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Eco-friendly Management of *Sclerotium rolfsii* causing Collar Rot of Brinjal (*Solanum melongena* L.)

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A B S T R A C T

Brinjal or eggplant is the fourth most important vegetable crop in India in terms of production; India being its second highest producing country with 23.7% of world's total share. Collar rot disease is proving to be a constraint for brinjal production with yield losses upto 30%. The pathogen *Sclerotium rolfsii* is able to attack all stages of the crop and is difficult to manage. A study was undertaken to investigate the efficacy of botanicals and bioagents in the management of the disease. The field experiment laid out in Randomized Block Design in the Department of Plant Pathology, SHUATS, Prayagraj during *Rabi* 2019-2020, evaluated the role of botanicals and bioagent on different growth and yield parameters of brinjal crop. Maximum plant height at 30 DAT (22.10 cm), 60 DAT (32.24 cm) and 90 DAT (40.50 cm), maximum number of branches at 30 DAT (3.53), 60 DAT (6.2) and 90 DAT (8.8), and maximum number of leaves at 30 DAT (20), 60 DAT (32.87) and 90 DAT (49.53) was obtained with seedling root dip treatment of *Trichoderma viride* +castor oil. The *Trichoderma viride* +castor oil treatment in combination, also recorded disease incidence of 0% at 30 DAT and 60 DAT, and minimum disease incidence at 90 DAT (4.17%), and the highest yield (0.575 Kg/plant) as compared to control.

Introduction

Vegetables are an essential part of healthy diet, aiding in meeting the daily nutritional requirements. Brinjal (*Solanum melongena* L.), known as the king of vegetables, is an important crop cultivated worldwide throughout the tropics and subtropics. It is indigenous to India and is extensively grown in China and South-East Asia. This solanaceous crop is India's contribution to the global palate. Regarding nutritional value per 100 g, brinjal has a very low caloric value (24 Kcal), protein (2%) and vitamin C (2.2 mg) but is a very good source of dietary fibre (3.4 g), potassium (230 mg), manganese (14 mg), calcium (9 mg), copper (0.082 mg) and thiamin (0.039 mg) (Naeem and Ozgen, 2019).

The collar rot disease on solanaceous crop may occur at any growth stage of the plant. Common symptoms include dark brown lesions at the collar region ofthe stem

followed by wilting of plants. Fungal invasion can be seen, in the form of a girdle in the collar region, just above the soil line. The girdling advances upwards, along with the white mycelium followed by formation of cream to dark brown coloured sclerotia. Along with the signs of the pathogen, the infected stem and root exhibit characteristic soft rotting and tissue maceration (Daunde *et al.*, 2018).

The pathogen of collar rot, *Sclerotium rolfsii*,has become one of the major threats both under nursery and field cultivated brinjal crop. It attacks the seedlings in the nursery bed as well as adult plants in the transplanted fields. The severity of the pathogen can be attributed to the ability of its sclerotia to withstand adverse conditions (Singh and Singh, 1994). *S. rolfsii* is a soil borne facultative pathogen, belonging to the sub-division Deuteromycotina. It is especially severe on legumes, solanaceous crops and cucurbits**.** Collar rot disease incidence of 60-100% in brinjal has been reported (Siddique *et al*, 2016; Hasan and Meah, 2019) with 16-30% yield losses (Singh and Dhancholia, 1991; Jadon, 2009). Infestation from seedling to flowering stages may result in 100% crop loss.

In the line of management for *S. rolfsii*, strategic attempts include, deep ploughing (at least 20 cm), organic amendments, soil solarization, biological or chemical control but without any satisfactory result. Also, there is no recognized resistant variety of brinjal against collar rot disease. Moreover, the application of chemical to the soil is cost-expensive and affects the environment severely. The control and management of collar rot disease and soil-borne fungal plant pathogens still remains a challenge.

