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Management of insect pests and diseases of tomato in farmer's field through IPDM practices

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ABSTRACT

Integrated management practices in tomato against major insect pests and diseases were demonstrated by ICAR-Krishi Vigyan Kendra, Kolar, Karnataka (India) through Frontline demonstration (FLD) in the selected tomato farmer's fields during 2014-15, 2015-16 and 2018-19. The demonstrated technologies found most effective in insect pest management and resulted in reduction in mean white fly incidence (0.99/leaf), thrips incidence (0.51/leaf), serpentine leaf minor incidence (1.09 mines/leaf), red mite incidence (0.69/leaf), fruit borer incidence (1.51 %) and American pin worm incidence (3.20 %) as compared to farmer's practice plots. Similar effect was noted on disease management wherein demonstrated plots recorded least mean late blight incidence (9.79 PDI), early blight incidence (5.77 PDI), tomato leaf curl incidence (3.13 %) and tomato spotted wilt incidence (1.31 %) compared to farmer's practice plots. These insect pests and diseases are the major constraints in tomato production and affect the yield to a greater extent. The average increase in mean tomato yield in demonstration plots was 7.73 t/ha (16.65 %) over farmers practice. Further, upon adoption of integrated management practices, growers have realized higher mean net returns (135917 Rs./ha) and benefit cost ratio (1.76) as against the farmers practice (89744 Rs./ha and 1.49 of net returns and benefit cost ratio, respectively). The difference in the yield was due to adoption of integrated insect pests and disease management practices by the tomato farmers as demonstrated by the KVK. Thus, the demonstrated technologies proved to be highly effective in insect pests and diseases management compared to the existing farmers practice for tomato farmers of the district.

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INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is grown throughout the world. It is the second most important vegetable crop after potato due to their high nutritional

value. In India the crop occupies an area of 0.87 million hectare, with a total annual production of 16.83 million tonnes and with the productivity of 19.50 t/ha (Anonymous, 2012). In Karnataka, Kolar, Chikkaballapur, Bengaluru rural district, Belgaum and Dharwad are major tomato growing districts.

In Kolar tomato is cultivated in an area of 9595 ha and average yield per hectare is very low. The low productivity is mainly due to occurrence of various insect pests and diseases. Crop in the region suffers from the insect pests like white fly, thrips, serpentine leaf minor, red mite, fruit borer, american pin worm. Further, white fly and thrips acts as vectors for viral diseases (Fanigliulo *et al.*, 2009). Likewise, late blight, early blight, tomato leaf curl and tomato spotted wilt are most common and serious diseases causing huge yield loss in tomato every year.

Among the diseases, late blight is the most dreaded disease caused by the fungus *Phytophthora infestans*. The disease affects foliage as well as fruits causing heavy loss. Late blight pathogen survives from one season to another through infected crop debris and weeds thus serving as the primary source of inoculums. In the past few decades, the frequency and severity of the disease have increased in many parts of the world including India and have been a serious threat to tomato production (Chowdappa *et al.*, 2011). Similarly, tomato leaf curl and tomato spotted wilt have the potential to induce complete yield loss. Further, the other pests and diseases described above are regular in occurrence and impact the tomato yield in the region.

The other reasons for low yield are lack of knowledge among growers about improved integrated pest and diseases management (IPDM) practices in tomato to manage the debilitating insect pests and diseases. In view of these problems faced by tomato growers in the district, KVK intervened with suitable technology backstopping through FLDs on IPDM practices in tomato.

