Plant Archives Vol. 20 No. 1, 2020 pp. 657-660 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

POTENTIAL OF ANTAGONIST AND AM FUNGI ON THE MANAGEMENT OF ONION BASAL ROT CAUSED BY *FUSARIUM OXYSPORUM* F. SP. *CEPAE*

R. Yuvarani[1]*, K. Raja Mohan[2], P. Balabaskar[2] and P. Sivasakthivelan[3]

[1*]Department of Plant Pathology, TNAU, Madurai-625 104 (Tamilnadu), India.
[2]Department of Plant Pathology, Faculty of Agriculture, Annamalai University, Annamalai Nagar- 608 002. (TN)
[3]Department of Agricultural Microbiology, Faculty of Agriculture, Annamalai University, Annamalai Nagar

Abstract

In the present study, combined application of antagonist and AM fungi were tested against basal rot of onion under field experiment. Among the various treatments tested, T_7 involving soil application of *T. viride* (Tv_3), *P. fluorescens* (Pf_2) and *Glomus mosseae* significantly reduced the basal rot incidence and considerably increase the biometric of onion crop. It was followed by T_4. The control treatment recorded maximum disease incidence with minimum biometric of onion.

Key words: Onion, basal rot, *F. oxysporum* f.sp. *cepae*, biocontrol agents, *G. mosseae*

Introduction

Onion (*Allium cepa* var. *aggregatum* G. Don)) a bulbous, biennial herb, pungent and edible crop is one of the most important vegetable crops grown in India (Ilhe *et al*., 2013). The crop is affected by number of pathogens and among them, *Fusarium oxysporum* f.sp. *cepae* (Hans.) Snyder and Hansen is one of the most serious soil borne diseases causing significant yield loss of up to 50 per cent (Mishra *et al*., 2014). Basal rot was first reported in United States in 1910. In India, the incidence of basal rot was first reported by Mathur and Shukla (1963). In Tamil Nadu, this disease was first observed by Ramakrishnan and Eswaramoorthy (1982) from Coimbatore district. It is more prevalent where onion is grown under high temperature condition. It causes severe losses in the productivity both in the field and storage condition (Lager, 2011). Infected seeds and soil are the source of dispersal. This disease is widespread particularly in rainy season or high moisture conditions. Most of the damage from basal rot is observed during storage (Stadnik and Dhingra, 1996). Losses due to this disease ranging from 30 to 100% (Anupama *et al*., 2014; Priya *et al*., 2016) have also been reported. Bio control is an important component of integrated disease management (IDM) that provides disease control while being relatively harmless to humans, non-polluting and bio-degradable, selective in mode of action, difficult for pathogens to develop resistance, and enhances the growth parameters in a number of vegetable crops (Sheo Raj *et al*., 2004). *Trichoderma* spp. are fungi with the ability to tolerate the antagonistic activities of competing organisms in soil leading to extremely rapid growth and abundant production of spores, appropriate enzymes and antibiotics (Parke *et al*., 1991). Besides, *Trichoderma* spp. antagonistic bacteria are considered as ideal biological control agents owing to their rapid growth, easy handling and aggressive colonization of the rhizosphere (Gnanamanickam *et al*., 2002). They can antagonize pathogens through competition, auxin and hydrogen cyanide (HCN) production, increased uptake and availability of phosphorus (Muleta *et al*., 2007). In addition to these antagonists, obligate biotrophic endosymbionts, Arbuscular Mycorrhizae, are known as plant growth promoting fungi through increasing uptake of mineral nutrients, especially phosphorus (Gill *et al*., 2002). It is also reported that inoculation of mycorrhizae enhances the growth parameters of onion (Brown *et al*., 2008). Eco friendly approach will be always better; it

***Author for correspondence :** E-mail : rajendirany@gmail.com

ensures the maximum suppression of the disease without any adverse impact on the ecosystem. the present study was planned to test the integrated effect of these antagonists and am fungi for the management of onion basal rot.

Materials and methods

The components *viz*., *Trichoderma viride* (Tv_3), *Pseudomonas fluorescens* (Pf_2) and *Glomus mosseae*) of present study were selected based on their efficacy on inhibition of test pathogen *Fusarium oxysporum* f.sp. *cepae* and reduction of disease incidence of onion basal rot under *in vitro* and pot culture experiments in our earlier study.