Many plant oils have been reported to show antifungal activity against *S. rolfsii* (Kottearachchi *et al.*, 2012 and Sati *et al.*, 2013). Commonly available, biodegradable and safe for use botanicals of neem, mint, eucalyptus, mustard, citronella, sarpagandha, tulsi, marigold, castor and clove have resulted in inhibition of *S. rolfsii* (Dasgupta *et al.*, 2015; Siddique *et al.*, 2016; Tabing and Tiwari, 2018). *Trichoderma* spp. is one of the potent biocontrol agents for the management of soil-borne diseases. This bioagent, present in nearly all the soils, can control phytopathogens through various mechanisms including mycoparasitism, antibiosis and competition. *Trichoderma* produces chemicals called trichodermin which is responsible for its antagonistic properties. *Trichoderma* spp. have shown above 70% reduction in disease incidence of collar rot in brinjal (Bhagat and Pan, 2011; Islam *et al.*, 2016; Tabing and Tiwari, 2018). In view of this, the use of biocontrol agents and essential oils as substitutive solutions to synthetic pesticides is being aimed at.

Materials and Methods

Preparation of media

Potato Dextrose Agar (PDA) for isolation and maintenance of *Sclerotium rolfsii*

200 grams of peeled potatoes was cut into pieces and boiled in 1000 ml of distilled water. The extract was collected by passing through muslin cloth. 20 grams each of agar-agar and dextrose was dissolved in the potato extract, using heat if needed. pH was maintained at 5.6-6.5. The final volume was made up to 1000 ml by adding distilled water. The PDA solution was poured into conical flasks and tubes, plugged with non-absorbent cotton and sterilized at 121.6°C and 1.1 kg/cm^2(15 psi) pressure, for 20 minutes. The tubes were allowed to stand in inclined position to prepare slants.

Sorghum grain medium for mass multiplication of *Sclerotium rolfsii*

Sorghum grains were used as medium for the mass multiplication of *S. rolfsii* (Upadhyaya and Mukhopadhyay, 1986). 2000 g of sorghum seeds were soaked in 2% sucrose solution overnight and then allowed to air dry. The sorghum grains were transferred into conical flasks and plugged with non-absorbent cotton. For sterilization, they were autoclaved at 121°C at 15 psi pressure for 2 hours. Post sterilization, the sorghum grain medium was stored for 48 hours to detect any contamination. For mass multiplication, discs of sclerotia and mycelial growth were cut out from the pure culture of *S. rolfsii* using cork borer and transferred onto the sorghum grain medium in aseptic conditions. The flasks were shaken to allow the pathogen to spread out in the medium followed by incubation at 25±1°C for 2 weeks. This sorghum grain media containing the mass culture of the pathogen was grinded into smaller pieces in a food processor and incorporated into the treatment plots at the rate of 100 g/m^2, 10 days prior to the transplanting of seedlings and slightly watered from top.

Experimental site

The present study was carried out in the Central Research Field under the Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, during *Rabi* 2019-2020. The field experiment was laid-out in Randomized Block Design (RBD) with three replications of eight treatments, each in 2×1 m sized plots and 60×45 cm plant spacing was used.

Seedling treatment

5% each of neem oil, castor oil and clove oil suspensions were separately prepared by mixing 50 ml oil in 950 ml distilled water. For *T. viride*, 50 g per litre rate was used to prepare suspension in 1000 ml of water. For the botanicals and bioagent combinations, 25 ml oil and 25 g *T. viride* formulation were mixed in distilled water to make 1000 ml treatment solution. The roots of the seedlings were dipped in the allotted suspensions for 25-30 minutes and then allowed to air dry for 15 minutes, followed by transplanting in the designated treatment plots (Jadon, 2009).