MATERIAL AND METHODS

ICAR-Krishi Vigyan Kendra, Kolar is playing crucial role in technology backstopping for management of insect pests and diseases of tomato to the farmers of Kolar district. In this connection, KVK, had demonstrated

Table A: Demonstration of the entire crop stages in totato using technologies related to IPDM

Particular	Details	Source of technology
Demonstration (FLDs)	Soil application of bio-agents (*Trichoderma harzianum* and *Pseudomonas fluorescens* @1kg each/100 kg FYM spot application 15 days before planting), prophylactic spray with Mancozeb @ 0.2% twice at weekly interval before onset of the disease, curative sprays with Metalaxyl + Mancozeb @ 0.2%, Fosetyl Al @ 0.2%, and Dimethomorph @ 1.0% + Polyram @ 0.2% at weekly interval at onset of the disease (for late blight), spray with Difenoconazole @ 0.1% (for early blight), Imidachloprid @ 0.03%/ Acephate @ 0.1%/ Thiamethoxam @ 0.025%/ Fipronil @ 0.1%/ NSKE @ 5%/ Triazophos @ 0.2% (for SLM, thrips and white fly), sowing of two thick rows of barrier crop maize three weeks before tomato transplanting, yellow sticky traps installation, seedling root dip with insecticides and need based systemic insecticides application (for viral diseases), Marigold trap crop @ 1:16 ratio, one row marigold after 16 tomato rows, Chlorantraniliprole @ 0.01% (for fruit borer), installation of sex pheromone traps 20/acre, Emamectin benzoate @ 0.05%/ Spinosad @ 0.02% (for south American pin worm) Fenazaquin @ 0.1%/ Spiromecifen @ 0.1% (for red mite)	UAS Bengaluru; UHS Bagalkot and TNAU Coimbatore
Farmer's practice	Indiscriminate spray of one or combination of two fungicide or insecticides *viz.,* Mancozeb @ 0.2%, Dimethomorph @ 0.1% + Metiram @ 0.2%, Copper Oxy Chloride @ 0.3%, Fenamidone + Mancozeb @ 0.3%, Metalaxyl + Mancozeb @ 0.2%, Cymoxanil + Mancozeb @ 0.3%, Copper Hydroxide @ 0.2%, Propineb @ 0.2%, Chlorothalonil @ 0.2% Imidachloprid @ 0.05%, Acephate @ 0.15%/ Thiamethoxam @ 0.05%/ Fipronil @ 0.1%/ NSKE @ 5%/ Triazophos @ 0.2%, Chlorantraniliprole @ 0.05%, Emamectin benzoate @ 0.05%/ Spinosad @ 0.05%, Acetamprid @0.05% at weekly intervals starting from disease or insect pest onset till completion of crop cycle.	-

Table B: Early blight disease assessments by 0-7 severity scale

Score	Description
0	No symptoms on the leaf
1	0-5 % leaf area infected and covered by spot, no spot on petiole and branches
2	6-20 % leaf area infected and covered by spot, some spots on petiole
3	21-40 % leaf area infected and covered by spot, spots also seen on petiole, branches
4	41-70 % leaf area infected and covered by spot, spots also seen on petiole, braches, stem
5	>71 % leaf area infected and covered by spot, spots also seen on petiole, branch, stem and fruits

Table C : Late blight disease assessments by 1-9 severity scale

Plant area infected (%)	Description	Score
No infections	No infections/No. symptoms	1
1-10	First symptoms as grey-green to brown lesion observed on leaves	2
11-20	Symptoms obvious. Yellowing or browning of some leaves or small lesions 50% of plant height	3
21-30	Increased yellowing or browning, or small lesions to 75% of plant height	4
31-40	Small lesions to 75% of plant height the leaves dead	5
41-50	Yellowing or browning to 50% of plant height	6
51-60	Yellowing or browning to 75% of plant height	7
61-70	Entire plant yellow to brown, all leaves infected	8
>71-100	All leaves dead/collapsed	9

the improved integrated insect pests and diseases management practices (IPDM) in tomato through frontline demonstration (FLD) for three years. During 2014-15, FLD was conducted in Lingapura, 2015-16 in Honaganahalli and 2018-19 in Aneganahalli in ten tomato grower's field. The agronomic practices recommended by UHS Bagalkot were followed to raise the crop. Technologies related to IPDM in tomato were demonstrated in the entire crop stages (pre-planting, planting till harvesting) details of which are given Table A.

