International Journal of Applied and Natural Sciences (IJANS)
ISSN(P): 2319-4014; ISSN(E): 2319-4022
Vol. 7, Issue 3, Apr - May 2018; 49 - 56

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

INTEGRATED MANAGEMENT OF WILT *FUSARIUM OXYSPORUM* F. SP. *LYCOPERSICI* IN TOMATO CROP

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ABSTRACT

The experiment was conducted to know the integrated Management of wilt in tomato crop to find out effective measures to control the wilt disease in tomato. Soil solarization with polyethylene sheets, seed treatment with Mancozeb @ 3g /Kg seed, soil drenching with copper oxychloride @ 3g/L and soil application of Trichoderma viride and pseudomonas fluorescence along with FYM @ 25T/h is found to be effective in controlling wilt disease in Tomato. Disease incidence was recorded at 10.18, 14.12, 20.44, 28.92 at 15, 30, 45, 60 days after planting. Highest yield (25.20t/ha) and the highest cost-benefit ratio were observed with soil solarization with polyethylene sheets, seed treatment with Mancozeb @ 3g /Kg seed, soil drenching with copper oxychloride @ 3g/L. and soil application of Trichoderma viride and pseudomonas fluorescence along with FYM @ 25T/h was 1:2.98.

KEYWORDS: *Tomato, Wilt, IDM*

Article History

Received: *20 Apr 2018* | ***Revised:*** *25 Apr 2018* | ***Accepted:*** *28 Apr 2018*

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is an important vegetable crop grown all over the world for its fleshy fruits due to its varied climatic tolerance and high nutritive value. It is an important source of minerals and vitamin A and C. It is also known as 'Red Gold' and has a high potential for developing value-added products like soup, juice, ketchup, paste, and powder through processing. It is also important for its edible fruits that can be consumed either directly as a raw vegetable in sand witches, drinks or cooked foods. The total area under tomato cultivation in India is 7.74 million hectares with the production of 17.398 million tonnes. Among the states, the highest production is contributed by Orissa. In Andhra Pradesh, it is cultivated in an area of 93.73 thousand hectares with the production of 2142.76 thousand tonnes. (Anon, 2014-15). The productivity of tomato in India is very low as compared to other countries of the world. One of the main constraints to tomato cultivation is a disease which is caused by viruses, bacteria, nematodes, fungi, etc. Among diseases, Fusarium wilt caused by *Fusarium oxysporum* f. sp. *lycopersici* Synder and Hansen, is the most important disease in all tomato growing areas of the world. *Fusarium* wilt is an important soil born disease in tomato crop causing severe economic loss to the farmers due to complete death of plants. Hence there is a need to develop low-cost production technology with biological and chemical methods.

The management of the disease can be done through cultural practices (Katan, 1989), use of resistant varieties (Singh & Singh 2000; Rodriguez *et al*., 2003), chemical measures (Zindan *et al*., 2000), biological control (Gnanamanikram, 2002; Myresiotis *et al*., 2012; Bansal *et al*., 2004). Cultural practices like field sanitation, deep summer ploughing, soil solarization, soil amendments and crop rotation, etc. can minimize the possibility of disease but cannot completely control the disease in standing crops. Other alternative methods of controlling the disease have to be explored biological control. In this context, *Trichoderma harzianum, Trichoderma viride, C. globosum & Gliocladium virens* have been exploited for management of diseases, but biological control alone cannot manage the disease completely because a little fluctuation in temperature, pH, moisture, etc. largely affects the efficacy of bio-agent. The use of resistant variety is another important method which is reliable and cheap for management of plant disease, but due to the development of new races of the pathogen, the resistant variety becomes susceptible one. Hence, the use of fungicides is the last and only method for plant disease management. But continuous use of fungicide may develop the resistant strain of the pathogen which has also an adverse effect on tomato fruits as well as human health. Since all the methods have some limitations' no single method can manage the disease effectively. So an integration of available methods is mandatory for sustainable management of the disease. Therefore, the study was undertaken in the present investigation.

MATERIALS AND METHODS

A field experiment was conducted at Horticultural Research Station, Mahanandi, Kurnool dt. (A. P.)**.** It was conducted in the randomized block design with a spacing of 60x45 cm with 14 treatments. Local popular tomato variety Pusa early dwarf was grown in a plot size 3x2M. General agronomical practices were followed for management of the crop. Polyethylene sheets were kept in the plots 45 days before planting for soil solarization. Application of FYM is common for all treatments except control.

The crop was raised as per the recommended package of practices, except plant protection measures. After transplanting, initial plant population was recorded and at the time of harvesting, final plant population was recorded.

Treatment details:

T_1: Soil solarizaion with polyethylene sheets for 45 days before planting

T_2: Seed treatment with Mancozeb @ 3g/Kg seed

T_3: Seed treatment with *Trichoderma viride* @ 5g/Kg seed.

