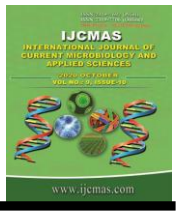
Int.J.Curr.Microbiol.App.Sci (2020) *9*(10): 128-135

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 10 (2020)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2020.910.017

In vitro Management *Fusarium* Wilt of Tomato through Biological and Chemical Methods

Amruta D. Gadhave[1], Pushpa D. Patil[2], R. R. Rathod[1*], U. R. Phondekar[1], Y. K. Nirgude[1], Revati R. Nalawade[1] and Josiya Joy[1]

[1]Department of Plant Pathology, College of Agriculture, DBSKKV, Dapoli (MH), India
[2]Department of Plant pathology, Reginoal Agricultural, Research Station, Karjat, Dist-Raigad, India

**Corresponding author*

Keywords

Fusarium oxysporum f. sp. *lycopersici*, Tomato wilt, Fungicides and bioagents

Article Info

Accepted:
04 September 2020
Available Online:
10 October 2020

A B S T R A C T

Fusarium oxysporum f. sp. *lycopersici* cause tomato wilt is one of the major diseases on tomato which is soil and seed borne. Heavy inoculum in soil and favorable environment condition results in the death of infected plant and therefore total yield loss. Hence, an attempt was made in this study, with two antagonists, two fungicides (alone and combinations) against *Fusarium* tomato wilt. Pot culture studies found that Average reduction of *F. oxysporum* f. sp. *lycopersici* recorded with the test fungicides and bioagent ranged from 25.81% to 72.21%, as against 00.00% in untreated control. However, the fungicides and bioagents *viz.*, Carbendazim 50% WP + *T. harzianum* resulted with (72.21%) maximum disease reduction, followed by Carbendazim 50% WP resulted with (62.96%) disease reduction, Carbendazim 25% + Mancozeb 50 % WS resulted with (61.10%) disease reduction, , *T. harzianum* resulted with (55.55%) disease reduction, Carbendazim 50% WP + *T. virens* resulted with (53.07%) disease reduction,, Carbendazim 25% + Mancozeb 50 % WS + *T. harzianum* resulted with (35.18%) disease reduction , *T. virens* resulted with (33.32%) disease reduction but Carbendazim 25% + Mancozeb 50 % WS + *T. virens* showed lowest disease reduction (25.81%).

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetable crops belonging to family Solanaceae. Tomato is intensively cultivated in India, The annual production of tomato in India during 2017-18 was 22337.29MT with an area of about 801 thousand ha, and productivity of 27.8 MT/ha (Anonymous, 2017), In Maharashtra state, it is grown on an area of about 43.64 thousand ha with production of 976.58.MT, and productivity of 22.07MT/ha (Anonymous, 2017).

The tomato is consumed in diverse forms, including raw, as an ingredient in several dishes, sauces, salads, and drinks. While it is botanically a berry fruit, it is considered a vegetable for culinary purposes. The fruit is

rich in lycopene, which has beneficial health effects. The plants typically grow to 1–3 meters in height and have a weak stem that often sprawls over the ground. It is a perennial in its native habitat, although often grown outdoors in temperate climates as an annual.

Most cultivars produce red fruits, but a number of genotypes with yellow, orange, pink, purple, green, black, or white fruit are also available. Multi-colored and striped fruits are also quite striking. Tomatoes grown for canning and sauces are known as plum tomatoes, which typically have lower water content with elongated fruits. (Source: Series of Crop Specific Biology Documents, 2016).

This vegetable crop suffers from various diseases that significantly affect its growth and yield. A number of economically important tomato diseases caused by fungi are transmitted by seed or transplants. Tomatoes are parasitized by a number of pathogens, including *Fusarium oxysporium* f. sp. *lycopersici* (Sacc.) (W.C. Snyder *et al.,* 2003). Early blight [*Alternaria solani,* Ell and Mart, Jones and Grout], late blight *Phytophthora infestans* (Mont.)], damping off [*Pythium aphanidermatum* (Edson) Fitzag], fruit rot [*Phytophthora* spp], root rot [*Macrophomia phaseoli* (Maubl.) Ashby], leaf mould [*Cladosporium fulvum* (Ke)], Bacterial wilt [*Pseudomonas solanacearum* Smith] and number of viruses. Among these diseases fungal wilt [*Fusarium oxysporum* f. sp. *lycopersici*] is one of the most severe.

