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Field evaluation of fungicides and bioagents against stem rot of tomato caused by *Sclerotium rolfsii* Sacc

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Abstract
The study is aimed at determining the efficacy of fungicides and bioagents on management of *S. rolfsii* under field condition. In these studies, six different fungicides *viz*., mancozeb 75 WP, thiram 75 WP, tebuconazole 25.9 EC, carboxin 75 WP, carboxin (37.5%) + thiram (37.5%) WP, tebuconazole (50%) + trifloxystrobin (25%) WG and two bioagents (*Trichoderma harzianum* and *Trichoderma viride*) were tested against stem rot in field condition. Among the different treatments drenching with carboxin (37.5%) + thiram (37.5%) at 0.1 per cent at time of disease initiation was found most effective with lowest disease incidence (2.38%, 4.37% and 5.16%) at 60, 75 and 90 days after transplanting, respectively with maximum fruit yield (36.55 t/ha). Significantly followed by carboxin (75 WP) at 0.1 per cent and tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent. While bioagents was found less effective as compared to fungicides treatments for management of stem rot of tomato.

Keywords: Stem rot, tomato, *Sclerotium rolfsii*, fungicides, bioagents, management, yield

Introduction
Tomato (*Solanum lycopersicum* L.) is one of the most widely cultivated vegetable crops in the world. It is a small annual or short-lived perennial herb with 2n=24 chromosomes number and belongs to the family *Solanaceae*. The tomato has originated in Peru and Mexican regions and was introduced into India by the Portuguese. The major tomato growing countries are Brazil, China, Egypt, India and Iran. Tomato is typical versatile vegetable and universally treated as "Protective Food".

Tomato is infected by more than 50 pathogens of various pathogens *viz*; fungi, bacteria, nematode and viruses right from seed germination to seed production and maturity resulting into substantial yield losses. Tomato is affected by several disease *viz*., Early blight, Damping off, Late blight, Wilt, Septoria leaf blight, Anthracnose, Powdery mildew, Root rot, Stem rot, Bacterial wilt, Stem and fruit canker, Root knot nematode, Tomato mosaic virus, Tobacco leaf curl virus and Tomato spotted wilt virus (Rangaswami and Mahadevan, 2002) [6].

Among the soil borne diseases of tomato stem rot caused by *Sclerotium rolfsii* Sacc. is the most destructive disease. In tomato *S. rolfsii* was responsible for a crop loss of 30 per cent and observed about 40 to 50 per cent mortality of plants (Mahato *et al*., 2017). In 1892, Peter Henry Rolfs first published a description of a new disease on tomato where some fields in Florida showed a greater than 70 per cent loss and the fungus was named *Sclerotium rolfsii* by Saccardo in 1911 (Kator *et al*., 2015) [3].

The disease caused by *S. rolfsii* was caused different diseases of the plant parts that affects, such as collar rot, basal stem rot, southern blight, root rot, white blight, white mould, white canker etc. has been observed extensively in moderate to severe form in the fields of Gujarat. The pathogen is soil-borne, polyphagous, more destructive and attain serious proportion in tropical, subtropical and warm temperate regions at 25-30ºC and 80-85 per cent relative humidity (Kator *et al*., 2015) [3]. Therefore, the present study was undertaken to evaluate some fungicides and bio-agent against stem rot disease of tomato caused by *S. rolfsii* in field condition.

Materials and Methods
Field experiment was conducted during *kharif* seasons of the year 2020 and 2021 at College Farm, N. M. College of Agriculture, NAU, Navsari to manage the stem rot of tomato.

The experiment was laid out as randomized block design with nine set of treatments with control, all the treatments were replicated thrice.

Thirty days old seedlings of tomato cv. GAT-5 were transplanted in field. Size of the plot was

4.8 × 3.6 m and the spacing was 60 cm × 40 cm. The crop was raised as per standard agronomical practices were followed as per recommendations. Treatments details are given in Table 1. The one time drenching of all fungicides treatments was undertaken at a first appearance of stem rot disease symptoms. While in case bioagents used as soil application @ 2.5 kg/ha at time of transplanting of tomato with well decomposed FYM @ 250 kg/ha.

Forty-two plants as net plot per treatment per replication were selected and recording observations at 60, 75 and 90 days after transplanting and Per cent disease incidence was assessed by formula as mentioned by Wheeler, (1969) [7].

$$\text{Disease incidence (\%)} = \frac{\text{Number of stem rot infecated plants}}{\text{Total number of plants observed}} \times 100$$

In both the seasons (2020 and 2021) mature and ripened tomato fruits were harvested regularly in all the treatments replicated and cumulative fruit yield for all pickings per plot was recorded and yield in t/ha was calculated.