T4: Soil drenching with copper oxychloride @ 3g/L.

T5: Soil application of *Trichoderma viride* multiplied in FYM @ 250 Kg / ha (5 Kgs) *Trichoderma viride* should be mixed with 250 Kgs of Farmyard manure and kept as heap under a tree and covered with a thin gunny bag regularly sprinkled with water for 30 days for multiplication of *Trichoderma viride* in FYM.

T6: Soil application of *pseudomonas fluorescens* multiplied in FYM @ 250 Kg / ha

T7: T1+T2+T4

T8: T1+T2+T5

T9: T1+T2+T6

T10: T2+T4+T5

T11: T2+T4+T5+T6

T12: T1+T2+T4+T5

T13: T1+T2+T4+T5+T6

T14: Control

Measurement of Disease Severity

The disease incidence was measured after 15 days of final spraying. The disease severity was recorded by 0–4 scale as described by Weitang *et al.*, (2004), where zero representing no infection and four denoting plants completely infected. Three replications were maintained for each treatment. The 0–4 scale of the disease severity was classified as follows

0 – No infection.

1- A slight infection, which is about 25% of full scale, one or two leaves became yellow.

2- Moderate infection, two or three leaves became yellow, 50% of the leaves became wilted.

3 - Extensive infection, all plant leaves became yellow, 75% of the leaves become wilted, and growth is inhibited.

4 -Complete infection, the whole plant leaves become yellow, 100% of the leaves become wilted, and the plants die.

The percentage of disease incidence was determined using the formula given by Weitang *et al*. (2004)

$$= \frac{\sum \text{Scale} \times \text{Number of plants}}{\text{Highest scale} \times \text{Total number of plants}} \times 100$$

The disease incidence was recorded t 15, 30, 45, 60 days after transplanting of tomato seedlings.

Yield/Plant

The edible fruits were harvested twice a week from each selected plant and weighted with the help of physical balance. The total weight of all picking was recorded after adding weight of fruits at each picking.

Table 1: Plant Population in Integrated Management of Wilt in Tomato Crop

S. No	Particulars	Initial Plant Population /Plot	Final Plant Population /Plot
T1	Soil solarizaion with polyethylene sheet for 45 days before planting	21.36	19.23
T2	Seed treatment with mancozeb @ 3g/Kg seed	22.15	18.26
T3	Seed treatment with *Trichoderma viride* @ 5g/Kg seed	21.13	17.38
T4	Soil drenching with copper oxy chloride @ 3g/L	21.56	18.39
T5	Soil application of *Trichoderma viride* multiplied in FYM @ 250 Kg / ha (5 Kgs) of *Trichoderma viride* should be mixed with 250 Kgs of Farmyard manure and kept as heap under a tree and covered with thin gunny bag and regularly sprinkled with water for 30 days for multiplication of *Trichoderma viride* in FYM.	22.13	19.46
T6	Soil application of *pseudomonas fluorescens* multiplied in FYM @ 250 Kg / ha	20.16	16.79

Table 1 Contd.,			
T7	T7: T1+T2+T4	21.38	18.46
T8	T1+T2+T5	21.98	19.61
T9	T1+T2+T6	22.19	18.49
T10	T2+T4+T5	21.35	18.06
T11	T2+T4+T5+T6	23.46	21.38
T12	T1+T2+T4+T5	22.10	21.03
T13	T1+T2+T4+T5+T6	**25.19**	**22.76**
T14	Control	13.79	9.46

Table 2: Disease Incidence and Yield in Integrated Management of wilt in Tomato Crop

Treatment Details	15 Days	30 Days	45 Days	60 Days	Pooled Yield Data (t/ha)	Cost Benefit Ratio
T_1 : Soil solarizaion with polyethylene sheets for 45 days before planting	19.90	23.86	31.78	39.04	16.08	1: 1.45
T_2 : Seed treatment with Mancozeb@ 3g/Kg seed	18.91	22.62	29.84	37.59	17.55	1: 1.38
T_3 : Seed treatment with *Trichoderma viride* @ 5g/Kg seed.	18.00	21.96	29.12	37.69	17.26	1: 1.36
T_4: Soil drenching with copper oxy chloride @ 3g/L	16.54	21.01	26.98	35.25	18.80	1: 1.85
T_5 : Soil application of *Trichoderma viride* multiplied in FYM @ 250 Kg / ha (5 Kgs) of *Trichoderma viride* should be mixed with 250 Kgs of Farmyard manure and kept as heap under a tree and covered with thin gunny bag and regularly sprinkled with water for 30 days for multiplication of *Trichoderma viride* in FYM.	15.52	19.82	26.49	35.28	19.66	1: 1.92
T_6: Soil application of *pseudomonas fluorescence* multiplied in FYM @ 250 Kg / ha	17.84	21.86	26.83	32.82	18.59	1: 1.78
T_7: T1+T2+T4	14.63	18.99	24.10	33.16	18.81	1: 1.88
T_8: T1+T2+T5	14.09	17.99	24.57	33.50	20.43	1: 2.05
T_9: T1+T2+T6	16.05	19.01	26.39	34.70	20.01	1: 1.99
T_{10}: T2+T4+T5	14.06	17.58	23.47	33.48	25.79	1: 2.95
T_{11}: T2+T4+T5+T6	11.77	15.73	22.53	31.57	21.13	1: 2.54
T_{12}: T1+T2+T4+T5	10.72	14.54	22.04	31.04	23.20	1: 2.82
T_{13}: T1+T2+T4+T5+T6	**10.18**	**14.12**	**20.44**	**28.92**	**25.20**	**1: 2.98**
T_{14}: Control	23.99	27.46	34.44	42.34	14.44	1: 1.28