The causal agent of *Fusarium* wilt is soil borne pathogen which can persist many years in the all type of soil without a host throughout world. *Fusarium* spp. are saprophytes and are able to grow on soil organic matter for a prolonged period. Most infections originate from the population associated with infected tomato debris. Healthy plants can become infected by *F. oxysporum* if the soil in which they are growing is infested with the pathogen (Farr *et al.,* 1989). However, pathogenic fungi of the genus *Fusarium* that is the causal agents of tomato wilt cause root and basal stem deterioration and result in the wilting of vegetable plants.

Browning of the vascular tissue is strong evidence of *Fusarium* wilt (Snyder and Hans, 2003). A disease, causing heavy losses ranging from 20-80 per cent. Keeping in mind economic importance of tomato and losses incurred by *Fusarium oxysporum* f. sp. *lycopersici,* present study was planned and conducted at the Department of Plant Pathology, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli.

Materials and Methods

Those fungicides and bioagents which found most effective against *Fusarium oxysporum* f. sp. *lycopersici* during present *in vitro* studies were selected and used (alone and in-combination) for integrated management of *Fusarium* wilt of tomato, by applying sick soil, as detailed earlier.

The test fungicides and bioagents were applied (alone and in-combination) as pre root dipping treatment to the healthy tomato seedlings / soil drenching and transplanted (5 seedling / pot) in the pot, containing *Fusarium oxysporum* f. sp. *lycopersici* sick soil / potting mixture.

For each treatment, two pot / replication were maintained. The pots transplanted with (5 seedlings / pot) with healthy seedlings of tomato containing only *Fusarium oxysporum* f. sp. *lycopersici* sick soil (without any treatment) was maintained as untreated control (Table 2).

The experiment was conducted by using nine treatments and three replications in CRD design. disease incidence was measured after 30, 60, and 90 days after transplanting.

Observations were recorded on disease intensity and reduction (%) of *FOL*. Disease intensity was determined using the formulas as given by Song *et al.,* (2004).

0: No wilt symptoms.

1: Slight severity; Plants with leaf wilting (25%) and yellowing of one or two leaves.

2:Moderate severity; Plants with leaf wilting (50%) and yellowing of two or three leaves

3:Extensive severity; Plants with leaf wilting (75%), yellowing of all leaves and inhibited growth.

4:Complete severity; 100% wilting of leaves, complete yellowing of all leaves, and plant death.

Where,

DI = disease intensity (%)

Pi = number of infected plants

Pt = total number of plants

Reduction (%) of disease was calculated by using the following formula according to (Alwathnani *et al.,* 2012).

Where,

R = % Disease reduction.

C = % Disease incidence in untreated plants

T = % Disease incidence in treated plants.

Results and Discussion

Table 1 revealed that, effect of disease intensity at 30 days after transplanting, ranged from 5.00 % to 25.00 %, as against 30.00 % in untreated control However, with the fungicides and bio-agent *viz.,* Carbendazim 50% WP + *T. harzianum* was found most effective with significantly least disease incidence (5.00 %) and it's highest reduction (83.33 %), followed by *T. harzianum* (6.67 and 77.77 %, respectively), Carbendazim 25% + Mancozeb 50 % WS (8.33% and 72.22 %, respectively), Carbendazim 50% WP + *T. virens* (8.33% and 72.22% respectively), Carbendazim 50% WP (10.00% and 66.66% respectively), *T. virens* (10.00% and 66.66%, respectively), Carbendazim 25% + Mancozeb 50 % WS + *T. harzianum* (11.67 and 61.11% respectively) and Carbendazim 25% + Mancozeb 50 % WS + *T. virens* (25.00% and 16.66% respectively) (Fig. 1).

60 days after transplanting, disease incidence of *F. oxysporum* f. sp. *lycopersici*, ranged from 10.00 % to 25.00 %, as against 30.00 % in untreated control However, with the fungicides and bio-agent *viz.,* Carbendazim 50% WP + *T. harzianum* was found most effective with significantly least disease incidence (10.00 %) and it's highest reduction (66.66%), followed by Carbendazim 50% WP (11.67and 61.11 %, respectively), Carbendazim 25% + Mancozeb 50 % WS (13.33% and 55.55 %, respectively).