Observations on insect pests and disease *viz.*, white fly incidence (number/leaf), thrips incidence (number/leaf), serpentine leaf minor incidence (number of mines/leaf), red mite incidence (number/leaf), fruit borer incidence (%), american pin worm (%), late blight incidence (PDI), early blight incidence (PDI), tomato leaf curl incidence (%) and tomato spotted wilt incidence (%) were recorded visually 15 days before completion harvest and tomato fruit yield observations were recorded till harvesting completes in demonstration and farmer's practice plot.

The early blight disease assessments were made by following 0-7 severity scale (Datar and Mayee, 1981) and details of which are presented Table B.

The late blight disease assessments were made by following 1-9 severity scale (Horneburg and Becker, 2011) and details of which is given Table C.

The disease index (%) of early and late blight was computed using the following formula (Wheeler, 1969).

$$\text{Disease index (\%)} = \frac{\text{Sum of all individual ratings}}{\text{Total number of plants examined x Maximum score}} \text{ x } 100$$

RESULTS AND DISCUSSION

The demonstrated improved integrated insect pest and diseases management practices in tomato were highly effective in curbing the pests and diseases menace in tomato and results are presented hereunder. During 2014-15, the demo plots recorded reduced incidence of insect pests and disease *viz.*, white fly (1.72/leaf), thrips (0.53/leaf), serpentine leaf minor (0.97 mines/leaf), red mite (0.74/leaf), fruit borer (1.43%), late blight (11.50 PDI), early blight (1.98 PDI), tomato leaf curl (3.26%) and tomato spotted wilt (1.10%) as against farmer's practice plots which recorded higher incidence of insect pests and diseases (white fly - 3.26/leaf, thrips - 1.19/leaf, serpentine leaf minor - 4.51 mines/leaf, red mite - 2.31/leaf, fruit borer - 3.50%, late blight - 18.90 PDI, early

blight - 5.21 PDI, tomato leaf curl – 6.30% and tomato spotted wilt – 2.86%). Results followed same trend during 2015-16 and 2018-19. Even the mean pooled data of three years followed the similar trend wherein demo plots noted with low incidence of white fly (0.99/leaf), thrips (0.51/leaf), serpentine leaf minor (1.09 mines/leaf), red mite (0.69/leaf), fruit borer (1.51%), South American pin worm (3.20%), late blight (9.79 PDI), early blight (5.77 PDI), tomato leaf curl (3.13%) and tomato spotted wilt (1.31%) as against farmer's practice plots which recorded higher incidence of above mentioned insect pests and diseases (Table 1 and 2).

The demonstrated technologies had great impact on yield and economics of technology adopted tomato growers. During 2014-15 the demo plots recorded higher fruit yield of 51.66 t/ha which was 11.51 per cent increase over the farmer's practice plot (46.33 t/ha). Same trend was evidenced during 2015-16, 2018-19 and even in mean pooled data of three years the same trend noticed wherein 16.65 per cent increase in yield over the farmer's practice plot was evidenced. Further, upon adoption of integrated management practices, growers have realized higher mean net returns (135917 Rs./ha) and benefit cost ratio (1.76) as against the farmer's practice (89744 Rs./ha and 1.49 of net returns and benefit cost ratio, respectively) (Table 3).

