_3 (51.02 t/ha).

Table 1. Effectiveness of different treatments in reducing whitefly population and ToLCV infection and yield of tomato at Gazipur during Rabi 2021-22

Treatments	Mean whitefly population /5 leaves	Reduction of whitefly population over control (%)	Mean ToLCV infected plants (%)	Reduction of ToLCV infected plants over control (%)	Marketable yield (t ha^{-1})
T_1= Seed treatment with Fortenza 60 FS @ 2.5 ml^{-1} kg seed + Spraying Fizimite 10% @ 1 ml l^{-1} of water. Total 5 sprays at 10 days interval	9.25b	64.20	15.34b	59.67	47.82ab
T_2= Seedbed netting, 60 mesh nylon net + Spraying Fizimite 10% @ 1 ml l^{-1} of water. 5 sprays at 10 days interval	9.62b	65.01	15.25b	59.91	47.06b
T_3= Seed treatment with Fortenza 60 FS @ 2.5 ml kg^{-1} seed + Alternate spraying of Fizimite 10% @ 1 ml l^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and Two sprays with Tundra 20 SP at 10 days interval = T_3	3.23d	84.41	6.24c	83.60	51.02a
T_4= Seedbed netting with 60 mesh nylon net + Alternate spraying of Fizimite 10% @ 1 ml^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and Two sprays with Tundra 20 SP at 10 days interval =T_4	2.98d	85.62	6.02c	84.21	51.15a
T_5= Farmers' practice: Spraying of Imitaf 20 SL @ 0.5 ml l^{-1} of water. Total 5 sprays at 7 days interval =T_5	5.42c	69.01	9.05d	76.21	49.05ab
T_6= Untreated Control	20.72a	-	38.04a	-	43.06c
CV (%)	12.61	-	9.14	-	3.69

Means having same letter(s) in a column are not significantly different at P> 0.05.

Correlation between key parameters

The correlation between whitefly population and ToLCV infection in tomato is represented in Fig. 1. The relationship is significant and it was observed that ToLCV infection in tomato increased with the increase of whitefly population. Whereas, the correlation between ToLCV infection and yield of tomato is represented in Fig. 2. The relationship is significant and it was observed that around 94% yield would be affected by ToLCV infection in tomato plants.