Carbendazim 50% WP + *T. virens* (13.33% and 55.55% respectively), *T. harzianum* (16.67% and 44.44% respectively), Carbendazim 25% + Mancozeb 50 % WS + *T. virens* (20.00% and 33.33%, respectively), Carbendazim 25% + Mancozeb 50 % WS + *T. harzianum* (23.33% and 22.22% respectively) and *T. virens* (25.00% and 16.66% respectively).

Table.1 Effect of various fungicides and bioagents on disease intensity (%) and reduction (%) of *Fusarium oxysporum* f. sp. *lycopersici* of tomato plants

Tr. No.	Treatment	Rate	Disease Intensity (%)			Average Disease Intensity (%)	Reduction over control (%)			Average reduction (%)
			30 DAT	60 DAT	90 DAT		30 DAT	60 DAT	90 DAT	
T_1	Carbendazim	RD @ 1g/1lit	10.00	11.67	11.67	11.11	66.66	61.11	61.11	62.96
	50% WP	water/30	(18.43)	(19.97)	(19.97)	(19.47)	(54.73)	(51.41)	(51.41)	(25.51)
		plants								
T_2	Carbendazim	RD @ 2.5	8.33	13.33	13.33	11.66	72.22	55.55	55.55	61.10
	25% +	g/1 lit.	(16.77)	(21.41)	(21.41)	(19.96)	(58.19)	(48.18)	(48.18)	(51.41)
	Mancozeb 50	water/30								
	% WS	plants								
T_3	*T. harzianum*	RD @ 200	6.67	16.67	16.67	13.33	77.77	44.44	44.44	55.55
		ml Broth/30	(14.96)	(24.09)	(24.09)	(12.41)	(61.86)	(41.80)	(41.80)	(48.18)
		plants								
T_4	*T. virens*	RD @ 200	10.00	25.00	25.00	20	66.66	16.66	16.66	33.32
		ml Broth/30	(18.43)	(30)	(30)	(26.56)	(54.73)	(24.08)	(24.08)	(32.25)
		plants								
T_5	Carbendazim	RD @1g/1lit	5.00	10.00	10.00	8.33	83.33	66.66	66.66	72.21
	50% WP + *T.*	water + SD	(12.92)	(18.43)	(18.43)	(16.77)	(65.93)	(54.73)	(54.73)	(58.18)
	harzianum	30 ml Broth								
		/pot 30 DAT								
T_6	Carbendazim	RD @1g/1lit	8.33	13.33	20.00	13.88	72.22	55.55	33.33	53.7
	50% WP + *T.*	water + SD30	(16.77)	(21.41)	(26.56)	(21.87)	(58.19)	(48.18)	(35.26)	(47.12)
	virens	ml Broth /pot								
		30 DAT								
T_7	Carbendazim	RD @ 2.5	11.67	23.33	23.33	19.44	61.11	22.22	22.22	35.18
	25% +	g/1 lit water	(19.97)	(28.88)	(28.88)	(26.16)	(51.41)	(28.12)	(28.12)	(36.37)
	Mancozeb 50	+ SD 30 ml								
	%WS+*T.*	Broth /pot 30								
	harzianum	DAT								
T_8	Carbendazim	RD @ 2.5	25.00	20.00	21.67	22.22	16.66	33.33	27.77	25.81
	25% +	g/1 lit water	(30.00)	(26.56)	(27.74)	(28.12)	(24.08)	(35.26)	(31.80)	(30.53)
	Mancozeb 50	+ SD 30 ml								
	%WS+*T.*	Broth /pot 30								
	virens	DAT								
T_9	Control	-	30.00	30.00	30.00	30	00.00	00.00	00.00	00.00
	(Untreated)		(33.21)	(33.21)	(33.21)	(33.21)	(00.00)	(00.00)	(00.00)	(00.00)
S. E.	**m ±**		**4.54**	**3.14**	**3.42**					
C.D (P = 0.01)			**13.51**	**9.34**	**10.18**					