Field trial

Treatment schedule

T1 : Soil application of *T. viride* @ 2.5kg/ha

T2 : Soil application of *P. fluorescens* @ 2.5kg/ha

T3 : Soil application of *G. mosseae* @ 12.5kg/ha

T4 : Soil application of *T. viride* and *P. fluorescens* @ 2.5kg/ha

T5 : Soil application of *T. viride* @ 2.5kg/ha and *G. mosseae* @ 12.5kg/ha

T6 : Soil application of *P. fluorescens* @ 2.5kg/ha and *G. mosseae* @ 12.5kg/ha

T7 : Soil application of *T. viride* @ 2.5kg/ha + *P. fluorescens* @ 2.5kg/ha + *G. mosseae* @ 12.5kg/ha

T8 : Carbendazim 50% WP @ 0.1%

T9 : Control

Based on the best results obtained from the pot culture experiments, field trial were conducted in basal rot prone farmer's field at vallampadugai in cuddalore district of Tamilnadu 2017-2018, representing irrigated conditions by integrating the best treatments identified in the pot culture experiments. The blanket fertilizer schedule of (100 : 50 : 50) NPK ha^{-1} recommended by the State Agricultural Department was followed. Randomized Block Design (RBD) was used for each treatment. Each treatment was replicated thrice and a suitable control was also maintained. The variety CO_5 was used in this study. Carbendazim 50 WP @ 0.1% as soil drenchingwas used for comparison. The following observations *viz*., per cent disease incidence (%), shoot length (mm), root length (mm), number of bulb per plant and yield (t/ha) were recorded at harvest.

Result and Discussion

The combined application of biocontrol agents

Effect of combined application of antagonists (Tv_3, Pf_2) and *G. mosseae* on onion basal rot incidence (Field trial).

Tr. No.	Treatments	Disease incidence (%)			% disease increase over control		
		30 DAS	45 DAS	At harvest	30 DAS	45 DAS	At harvest
T_1	SA of *Trichoderma viride*(5) @ 2.5kg/ha	4.82^{e}	9.72^{f}	14.35^{f}	68.39	68.47	64.98
		(12.68)	(18.16)	(22.26)			
T_2	SA of *Pseudomonas fluorescens*(2) @ 2.5 kg/ha	5.35^{f}	10.81^{g}	15.81^{g}	64.91	64.93	61.42
		(13.37)	(19.19)	(23.42)			
T_3	SA of *Glomus mosseae* @ 12.5kg/ha	7.81^{g}	15.08^{h}	18.02^{h}	71.47	51.08	56.02
		(16.22)	(22.85)	(25.11)			
T_4	SA of *Trichoderma viride*(5) @ 2.5kg/ha + SA of *Pseudomonas fluorescens*(2) @ 2.5kg/ha	2.12^{b}	5.25^{b}	9.23^{b}	86.09	82.97	77.47
		(8.37)	(13.24)	(17.68)			
T_5	SA of *Trichoderma viride*(5) @ 2.5kg/ha + SA of *Glomus mosseae* @ 12.5kg/ha	3.53^{c}	7.83^{d}	10.82^{d}	85.24	74.60	73.59
		(10.82)	(16.24)	(19.20)			
T_6	SA of *Pseudomonas fluorescens*(2) @ 2.5kg/ha + SA of *Glomus mosseae* @ 12.5kg/ha	4.00^{d}	8.12^{e}	12.52^{e}	76.85	73.66	69.44
		(11.53)	(16.55)	(20.72)			
T_7	SA of *Trichoderma viride*(5) @ 2.5kg/ha + SA of *Pseudomonas fluorescens*(2) @ 2.5kg/ha + SA of *Glomus mosseae* @ 12.5kg/ha	2.00	3.48^{a}	6.95^{a}	86.88	88.87	83.04
		(8.13)	(10.75)	(13.24)			
T_8	Carbendazim 50% WP @ 0.1%	2.25^{c}	4.51^{c}	7.42^{c}	85.24	85.37	81.89
		(8.62)	(12.26)	(15.80)			
T_9	Control	15.25^{h}	30.83^{i}	40.98^{i}	00.00	00.00	00.00
		(8.62)	(33.72)	(39.80)			

*Mean of three replications

*In a column, means followed by a common letter are not significantly different at 5% level by Duncan's multiple range test (DMRT).