Table 1: Fungicides and biocontrol agents used for the management of the tomato stem rot

Tr. No.	Treatments	Conc. (%)	Dose
T_1	Thiram 75 WP	0.25	3.33 g/lit
T_2	Mancozeb 75 WP	0.25	3.33 g/lit
T_3	Tebuconazole 25.9 EC	0.05	2.00 ml/lit
T_4	Carboxin 75 WP	0.1	1.33 g/lit
T_5	Carboxin (37.5%) + Thiram (37.5%) WP	0.1	1.33 g/lit
T_6	Tebuconazole (50%) + Trifloxystrobin (25%) WG	0.1	1.33 g/lit
T_7	*Trichoderma harzianum* (2×10^6 cfu/g)	2.5 kg/ha with 250 kg FYM	
T_8	*Trichoderma viride* (2×10^6 cfu/g)	2.5 kg/ha with 250 kg FYM	
T_9	Control	-	

Results and Discussion

Per cent disease incidence during 2020

At 60 DAT disease incidence ranged from 2.38 per cent to 12.70 per cent as against 17.46 per cent in control. Among all treatments, minimum disease incidence (2.38%) was recorded in treatment carboxin (37.5%) + thiram (37.5%) at 0.1 per cent and it was statistically at par with carboxin (75 WP) at 0.1 per cent (3.17%) and tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (3.97%).

After 75 DAT disease incidence recorded comparatively negligible increase over that of observed after 60 DAT and ranged from 5.56 to 14.29 per cent as against 23.02 per cent in control. Among all treatments, significantly least disease incidence (5.56%) was recorded with the fungicide drenching of carboxin (37.5%) + thiram (37.5%) at 0.1 per cent and it was statistically at par with carboxin (75 WP) at 0.1 per cent (7.14%) and tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (7.94%).

The indicated that per cent disease incidence of stem rot was increase at 90 DAT of crop. It was significantly lower (6.35%) in the treatment carboxin (37.5%) + thiram (37.5%) at 0.1 per cent and it was statistically at par with carboxin (75 WP) (8.73%) as compared to control (31.75%).

Per cent disease incidence during 2021

At 60 DAT disease incidence ranged from 2.38 per cent to 11.11 per cent as against 15.87 per cent in control. Among all treatments, minimum disease incidence (2.38%) was recorded in treatment carboxin (37.5%) + thiram (37.5%) at 0.1 per cent and it was statistically at par with carboxin (75 WP) at 0.1 per cent (3.17%).

After 75 DAT disease incidence increased over that of observed after 60 DAT and was ranged from 3.17 to 15.08 per cent as against 22.22 per cent in control. Among all treatments, significantly least disease incidence (3.17%) was with the treatment of carboxin (37.5%) + thiram (37.5%) at 0.1 per cent and it was statistically at par with carboxin (75 WP) at 0.1 per cent (3.97%) and tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (3.97%).

At 90 DAT all the treatments were superior in their efficacy as compared to the control. Among the treatments, the lower disease incidence was observed in carboxin (37.5%) + thiram (37.5%) at 0.1 per cent (3.97%) and was at par with carboxin (75 WP) at 0.1 per cent (4.76%) and tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (5.56%).

Pooled of 2020 and 2021

At 60 DAT, all the treatments were superior their efficacy as compared to the control. Among the treatments, significantly less disease incidence was observed in carboxin (37.5%) + thiram (37.5%) at 0.1 per cent (2.38%) and at par with treatment carboxin (75 WP) at 0.1 per cent (3.17%). Next best treatment was tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (3.97%) found at par with tebuconazole (25.9 EC) at 0.05 per cent (5.56%). Moreover, next best in mancozeb (75 WP) at 0.25 per cent (7.14%) and thiram (75 WP) at 0.25 per cent (9.13%). In case of bioagents *T. harzianum* @ 2.5 kg/ha (11.11%) and *T. viride* @ 2.5 kg/ha (11.90%) found less effective as compared to fungicide treatments. While, maximum disease recorded in control (16.67%).

As far as pooled data were concerned at 75 DAT disease incidence ranged from 4.37 to 14.68 per cent as against 22.62 per cent in control. Among all treatments, minimum disease incidence (4.37%) was recorded in treatment carboxin (37.5%) + thiram (37.5%) at 0.1 per cent and it was statistically at par with carboxin (75 WP) at 0.1 per cent (5.55%). Moreover, next best in order of merit were recorded with minimum PDI by the application of tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (5.95%), mancozeb (75 WP) at 0.25 per cent (9.92%), thiram (75 WP) at 0.25 per cent (11.51%), *T. harzianum* @ 2.5 kg/ha (13.49%) and *T. viride* @ 2.5 kg/ha (14.68%).