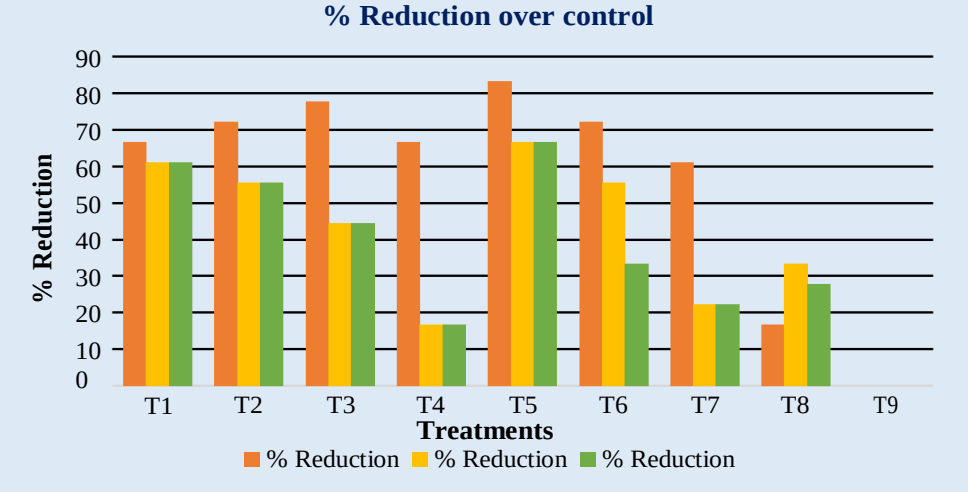
* Mean of three replications

Figures in parentheses are Arcsine values, RD- Root Dipping, SD- Soil drenching

Table.2

Tr. No.	Treatments	Tr. No.	Treatments
T1	Carbendazim 50% WP	T6	Carbendazim 50% WP + *T. virens*
T2	Carbendazim 25% +	T7	Carbendazim 25% + Mancozeb 50
	Mancozeb 50 % WS		% WS + *T. harzianum*
T3	*T. harzianum*	T8	Carbendazim 25% + Mancozeb 50
			% WS + *T. virens*
T4	*T. virens*	T9	Control (Untreated) -
T5	Carbendazim 50% WP + *T.*		
	harzianum		

Fig.1 Pot culture experiment on integrated management of *Fusarium* wilt of Tomato



90 days after transplanting, disease incidence of *F. oxysporum* f. sp. *lycopersici*, ranged from 10.00 % to 25.00 %, as against 30.00 % in untreated control However, with the fungicides and bio-agent *viz.*, Carbendazim 50% WP + *T. harzianum* was found most effective with significantly least disease incidence (10.00 %) and it's highest reduction (66.66%), followed by Carbendazim 50% WP (11.67 and 61.11 %, respectively), Carbendazim 25% + Mancozeb 50 % WS (13.33% and 55.55 %, respectively.), *T. harzianum* (16.67% and 44.44% respectively), Carbendazim 50% WP + *T. virens* (20.00% and 33.33%, respectively), Carbendazim 25% + Mancozeb 50 % WS + *T. virens* (21.67% and 27.77% respectively) and *T. virens* (25.00% and 16.66% respectively).

Average disease intensity of *F. oxysporum* f. sp. *lycopersici* recorded with the test fungicides and bioagent ranged from 8.33% to 22.22%, as against 30.00% in untreated control. However, the fungicides and bioagents *viz.*, Carbendazim 50% WP + *T. harzianum* resulted with (8.33%) disease intensity, followed by Carbendazim 50% WP resulted with (11.11%), disease intensity, Carbendazim 25% + Mancozeb 50 % WS resulted with (11.66) disease intensity, *T. harzianum* resulted with (13.33%) disease intensity, Carbendazim 50% WP + *T. virens*

resulted with (13.88%) disease intensity, Carbendazim 25% + Mancozeb 50% WS + *T. harzianum* resulted with (19.44%) disease intensity, *T. virens* resulted with (20.00%) disease intensity but Carbendazim 25% + Mancozeb 50 % WS + *T. virens* showed maximum disease intensity (22.22%).