Table 1: Effect of demonstrated technologies on management of insect pests of tomato in farmer's field during 2014-15, 2015-16 and 2018-19

Parameter	2014-15		2015-16		2018-19		Pooled results of three years	
	Demonstration	Farmer's practice	Demonstration	Farmer's practice	Demonstration	Farmer's practice	Demonstration	Farmer's practice
White fly incidence (no./leaf)	1.72	3.26	0.92	2.37	0.32	0.84	0.99	2.16
Thrips incidence (no./leaf)	0.53	1.19	0.55	1.28	0.44	1.16	0.51	1.21
Fruit borer incidence (%)	1.43	3.50	1.07	2.11	2.04	3.16	1.51	2.92
Serpentine leaf minor incidence (no. of mines/leaf)	0.97	4.51	1.08	4.38	1.23	5.36	1.09	4.75
Mite incidence (no./leaf)	0.74	2.31	0.66	2.19	0.68	1.72	0.69	2.07
American pin worm (%)	-	-	0.52	0.87	5.88	12.72	3.20	6.80

Table 2: Effect of demonstrated technologies on management of diseases of tomato in farmer's field during 2014-15, 2015-16 and 2018-19

Parameter	2014-15		2015-16		2018-19		Pooled results of three years	
	Demonstration	Farmer's practice	Demonstration	Farmer's practice	Demonstration	Farmer's practice	Demonstration	Farmer's practice
Late blight incidence (PDI)	11.50	18.90	7.60	15.22	10.28	18.62	9.79	17.58
Early blight incidence (PDI)	1.98	5.21	2.14	13.63	13.18	23.87	5.77	14.24
Tomato leaf curl incidence (%)	3.26	6.30	2.66	7.88	3.46	6.56	3.13	6.91
Tomato spotted wilt incidence (%)	1.10	2.86	1.39	3.37	1.44	3.11	1.31	3.11

Table 3 : Effect of demonstrated technologies on yield and economics of tomato farmers during 2014-15, 2015-16 and 2018-19

Parameter	2014-15		2015-16		2018-19		Pooled results of three years	
	Demonstration	Farmer's practice	Demonstration	Farmer's practice	Demonstration	Farmer's practice	Demonstration	Farmer's practice
Yield (t/ha)	51.66	46.33	47.64	40.98	63.10	51.90	54.13	46.40
Gross cost (Rs./ha)	171976	174295	103570	109280	225202	222240	166916	168605
Gross returns (Rs./ha)	284166	254833	163702	141344	460630	378870	302833	258349
Net returns (Rs./ha)	112190	80538	60132	32064	235428	156630	135917	89744
Benefit cost ratio	1.65	1.46	1.59	1.30	2.05	1.71	1.76	1.49

In the study, low incidence of late blight was observed in demo plots which might be mainly because the technologies demonstrated to manage the deadly late blight of potato consist of diverse strategies *viz.*, Soil application of bio-agents (*Trichoderma harzianum* and *Pseudomonas fluorescens*), prophylactic spray with Mancozeb @ 0.2% twice at weekly interval before onset of the disease, curative sprays with Metalaxyl + Mancozeb @ 0.2%, Fosetyl Al @ 0.2% and Dimethomorph @ 1.0% + Polyram @ 0.2% at weekly interval at onset of the disease which are likely to be active during the entire crop cycle under field conditions and turned out to be most efficient in management of disease. These results are in line with report of Haveri *et al*. (2018). The mean early blight incidence in demo plots was low compared to farmer's practice plots which might be due timely application of triazole group of fungicide *i.e.,* difenoconazole. Similar findings were reported by Sharma *et al*. (2018) in tomato.

Incidence of viral diseases *viz.*, leaf curl and spotted wilt in demo plots was least as compared to farmer's practice plots whish was might be due to adoption of integrated disease management (IDM) practices mainly sowing of barrier crop, basal application of *Neem* cake, yellow sticky traps installation, seedling root dip in insecticides and need based systemic insecticides application. These findings agree with the report of Fanigliulo *et al.* (2009). In present study, lowest sucking insects, fruit borer and American pin worm infestation was recorded in demo plot which might be due to adoption of integrated pest management (IPM) practices by the farmers. These results are in agreement with Picanco *et al*. (2007).

In conclusion, the improved IPDM practices in tomato demonstrated by the KVK against major insect pests and diseases proved to be highly effective. Further, they also found to be remunerative and region specific for the tomato growers of the district.

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