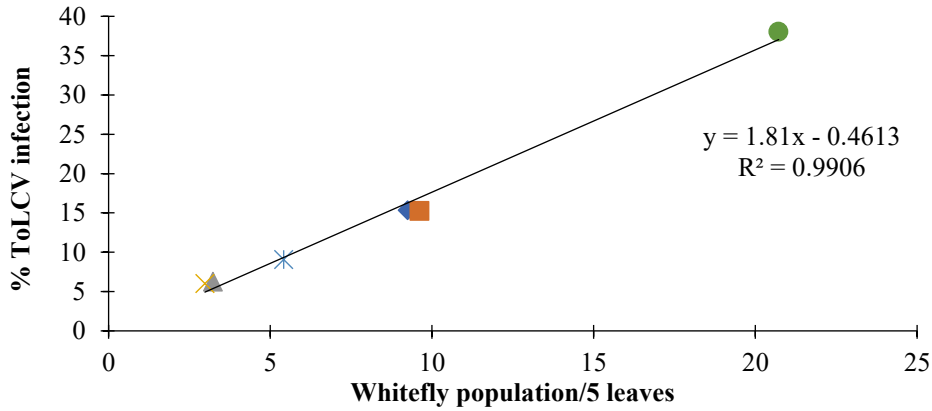

Fig. 1. Relationship between whitefly population and ToLCV infection in Tomato

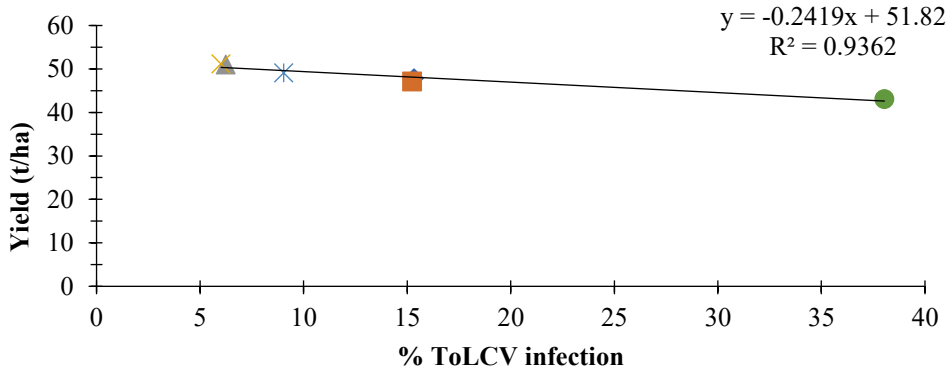

Fig. 2. Relationship between ToLCV infection and yield of Tomato

Marginal benefit-cost ratio of different management packages

The marginal benefit-cost ratio (MBCR) as worked out based on the expenses incurred and value of tomato obtained from the treated plots for the control of whitefly population and ToLCV infection in tomato is given in Table 2. It was noted here that expenses incurred referred to those only on pest control. It was

revealed that the highest marginal benefit-cost ratio (MBCR) (8.85) was calculated from T_3 (Seed treatment with Fortenza 60 FS @ 2.5 ml kg^{-1} seed + Alternate spraying of Fizimite 10% @ 1 ml^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and Two sprays with Tundra 20 SP at 10 days interval). Management approach T_4 (Seedbed netting with 60 mesh nylon net + Alternate spraying of Fizimite 10% @ 1 ml l^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and Two sprays with Tundra 20 SP at 10 days interval) also offered statifactory MBCR (8.00). So, considering MBCR, seed treatment or seedbed netting along with alternate spraying of Fizimite 10% @ 1 ml l^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water could be recommended against whitefly for suppressing tomato leaf curl virus.

Table 2. Benefit cost analysis of different management packages for the management whitefly population and ToLCV infection in tomato at Gazipur during Rabi 2021-22

Treatments	Marketable yield (t ha^{-1})	[1]Gross return (Tk ha^{-1})	[2]Cost of treatment (Tk ha^{-1})	Net return (Tk ha^{-1})	Adjusted net return (Tk ha^{-1})	Marginal benefit cost ratio (MBCR)
T_1= Seed treatment with Fortenza 60 FS @ 2.5 ml^{-1} kg seed + Spraying Fizimite 10% @ 1 ml l^{-1} of water. Total 5 sprays at 10 days interval	47.82	956400	16990	939410	78210	4.60
T_2= Seedbed netting, 60 mesh nylon net + Spraying Fizimite 10% @ 1 ml l^{-1} of water. 5 sprays at 10 days interval	47.06	941200	18275	922925	61725	3.38
T_3= Seed treatment with Fortenza 60 FS @ 2.5 ml kg^{-1} seed + Alternate spraying of Fizimite 10% @ 1 ml l^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and Two sprays with Tundra 20 SP at 10 days interval = T_3	51.02	1020400	16390	1004010	145050	8.85
T_4= Seedbed netting with 60 mesh nylon net + Alternate spraying of Fizimite 10% @ 1 ml^{-1} of water and Tundra 20 SP @ 1 g l^{-1} of water. Total 5 sprays; 3 sprays with Fizimite 10% and Two sprays with	51.15	1020300	17675	1002675	141475	8.00

Treatments	Marketable yield (t ha^{-1})	[1]Gross return (Tk ha^{-1})	[2]Cost of treatment (Tk ha^{-1})	Net return (Tk ha^{-1})	Adjusted net return (Tk ha^{-1})	Marginal benefit cost ratio (MBCR)
Tundra 20 SP at 10 days interval =T_4						
T_5= Farmers' practice: Spraying of Imitaf 20 SL @ 0.5 ml l^{-1} of water. Total 5 sprays at 7 days interval =T_5	49.05	981000	15625	965375	104175	6.67
T_6= Untreated Control	43.06	861200	0.00	861200	-	-

[1]Farmgate price of tomato @ Tk. 20.00 kg^{-1};

[2][Seed rate of tomato: 250 g/ha; Cost of seed treating chemical Fortenza 60 FS: Tk. 24000/ litre; One laborer for seed treating of 2 ha crop @ Tk 550.00 labour^{-1} day^{-1}; Cost of seed bed netting/ha crop: 1525/-; Cost of Fizimite 10%: Tk. 4500/ litre; Cost of Tundra 20SP: Tk. 3900/ litre; Cost of Imitaf 20SL: Tk. 1850/ litre; Cost of spray: Two laborers for spraying ha $^{-1}$ crop @ Tk 550.00 labour^{-1} day^{-1}]