Table 1 contains a detailed study of disease reduction over control at 30DAT, 60DAT & 90DAT. Average reduction of *F. oxysporum* f. sp. *lycopersici* recorded with the test fungicides and bioagent ranged from 25.81% to 72.21%, as against 00.00% in untreated control. However, the fungicides and bioagents *viz.*, Carbendazim 50% WP + *T. harzianum* resulted with (72.21%) maximum disease reduction. Various *Trichoderma spp*. (*T. harzianum T. virens*) alone or in combination with compatible fungicides were reported effective to manage *Fusarium* wilt disease (Rather *et al.,* 2012; Trivedi and Rathi, 2016; Singh *et al.,* 2015). applied alone or in combination with fungicides and bioagents were reported to manage effectively the *Fusarium* wilt disease in various crops. Similar findings were recorded by Hossain *et al.,* 2013; Islam *et al.,* 2018; Haseeb *et al.,* 2006, followed by Carbendazim 50% WP resulted with (62.96%) disease reduction, These results of the present study of integrated efficacy of the test fungicides and bioagents against *Fusarium* wilt of tomato are in agreement with the reports of many earlier workers. Jha A.C *et al.,* (2018) reported the fungicides *viz*., Carbendazim @ 0.1% as effective against *Fusarium* wilt disease of tomato. Carbendazim 25% + Mancozeb 50 % WS resulted with (61.10%) disease reduction,, *T. harzianum* resulted with (55.55%) disease reduction, Carbendazim 50% WP + *T. virens* resulted with (53.07%) disease reduction,, Carbendazim 25% + Mancozeb 50 % WS *T. harzianum* resulted with (35.18%) disease reduction, *T. virens* resulted with (33.32%) disease reduction but Carbendazim 25% + Mancozeb 50 % WS + *T. virens* showed lowest disease reduction (25.81%).

In conclusion the integration of various fungicides and bioagents (alone and in combinations) evaluated *in vitro* under pot culture were found effective in reduction of disease. All the treatments used in this were significantly reduced disease intensity. Among all nine treatments, Carbendazim 50% WP + *T. harzianum* resulted with (72.21%) maximum disease reduction, followed by Carbendazim 50% WP resulted with (62.96%) disease reduction, Carbendazim 25% + Mancozeb 50 % WS resulted with (61.10%) disease reduction, also the other combination treatments *viz., T. harzianum*, Carbendazim 50% WP + *T. virens*, Carbendazim 25% + Mancozeb 50 % WS + *T. harzianum*, *T. virens*, were significantly reduced the disease as compare to control. but Carbendazim 25% + Mancozeb 50 % WS + *T. virens* showed lowest disease reduction (25.81%).

References

Agrios, G.N. 1988. Studied the symptoms of *Fusarium oxysporum Pl. Pathol, (3rd Edn) Academic Press, New York*. pp. 803.

Altinok, H.H. 2005. First report of *Fusarium* wilt of egg plant, caused by *Fusarium oxysporum* f. sp. *melongenae*, in Turkey. *Pl. Pathol.* 54: 577.

Ayed F., Majda D. R., Hayfa J. K. and Mohamed El Mahjoub. 2007. *In vitro* and *in vivo* evaluation of some biofungicides for potato *Fusarium* wilt biocontrol. *Int. J. of Agri. Res.* 2: 282-288.

Altinok, H.H. and Oktay, E. 2015. Determination of the *in vitro* effect of *Trichoderma harzianum* on phytopathogenic strains of *Fusarium*

oxysporum Not. Bot. Hort. Agrobo. 43 (2):494-500.

Amutha, C.; Darwin,C. and Henry, L. 2017. Survey and severity of tomato wilt disease incited by *Fusarium oxysporum* f. sp. *lycopersici* (Sacc.) in different districts of Tamilnadu. *Int. J. Sci. Res.* 8 (12): 22702-22704.

Anonymous 2017. National Horticultural Board Database, India.

Arora, D.K. and Upadhyay, R. 1978. Effect of fungal staling growth substances on colony interaction. *Pl. Soil*. 49:685-690.

Arunodhayam, K.; Reddy, N.P.; Eswara, and Madhuri, V. 2014. Pathogenicity and management of *Fusarium* wilt of chickpea, *Cicer arietinum* L. *Curr. Biotica*. 7(4): 343-358.

Anwar, A.; M.; Bhat, M. N. Mughal, G. H. Mir and Ambardar V.K. 2017. Integrated Management of Major Fungal Diseases of Tomato in Kashmir Valley, India *Int. J. Curr. Microbiol. App. Sci* 6 (8): 2454-2458.

Alwathnani, H.A., K. Perveen, R. Tahmaz and S. Alhaqbani. 2012. Evaluation of biological control potential of locally isolated antagonist fungi against *Fusarium oxysporum* under *in vitro* and pot conditions. *African J. Microbiol. Res*. 6(2):312-319.

Bai A. T., Ruth Ch., Arunodhayam G. K., Tanuja P. and Ramkrishna M. 2018. Survey and Identification of *Fusarium* Wilt Disease in Chilli (*Capsicum annuum* L.). *Int. J. Curr. Microbiol. App. Sci*. 7(6): 1073-1078.