As far as pooled data were concerned at 90 DAT disease incidence recorded comparatively increased over that of observed after 75 DAT and ranged from 5.16 to 17.46 per cent as against 31.34 per cent in control. Among all treatments, significantly least disease incidence (5.16%) was recorded with the treatment of carboxin (37.5%) + thiram (37.5%) at 0.1 per cent and it was statistically at par with carboxin (75 WP) at 0.1 per cent (6.75%). Moreover, next best in order of merit were recorded with minimum PDI by the application of tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (7.54%), mancozeb (75 WP) at 0.25 per cent (11.90%), thiram (75 WP) at 0.25 per cent (15.07%), *T. harzianum* @ 2.5 kg/ha (16.27%) and *T. viride* @ 2.5 kg/ha (17.46%).

Table 2: Field evaluation of fungicides and bioagents for the management stem rot of tomato

Tr. No.	Treatments	Conc. (%)	60 DAT			75 DAT			90 DAT		
			2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
T_1	Mancozeb 75 WP	0.25	16.33** (7.94)*	14.54 (6.35)	15.43 (7.14)	19.45 (11.11)	17.15 (8.73)	18.30 (9.92)	20.80 (12.70)	19.45 (11.11)	20.12 (11.90)
T_2	Thiram 75 WP	0.25	17.89 (9.52)	17.15 (8.73)	17.52 (9.13)	20.12 (11.90)	19.45 (11.11)	19.78 (11.51)	24.00 (16.67)	21.53 (13.49)	22.76 (15.07)
T_3	Tebuconazole 25.9 EC	0.05	14.54 (6.35)	12.60 (4.76)	13.57 (5.56)	17.98 (9.52)	14.54 (6.35)	16.26 (7.94)	18.71 (10.32)	16.33 (7.94)	17.52 (9.13)
T_4	Carboxin 75 WP	0.1	10.12 (3.17)	10.12 (3.17)	10.12 (3.17)	15.36 (7.14)	11.36 (3.97)	13.36 (5.55)	17.15 (8.73)	12.60 (4.76)	14.88 (6.75)
T_5	Carboxin (37.5%) + Thiram (37.5%) WP	0.1	8.88 (2.38)	8.88 (2.38)	8.88 (2.38)	13.57 (5.56)	10.12 (3.17)	11.84 (4.37)	14.54 (6.35)	11.36 (3.97)	12.95 (5.16)
T_6	Tebuconazole (50%) + Trifloxystrobin (25%) WG	0.1	11.36 (3.97)	11.36 (3.97)	11.36 (3.97)	16.32 (7.94)	11.36 (3.97)	13.84 (5.95)	17.89 (9.52)	13.57 (5.56)	15.73 (7.54)
T_7	*Trichoderma harzianum* (2×10^6 cfu/g)	2.5 kg/ha with 250 kg FYM	20.18 (11.90)	18.71 (10.32)	19.45 (11.11)	21.53 (13.49)	21.43 (13.49)	21.48 (13.49)	25.28 (18.25)	22.16 (14.29)	23.72 (16.27)
T_8	*Trichoderma viride* (2×10^6 cfu/g)	2.5 kg/ha with 250 kg FYM	20.86 (12.70)	19.45 (11.11)	20.15 (11.90)	22.05 (14.29)	22.65 (15.08)	22.35 (14.68)	25.85 (19.05)	23.39 (15.87)	24.62 (17.46)
T_9	Control	-	24.69 (17.46)	23.47 (15.87)	24.07 (16.67)	28.66 (23.02)	28.10 (22.22)	28.38 (22.62)	34.29 (31.75)	33.79 (30.95)	34.04 (31.34)
			0.89	0.73	0.58	1.03	0.88	0.68	1.06	1.05	0.74
			2.67	2.19	1.66	3.08	2.65	1.95	3.18	3.14	2.15
			9.58	8.36	9.03	9.14	8.82	9.01	8.32	9.37	8.81

* Figure in parenthesis is original value, ** Figure outside parenthesis is arcsine transform value, DAT: days after transplanting

Effect of fungicides and bioagents on fruit yield of tomato

Tomato fruit yield during *kharif* 2020

Tomato fruit yield during kharif 2020 was found higher in all treatments as compared to control. The highest fruit yield (35.88 t/ha) was obtained in carboxin (37.5%) + thiram (37.5%) at 0.1 per cent which was statistically at par with carboxin (75 WP) at 0.2 per cent (33.95 t/ha) and tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (32.41 t/ha).

Tomato fruit yield during *kharif* 2021

During *kharif* 2021, total fruit yield was more (37.23 t/ha) in the treatment carboxin (37.5%) + thiram (37.5%) at 0.1 per cent which was statistically at par with carboxin (75 WP) at 0.2 per cent (34.24 t/ha) and tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (33.76 t/ha).