Assessment for growth parameters and disease incidence of collar rot

Basic assessment of the plants was conducted. The growth parameters were monitored and plants were also inspected for disease symptoms and any other factors affecting them. Observations were recorded at 30, 60 and 90 days after transplanting (DAT) for plant height (cm), number of branches, number of leaves and per cent Disease Incidence (DI) of collar rot. To calculate the DI percentage, the following formula (Seem, 1984) was used:

$$DI = \frac{\text{Number of disease infected plants}}{\text{Total no. of plants assessed}} \times 100$$

Isolation and identification of pathogen

Isolation of the pathogen was done by tissue segment method (Rangaswami and Mahadevan, 1999) on PDA medium. Isolation was performed from the collar rot infected plants and it was identified as *Sclerotium rolfsii*. Infected brinjal stems (collar region) were collected from field. The collected samples were cut into small pieces; surface sterilized with mercuric chloride (0.1%) for 15-30 seconds, rinsed three times with sterile distilled water to remove the disinfectant and blotted dry. The sterilized pieces were plated (4 pieces/dish) on PDA medium in Petri plates under aseptic conditions and incubated at 25°C for 2 weeks. From the colony

obtained, pure cultures were prepared by aseptically transferring sclerotia or small bits of the fungus at the tip of a sterilized needle or forceps to the centre of fresh PDA medium in Petri plates or slants. Then, they were incubated for 2 weeks at 25°C.

To identify the pathogen, spore suspension of pure culture was prepared in sterilized distilled water. One drop of the spore suspension was placed on a slide and observed under the microscope. Morphological characters were noted and confirmation was attained through relevant literature.

Results and Discussion

The first indication of occurrence of collar rot disease in the crop was observed at as early as 25 DAT. The characteristics symptoms of the disease *viz.,* wilting, rotting in the collar region, white mycelial growth in the infected area and brown sclerotia were evident in the field on the symptomatic plants (Figure 1). In the subsequent days, the disease incidence of collar rot continued to increase, as indicated by the rise in the number of disease affected plants. The disease incidence data was thus noted at 30, 60 and 90 DAT, along with the growth parameters in the crop.

Study of the morphological characters of the fungal culture obtained by the isolation of the infected portion of the diseased plants revealed the pathogen as *Sclerotium rolfsii*. The fungus produced white mycelia growth on PDA within 3 days of incubation (Figure 2). Mycelium appeared septate and hyaline, long, straight, closely interwoven and thin-walled. The main branch hyphae possessed cross walls and clamp connections. A number of sclerotia arose on the mycelia, singly, resembling round structures with initially white to finally brown colour, and some of them joined together (Figure 3). The sclerotial balls when transferred to fresh PDA medium, germinated to produce the long filaments of hyphae.

Effect of treatments on plant growth parameters

Table 1 indicates that at all stages of the brinjal crop, at 30, 60 and 90 DAT, treatment T_6 (*Trichoderma viride* + castor oil) produced significantly superior outcome for all growth parameters *viz.,* plant height, number of branches and leaves. This was followed T_5 (*Trichoderma viride* + neem oil). Treatment with *Trichoderma viride* + castor oil before transplanting, produced maximum plant height, maximum number of branches per plant and maximum number of leaves per plant at 30, 60 and 90 DAT.

At 90 DAT (Figure 4), maximum plant height (cm) was recorded in treatment T_6(40.50), followed by T_5 (38.03), T_4 (37.85), T_1 (35.67), T_7(33.43), T_2 (32.54), T_3 (31.49) and T_0 (30.60); maximum number of branches was recorded in treatment T_6(8.8), followed by T_5 (8.1), T_4 (7.3), T_1 (6.6), T_7(6.3), T_2 (6.1), T_3 (5.6) and T_0 (5.5), and the maximum number of leaves was recorded in treatment T_6(49.54), followed by T_5 (46.47), T_4 (43.73), T_1 (41.13), T_7(38.67), T_2 (38.13), T_3 (35.13) and T_0 (34.27).

Effect of treatments on disease incidence

As shown in Table 2, T_6treatment also exhibited the minimum disease incidence of collar rot, thus providing the highest control for *Sclerotium rolfsii* among the treatments.Treatment with *Trichoderma viride* + castor oil before transplanting resulted in disease incidence of 0% at 30 DAT and 60 DAT, and minimum disease incidence at 90 DAT (4.17%). *Trichoderma viride* + castor oil treatment under field conditions gave the highest yield (0.575

Kg/plant). At 90 DAT (Figure 5), minimum DI percentage was recorded in T_6(4.17%), followed by T_5 (12.50%), T_4 (25.59%), T_1 (31.55%), T_7(33.13%), T_2 (35.71%), T_3 (39.68%) and T_0(43.33%).