Limited works have been done to develop management approach against whitefly transmiiting ToLCV comprising of seed treatment or seed bed netting in tomato. Kumar (2018) reported that the root treatment done with Imidacloprid 70 WS solution @ 3 g/L of water for 30 minutes followed by one spray with Imidacloprid 17.8 SL@ 0.3 ml/L and second spray with Dimethoate 30 EC @1.5ml/L water was more effective in reduction of whitefly population of tomato and offered the highest benefit cost ratio (BCR) (6.67) which was followed by seed treatment done with Imidaclorprid 70 WS @ 3g/kg of seed and 2 sprays done with Dimethoate 30 EC @1.5ml/L water having BCR 5.97. Sharma et *al*., (2017) reported that combination of carbofuran (soil application) + Imidacloprid (seed treatment) + Imidacloprid (foliar application) proved significantly superior and caused maximum reduction in whitefly population. However, Muqit and Akanda (2007) reported that tomato yellow leaf curl disease incidence was reduced by 12 to 37% and yield was increased by 5 to 21% due to netting (40 meshes) and pesticidal spray.

Many studies on whitefly management in tomato have been done on efficacy of insecticides. Jha and Kumar (2018) reported that imidacloprid provided the highest reduction of whitefly population in tomato, followed by mixture of profenophos and cypermethrin. Meena and Ranju (2014) reported that control of whitefly by prophenophos was most effective insecticides followed by indoxacarb > neem seed kernel extract (NSKE 5%). Balakrishnan *et al.*, (2009) also reported that indoxacarb 14.5 SC (500 ml ha^{-1}) against whitefly reduced population by

(79.01%). Although insecticidal control is one of the common means against whitefly, tomato being a vegetable crop, use of broad-spectrum insecticides will leave considerable toxic residues on the fruits and may cause considerable health hazards. Chemical control of whitefly is quite challenging because it also causes mortality of its natural enemies.The integration of pest management tactics was cheaper than synthetic insecticides even though the chemical insecticides offered good control of pests (Kumar. 2018). Therefore, Integrated Pest Management of tomato whitefly could be adopted for successfully managing leaf curl virus as alternative to chemical insecticides.

Conclusion

The present study clearly indicated that seed treatment or seedbed netting in combination with altrnatenate spraying of bio and chemical insecticide effectively controlled whitefly population resulting in reduced ToLCV infection in tomato with higher marginal benefit cost ratio. These integrated management practices can be recommended to farmers for sustainable whitefly and ToLCV management.

References

Balakrishnan, N., B. V. Kumar and P. Sivasubramanian. 2009. Bioefficacy of biofenthrin 10 EC against sucking insects, bollworm and natural enemies in cotton. *Madras Agric. J.* **96**(1-6): 225-229.

Jha, S. K. and M. Kumar. 2018. Evaluation and Economics of Various Insecticide against Whitefly *Bemisia tabaci* on Tomato. *Int. J. Curr. Microbiol. App. Sci*. **7**: 382-387.

Kumar, R. 2018. Evaluation of insecticides against whitefly on tomato and their effect on natural enemies. *J. Pharmacogn. Phytochem*. **7** (1S): 789-792.

Meena, L. K. and S. V. S. Ranju. 2014. Bioefficacy of insecticides against whitefly and leafhopper of tomato under field condition. *Annals of Plant Protection Science*. **22**(1): 14-17.

Muqit, A. and A. M. Akanda. 2007. Management of tomato yellow leaf curl virus through netting. *The Agriculturists.* **5**: 1-5.

Oliveira, M. R. V., Henneberry, T. J. and P. Anderson. 2001. History, current status, and collaborative research projects for *Bemisia tabaci*. *Crop Prot.* **20**: 709-723. doi: 10.1016/S0261-2194(01)00108-9.

Sakia, A. K. and V. Muniyappa. 1989. Epidemiology and control of tomato leaf curl virus in southern India. *Trop. Agric.* **66**: 350 – 354.

Schuster, D. J., P. A. Stansly, P. R. Gilreath, and J. E. Polston. 2008. Management of *Bemisia*, TYLCV and insecticide resistance in Florida vegetables. *J. Insect Sci*. **8**: 43-44.

Sharma, D., A. Maqbool, V V S. Jamwal, K. Srivastava, and A. Sharma. 2017. Seasonal dynamics and management of whitefly (*Bemesia tabaci* Genn.) in tomato (*Solanum esculentum* Mill.). *Braz. Arch. Boil. Technol*. **60**: e17160456.