Pooled of 2020 and 2021

In pooled of two years, total fruit yield was significantly higher in all the treatments over control. However, maximum fruit yield (36.55 t/ha) was obtained in plot drenching with carboxin (37.5%) + thiram (37.5%) at 0.1 per cent and it was at par with carboxin (75 WP) at 0.1 per cent (34.24 t/ha). Furthermore, next best order of merit was tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent (33.08 t/ha). Moreover, next best in order of merit were tebuconazole (25.9 EC) at 0.05 per cent (30.09 t/ha), mancozeb (75 WP) at 0.25 (29.03 t/ha), thiram (75 WP) at 0.25 per cent (29.97 t/ha), *T. harzianum* @ 2.5 kg/ha (26.62 t/ha) and *T. viride* @ 2.5 kg/ha (25.37 t/ha) as compared to control (20.26 t/ha).

Results obtained in present study are more or less similar with the findings of those reported earlier by several workers. Bhat *et al.* (2015) [1] recorded that drenching with carboxin (75 WP) (1 g/lit) at time of transplanting and flowering stage found lowest per cent disease incidence (7.90%) with maximum yield (22.30 t/ha) of stem rot of chilli. Ghevariya (2019) [2] observed that soil drenching of carboxin (37.5%) + thiram (37.5%) (1 g/lit) with *T. viride* (5 g/lit) effective for management of collar rot of chickpea. Nandeesha *et al.* (2021) [5] advocated integrated management strategies for the control of wilt complex in betelvine, most effective treatment was found drenching with carboxin (37.5%) + thiram (37.5%) at 0.2 per cent + neem cake (1 kg/plant) recorded lowest disease incidence (23.33%).

Table 3: Effect of fungicides and bioagents on fruit yield of tomato

Tr. No.	Treatments	Conc. (%)	Yield (t/ha)		
			2020	2021	Pooled
T_1	Mancozeb 75 WP	0.25	28.93	29.13	29.03
T_2	Thiram 75 WP	0.25	27.78	28.16	27.97
T_3	Tebuconazole 25.9 EC	0.05	29.71	30.48	30.09
T_4	Carboxin 75 WP	0.1	33.95	34.53	34.24
T_5	Carboxin (37.5%) + Thiram (37.5%) WP	0.1	35.88	37.23	36.55
T_6	Tebuconazole (50%) + Trifloxystrobin (25%) WG	0.1	32.41	33.76	33.08
T_7	*Trichoderma harzianum* (2×10^6 cfu/g)	2.5 kg/ha with 250 kg FYM	25.85	27.39	26.62
T_8	*Trichoderma viride* (2×10^6 cfu/g)	2.5 kg/ha with 250 kg FYM	24.69	26.04	25.37
T_9	Control	-	19.29	21.22	20.26
	S.Em. ±	-	19.29	21.22	20.26
	C.D. at 5%	-	1.48	1.78	1.16
	C.V. %	-	4.45	5.33	3.33

Conclusion

The studies on fungicides and bioagents indicate that drenching with carboxin (37.5%) + thiram (37.5%) at 0.1 per cent at time of disease initiation was found most effective with lowest disease incidence (3.97%) with maximum fruit yield (36.55 t/ha), significantly followed by carboxin (75 WP) at 0.1 per cent and tebuconazole (50%) + trifloxystrobin (25%) at 0.1 per cent found effective for the management of stem rot of tomato.

References

1. Bhat MN, Sardana HR, Singh D, Srivastava C, Ahmad M. Evaluation of chemicals and bioagents against *Sclerotium rolfsii* causing southern blight of bell pepper (*Capsicum annuum* L.). Indian Phytopatho. 2015;68(1):97-100.
2. Ghevariya TV. Collar rot disease of Indian bean caused by *Sclerotium* sp. and its management. Thesis Ph.D. (Agri.), Navsari Agricultural University, Navsari, 2019, 45-48.
3. Kator L, Hosea ZY, Oche OD. *Sclerotium rolfsii*; causative organism of southern blight, stem rot, white mold and sclerotia rot disease. Ann. of Bio. Res. 2015;11:78-89.
4. Mahato A, Biswas MK, Patra S. Prevalence of collar rot of tomato caused by *Sclerotium rolfsii* (Sacc.) under the red and lateritic zone of West Bengal, India. Int. J of Currt. Micro and App. Sci. 2017;11:3231-3236.
5. Nandeesha CV, Ravindra H, Nagarajappa A. Management of wilt disease complex of betelvine incited by Meloidogyne incognita and Sclerotium rolfsii. J of Ento. and Zoo. Stud. 2021;9(1):2268-2270.
6. Rangaswami G, Mahadevan A. Disease of crop plant in India. Prentice-Hall of India Private Limited, New Delhi (Fourth Edition). 2002, 306-314.
7. Wheeler BES. An introduction to plant disease. John Willey and Sons Ltd., London, U.K, 1969, 301.