Table.1 Effect of treatments on growth parameters of brinjal

Treatments		30 DAT			60 DAT			90 DAT		
		Plant Height (cm)	No. of Branches	No. of Leaves	Plant Height (cm)	No. of Branches	No. of Leaves	Plant Height (cm)	No. of Branches	No. of Leaves
T_0	Control	14.00	1.87	10.67	24.27	4.00	19.87	30.60	5.53	34.27
T_1	Neem oil 5%	17.83	2.47	13.93	29.43	4.73	26.67	35.67	6.60	41.13
T_2	Castor oil 5%	16.00	2.33	12.53	27.20	4.40	22.87	32.54	6.07	38.13
T_3	Clove oil 5%	15.27	2.27	11.60	25.87	4.20	20.93	31.49	5.60	35.13
T_4	*Trichoderma viride* 5%	18.77	2.93	16.00	30.27	5.40	29.27	37.85	7.27	43.73
T_5	*T. viride* + Neem oil 2.5% + 2.5%	20.30	3.07	18.00	31.97	5.60	30.93	38.03	8.13	46.47
T_6	***T. viride* + Castor oil** 2.5% + 2.5%	**22.10**	**3.53**	**20.00**	**34.24**	**6.20**	**32.87**	**40.50**	**8.80**	**49.53**
T_7	*T. viride* + Clove oil 2.5% + 2.5%	16.57	2.40	13.27	28.00	4.27	25.80	33.43	6.33	38.67
C.D. (5%)		0.804	0.385	1.872	1.087	0.521	1.895	1.980	0.390	1.986
SE(d) (±)		0.371	0.178	0.865	0.502	0.240	0.875	0.914	0.180	0.917

Table.2 Effect of treatments on disease incidence of collar rot in brinjal

Treatments		Disease Incidence %		
		30 DAT	**60 DAT**	**90 DAT**
T_0	Control	16.67	19.84	43.33
T_1	Neem oil 5%	0.00	8.33	31.55
T_2	Castor oil 5%	0.00	12.5	35.72
T_3	Clove oil 5%	8.33	13.1	39.68
T_4	*Trichoderma viride* 5%	0.00	4.17	25.60
T_5	*Trichoderma viride* + Neem oil 2.5% + 2.5%	0.00	0.00	12.5
T_6	***Trichoderma viride* + Castor oil** 2.5% + 2.5%	0.00	0.00	**4.17**
T_7	*Trichoderma viride* + Clove oil 2.5% + 2.5%	4.17	8.93	33.14
C.D. (5%)		8.178	9.997	15.014
SE(d) (±)		3.776	4.616	6.933

Fig.1 White mycelial growth of *Sclerotium rolfsii* seen on the collar region of Brinjal plant