Effect of combined application of antagonists (Tv_3, Pf_2) and *G. mosseae* on biometrics of onion (Field trial).

Tr. No.	Treatments	Shoot length(cm)	Root length(cm)	Number of bulbs/plant	Yield t/ha
T_1	SA of *Trichoderma viride*(5) @ 2.5kg/ha	33.45[f]	5.52[f]	4.3[e]	8.0[e]
T_2	SA of *Pseudomonas fluorescens*(2) @ 2.5 kg/ha	27.25[g]	5.41[g]	4.0[e]	7.8[f]
T_3	SA of *Glomus mosseae* @ 12.5kg/ha	25.28[h]	5.20[h]	3.3[d]	7.0[g]
T_4	SA of *Trichoderma viride*(5) @ 2.5kg/ha + SA of *Pseudomonas fluorescens*(2) @ 2.5kg/ha	35.95[b]	6.52[b]	5.3[b]	8.4[b]
T_5	SA of *Trichoderma viride*(5) @ 2.5kg/ha + SA of *Glomus mosseae* @ 12.5kg/ha	35.02[c]	6.00[c]	5.0[b]	8.2[c]
T_6	SA of *Pseudomonas fluorescens*(2) @ 2.5kg/ha + SA of *Glomus mosseae* @ 12.5kg/ha	34.20[d]	5.80[d]	4.3[c]	8.1[d]
T_7	SA of *Trichoderma viride*(5) @ 2.5kg/ha + SA of *Pseudomonas fluorescens*(2) @ 2.5kg/ha + SA of *Glomus mosseae* @ 12.5kg/ha	37.62[a]	6.75[a]	6.0[a]	9.4[a]
T_8	Carbendazim 50% WP@0.1%	32.14[e]	5.65[e]	4.3[c]	8.2[c]
T_9	Control	24.43[i]	4.54[i]	2.3[f]	6.9[h]

*****Mean of three replications

*In a column, means followed by a common letter are not significantly different at 5% level by Duncan's multiple range test (DMRT).

treatment (Soil application of *T. viride* @ 2.5kg/ha. + Soil application of *P. fluorescens* 2.5kg/ha + Soil application of *G. mosseae* @ 12.5 kg/ha) (Table 1 and 2) was more effective than individual treatments, which might be due to the additive and interactive effect of the bio agents. The treatment (T_7) maintain it superiority over other treatments in reducing the basal rot incidence by minimum recording an incidence of 2.00, 3.48 and 5.25 per cent basal rot incidence at 30, 45 and at harvest respectively. It was followed by T_4 with 2.12, 5.25 and 9.23 percent disease incidence at 30, 45 and at harvest repectively. The chemical treatment recorded 7.42 percent disease incidence while control treatment recorded higher per cent disease incidence (40.98%) at harvest.

Also, the same treatment considerably enhanced the biometric of onion which recorded the maximum shoot length (37.62 cm), root length (6.75) and number of bulbs per plant (6.0) and yield (9.4t/ha). Which was followed by T_4 recorded 35.95mm, 6.52mm, 5.3 and 8.4 of shoot length, root length, number of bulbs/plant and yield (t/ha) respectively. The control treatment recorded as least biometrics. The observations made in the present study are in accordance with the findings of Tayal *et al.* (2011) and Sathiyasivanathamoorthy (2017). Yendyo *et al.* (2018) also showed that the combined application of native isolates of *Trichoderma* spp. and *P. fluorescens* reduced the disease incidence of *Ralstonia* wilt of tomato.

References

Anupama, M.P., V.I. Benagi, V.B. Nargund and R.V. Patil (2014). Survey of onion basal rot caused by *Fusarium oxysporum* f.sp. *cepae* in Karnataka. *Karanataka J. Agric. sci.,* **27(2):** 245-246.