Barari H. (2016). Biocontrol of tomato *Fusarium* wilt by Trichoderma species under *in vitro* and *in vivo* conditions. *Cercetari Agronomice în Moldova*. 19 (165): 91-98.

Bashar, M. A.; Akter, A. and Hossain, K.S. 2015. Potential fungicides and plant extracts against *Fusarium* wilt of Brinjal. *Dhaka Univ. J. Biol. Sci*. 24 (2): 209-213.

Bhimani, M.D.; Golakiya B.B. and Akbari L.F. 2018. Evaluation of different fungicides against fenugreek wilt (*Fusarium oxysporum* Schlecht.) *I.J.C.S.* 6 (2): 29-34.

Bhadra, M.; Khair, A.; Hossain, M.A.; Shamoli, F.A. and Sikder M.M. 2016. Biological Control of Wilt of Eggplant Caused by *Fusarium solani* f. sp. *melongenae. Int. J. Expt. Agric.* 6 (2): 20-25.

Hossain, M.; Sultana, F.; Shah, M.; Islam, S. and Bhuiyan, K. A. 2013. Integrated management of wilt of chickpea (*Cicer arietinum* L.) caused by *Fusarium oxysporum* f. sp. *ciceri* with microbial antagonists, botanical extracts and fungicides. *African. J. Biotech*. 12 (29): 4699-4706.

Hussein S. N. 2016. Molecular identification and integrated management of F*usarium* f. sp. *cucumerinum* the causal agent of *Fusarium* wilt disease of *Cucumis sativus* L. in *Iraq. J. of Expt. Bio. and Agril. sconces*. 4 (4): 389-397.

Madhavi, M.; Kumar, P.C.; Reddy, R.R. and Singh, T.V.K. 2006. Integrated management of wilt of chilli incited by *Fusarium solani Indian J. Pl. Prot.* 34 (2):225-228.

Lal, K.; Singh, P.; Biswas, S. K.; Yadav, S.; Kumar, V. and Kumar N. 2018. Suitable Integrated Approach for Management of *Fusarium* Wilt of Tomato caused by *Fusarium oxysporum* f. sp. *lycopersici* (Sacc.). *J. P. A. M*. 9 (4): 56-63.

Rather T. R., Razdan V. K., Tewari A. K., Shanaz Efath, Bhat Z. A., Mir G. Hassan & T. A. Wani. 2012. Integrated management of wilt complex disease in Bell Pepper (*Capsicum annuum* L.). *Journal of*

Agricultural Science. 4 (7): 141-147.

Singh, R.; Biswas1, S.K.; Nagar, D.; Singh, J.; Singh, M. and Mishra, Y. K. 2015. Sustainable Integarated Approach for Manangment of *Fusarium* wilt of tomato caused *by Fusarium oxysporum* f.sp. *lycopersici Sustn. Agric. Res.* 4 (1):133-142.

Subhani, M.N.; Sahi, S.T.; Hussain, S.; Ali, A.; Iqbal J. and Hameed, K. 2011. Evalution of various fungicide for the control of gram wilt caused by *Fusarium oxysporum* f. sp. *ciceris. African J. Agric. Res.* 6 (19): 4555-4559.

Trivedi, L. and Rathi, Y.P.S. 2016. Integrated management of seed borne *Fusarium oxysporum* f.sp. *ciceri* in chickpea wilt complex. *World J. Pharm. Pharceut. Sci*. 5 (6):2392-2402.

Wani, S.A.; Mohiddin, F.A.; Hamid, B.; Rizvi, G.; Bhat K.A.; Hamid, A.; Alam, A.; Baba, Z.A.; Padder, S.A. and Bhat, M.A. 2014. Incidence of *Fusarium* wilt of chilli (*Capsicum annum* L.) in Kashmir valley and its management by *Trichoderma spp*. *Mycopath*. 12 (1): 1-8.

How to cite this article:

Amruta D. Gadhave, Pushpa D. Patil, R. R. Rathod, U. R. Phondekar, Y. K. Nirgude, Revati R. Nalawade and Josiya Joy. 2020. *In vitro* Management *Fusarium* Wilt of Tomato through Biological and Chemical Methods. *Int.J.Curr.Microbiol.App.Sci.* 9(10): 128-135.
doi: https://doi.org/10.20546/ijcmas.2020.910.017