Fig.2 Pure culture of *Sclerotium rolfsii* isolated from diseased plants

Fig.3 Formation of sclerotia of *Sclerotium rolfsii*

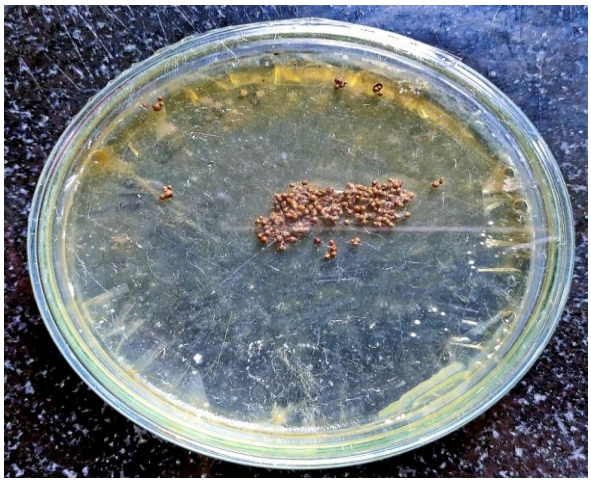


Fig.4 Comparison of effect of treatments on growth parameters of brinjal

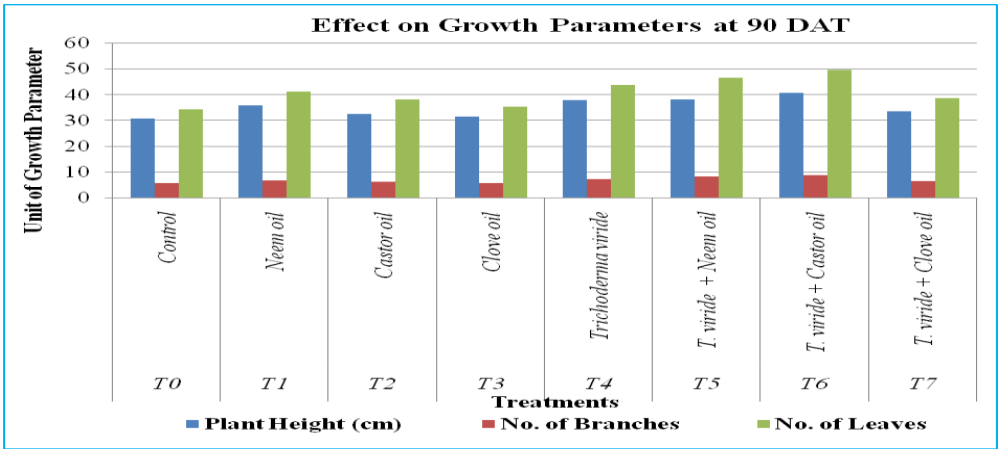
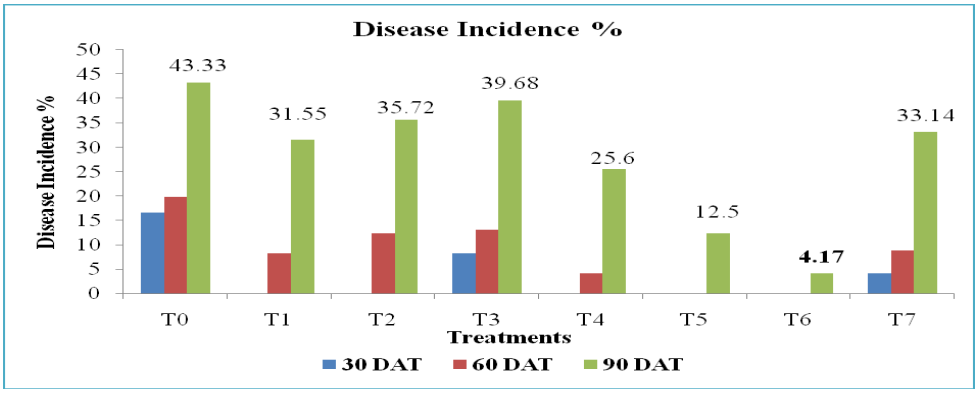


Fig.5 Comparison of effect of treatments on disease incidence of collar rot in brinjal



Present findings are in accordance with the findings of Karthikeyan *et al.*, (2006) (disease incidence of 39.98%), and Tabing and Tiwari (2018) who reported collar rot disease incidence of 44.44% in brinjal. Their control of collar rot with *Trichoderma viride* treatment provided minimum disease incidence of 7.41% and 25.92% in the case of neem oil treatment. Patil *et al.*, (2003), Islam *et al.*, (2016) and Bisen *et al.*, (2019) have reported *T. viride* treatment to limit disease incidence to 21.48%, 34.2% and 19.67%, respectively. *T. viride* and neem treatment has been found to be effective by Awasthi *et al.*, (2018) and Subhadarshini *et al.*, (2019) showing disease incidence of 13.66%.