Brown, M., E. Gregon, R. Gapasin, S. Miller and A. De Castro (2008). Management of soil borne diseases of onions in rice-vegetable system using specific biological control agents (vesicular-arbuscular mycorrhizae, VAM). *Plant Diseases,* **74:** 3-27.

Gnanamanickam, S.S., P. Vasudevan, M.S. Reddy, G. Defago and J.W. Kloepper (2002). In: Gnanamanickam, SS, Editor. *Biological control of crop diseases*. New York (NY): Marcel Dekker. pp.1-9.

Ilhe, M., N.A. Musmade and S.B. Kewade (2013). Studies on basal bulb rot of onion caused by *Fusarium oxysporum* f.sp. *cepae*. *Internat. J. Plant Protec*., **6(2):** 364-366.

Gill, T.S., R.S. Singh and J. Kaur (2002). Comparison of four arbuscular mycorrhizal fungi for root colonization, spore population and plant growth response in chickpea. *Indian Phytopathology.,* **55:** 210-213.

Lager, S. (2011). Survey of Fusarium species on yellow onion (Allium cepa) on Oland. M.Sc. thesis. Uppsala: Swedish (SLU), Swedish University of Agricultural Science. pp. 13-25.

Mathur, B.L. and H.C. Shukla (1963). Basal rot of onion. *Phytopathology,* **32:** 420.

Mishra, R.K., R.K. Jaiswal, D. Kumar, P.R. Saabale and A. Singh (2014). Management of major diseases and insect pests of onion and garlic: A comprehensive review. *J. Plant Breed. Crop Sci.,* **6(11):** 160-170.

Muleta, D., F. Assefa and U. Granhall (2007). *In vitro* antagonism of rhizobacteria isolated from *Coffea arabica* L. against emerging fungal coffee pathogens. *Engineering in Life Sci.,* **7:** 577–586.

Priya, R.U., Arun sataraddi and S. Darshan (2016). Survey of purple blotch of onion (*Alternaria porri* (Ellis) Cif.) in northern parts of Karnataka. *International Journal of Agriculture, Environment and Biotechnology,* **9(3):** 367-373.

Ramakrishnan, G. and S. Eswaramoorthy (1982). Incidence of wilt and bulb rotting in onion. *South Indian Hort.,* **30:** 144-145.

Parke, J.L., R.E. Joy and E.G. King (1991). Biological control of *Pythium* damping-off and *Aphanomyces* root rot of peas by application of *Pseudomonas cepacia* or *P. fluorescens* to seed. *Plant Dis.,* **75:** 987-992

Sathiyasivanthamoorthy, J. (2017). Studies on the management of dry root rot of Black gram (*Vigna mungo* L. Hepper) caused by *Macrophomina phaseolina* (Tassi) Goid. using antagonists and AM fungi. M.Sc. Thesis. Department of Plant Pathology, Annamalai University.

Sheo Raj., M.K. Meshram and D.L. Wasule (2004). Emerging biologically based technologies for disease management. In: Khadi BM, Katageri IS, Patil SB, Vamadevaiah HM, Udikeri SS, Eshanna editors. Proceedings of the International Symposium on Strategies for Sustainable Cotton Production - A Global Vision.3. *Crop Protection.,* 23-25.

Tayal, P., R. Kapoor and A.K. Bhatnagar (2011). Functional Synergism among *Glomus fasciculatum*, *Trichoderma viride* And *Pseudomonas Fluorescens* on *Fusarium* wilt in tomato. *Journal of Plant Pathology,* **93(3):** 745-750.

Stadnik, M.J. and O.D. Dhingra (1997). Root infection by *Fusarium oxysporum* f.sp. *cepae* at different growth stages and its relation to the development of onion basal rot. *Phytopath. Medit.,* **36(1):** 8–11.

Muleta, D., F. Assefa and U. Granhall (2007). *In vitro* antagonism of rhizobacteria isolated from *Coffea arabica* L. against emerging fungal coffee pathogens. *Engineering in Life Sci.,* **7:** 577–586.

Yendyo, S. and B.R. Pandey (2018). Evaluation of Trichoderma spp., *Pseudomonas fluorescens* and *Bacillus subtilis* for biological control of Ralstonia wilt of tomato (version 2; referees: 2 approved) *F1000 Research.,* **6:** 20-28.