(Four years pooled data from 2009-10 to 2012-13)

SEm	0.54	0.47	0.50	0.36	0.33
CD at5%	1.57	1.38	1.45	1.05	0.95
CV %	11.27	7.80	6.06	3.43	5.17

RESULTS AND DISCUSSIONS

In this experiment maximum initial (25.19) and final population (22.76) was recorded in T13- (T1+T2+T4+T5+T6) treatment (Table-1). Soil solarization with polyethylene sheets, seed treatment with Mancozeb @ 3g /Kg seed, soil drenching with copper oxychloride @ 3g/L and soil application of *Trichoderma viride* and *pseudomonas fluorescence* along with FYM @ 25T/h is found to be effective in controlling wilt disease in Tomato. Disease incidence was recorded at 10.18, 14.12, 20.44, 28.92 at 15, 30, 45, 60 days after planting. Highest yield (25.20t/ha) and the highest cost-benefit ratio was observed with soil solarization with polyethylene sheets, seed treatment

with Mancozeb @ 3g /Kg seed, soil drenching with copper oxychloride @ 3g/L. and soil application of *Trichoderma viride* and *pseudomonas fluorescence* along with FYM @ 25T/h was 1:2.98 (Table-2). According to Ravindra Singh *et al* (2015) Integration of different methods for sustainable management of Fusarium wilt of tomato revealed that all the treatments were able to significantly reduce the disease severity over control. Among the treatments, the minimum disease severity was recorded in the T3 treatment where the treatment was given as a seed treatment with *T. harzianum* + soil application of neem cake powder + foliar spray of carbendazim, representing the value 4.82, 8.23, 12.37 and 16.37 per cent against 10.75, 14.84, 20.00 and 25.75 per cent in case of control at 30, 45, 60 and 75 days age of plant, respectively. As per yield is concerned, it has found that the maximum yield was obtained per plant for the treatment given as a seed treatment with *T. Harzianum* + soil treatment with neem cake powder + foliar spray with carbendazim, showing the value of 500 g. per plant which was followed by the treatment given as a seed treatment with *T. harzianum* + soil treatment with neem cake powder+ foliar spray with neem leaf extract showing 470 g per plant. Shanmugaiah et al. (2009) observed cotton seeds treated with *T. viride* increased seed germination, root and shoot length, fresh and dry weight and vigor index over control. Bombiti Nzanza et al. (2011) studied for biomass production in 6-week old tomato seedlings as influenced by *T. harzianum* and Arbuscular mycorrhizal fungi (AMF). Chandanie *et al*. (2009) demonstrated that, the combined inoculation of AMF with *Trichoderma* synergistically increased dry shoot mass when compared with inoculation of *Trichoderma* and AMF alone. The results in accordance with Rashmi Srivastava *et al* (2010) application of *T. harzianum* and fluorescent Pseudomonas by seed bio-priming significantly increased seed germination (22–48%) and reduced the days required for germination (2.0–2.5 days). All bioagents used in this study significantly reduced the incidence of wilt in pot and field trials and combinations of bioagents was more effective than single isolate treatments. The combination of fluorescent

Pseudomonas, T. harzianum and AMF provided significantly better control than un inoculated treatment, reducing disease incidence and severity by 74% and 67% in pots and field, respectively. Hence, soil solarization with polyethylene sheets, seed treatment with Mancozeb @ 3g /Kg seed, soil drenching with copper oxychloride @ 3g/L and soil application of *Trichoderma viride* and *pseudomonas fluorescence* along with FYM @ 25T/h is found to be effective in controlling wilt disease in Tomato.

CONCLUSIONS

Highest yield (25.20t/ha) and highest cost-benefit ratio 1;2.98 was observed with soil solarization with polyethylene sheets, seed treatment with Mancozeb @ 3g /Kg seed, soil drenching with copper oxychloride @ 3g/L. and soil application of Trichoderma viride and pseudomonas fluorescence along with FYM @ 25T/h. In controlling Fusarium wilt disease (10.18, 14.12, 20.44, 28.92 at 15, 30, 45, 60 days after planting) in tomato.

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