It can be concluded from the study that bioagent *Trichoderma viride* and botanicalcastor oil in combination, was the most effective treatment against collar rot of brinjal.Under field conditions, the best plant height, the maximum number of branches and the maximum number of leaves was obtained with *Trichoderma viride* +castor oil treatment.

Trichoderma viride +castor oil treatment caused 95.83% inhibition of collar rot disease in brinjal. The treatment resulted in disease incidence of 0% at 30 DAT and 60 DAT, and minimum disease incidence at 90 DAT (4.17%).Thus, eco-friendly management of

collar rot of brinjal with *Trichoderma viride* +castor oil treatment can be applied and recommended as an effective disease management strategy.

References

Awasthi, D. P., Mishra, N. K. and Dasgupta, B. (2018). Management of stem rot of groundnut (*Sclerotium rolfsii* Sacc.) by plant oils. *Journal of Pharmacognosy and Phytochemistry*, 7(4): 2309-2311.

Bhagat, S. and Pan, S. (2011). Parasitic ability of *Trichoderma* isolates against sclerotia of *Sclerotium rolfsii* and management of collar rot of Brinjal. *Biopesticides International*, 7(1): 52-59.

Bisen, K., Ray, S. and Singh, S. P. (2019). Consortium of compatible *Trichoderma* isolates mediated elicitation of immune response in *Solanum melongena* after challenge with *Sclerotium rolfsii*. *Archives of Phytopathology and Plant Protection*, 52(7-8): 733-756.

Dasgupta, B., Barman, S., Sarkar, S. and Das, S. (2015). Efficacy of some essential oils against stem rot of groundnut (*Arachis hypogaea* L.) caused by *Sclerotium rolfsii* (Sacc.). *The Bioscan*, 10(4): 1829-1832.

Daunde, A. T, Apet, K. T., Suryawanshi, A. P. and Khandare, V. S. (2018). Prevalence of collar rot of chilli caused by *Sclerotium rolfsii* Sacc. under the agro-climatic zones of Marathwada region of Maharashtra. *Journal of Pharmacognosy and Phytochemistry*, 7(4): 1905-1908.

Hasan, M. M. and Meah, M. B. (2019). Anatomy and biochemical study of collar rot resistance in eggplant. *International Journal of Pathogen Research*,2(2): 1-13.

Islam, Md. M., Hossain, D. M., Nonaka, M. and Harada, N. (2016). Biological control of tomato collar rot induced by *Sclerotium rolfsii* using *Trichoderma* species isolated in Bangladesh. *Archives of Phytopathology and Plant Protection*, 50(3-4): 109-116.

Jadon, K. S. (2009). Eco-friendly management of brinjal collar rot caused by *Sclerotium rolfsii* Sacc. *Indian Phytopathology*, 62(3): 345-347.

Karthikeyan, V., Sankaralingam, A. and Nakkeeran, S. (2006). Biological control of groundnut stem rot caused by *Sclerotium rolfsii* (Sacc.). *Archives of Phytopathology and Plant Protection*, 39(3): 239-246.

Kottearachchi, N. S., Sammani, A., Kelaniyangoda, D. B. andSamarasekara, R. (2012). Anti-fungal activity of essential oils of Ceylon *Eucalyptus* species for the control of *Fusarium solani* and *Sclerotium rolfsii*. *Archives of Phytopathology andPlant Protection*,45(17): 2026-2035.

Lawande, K. E. and Chavan, J. K. (1998). Eggplant (Brinjal). In *Handbook of vegetable science and technology* by Salunkhe, D. K. and Kadam, S. S., CRC Press, pp. 225-244.

Naeem, M. Y. and Ozgen, S. U. O. (2019). Nutritional content and health benefits of eggplant. *Turkish Journal of Agriculture-Food Science and Technology*, 7(3): 31-36.

Patil, B. N., Raut, B. T., Patil, M., Ambhore, A. K. and Sonavane, R. S. (2003). Efficacy of different biological agents and chemicals against seed/seedling root rot of sunflower. *Annals of Plant Physiology*,17(2): 187-189.

Rangaswami, G., and Magadevan, A. (1999). Diseases of crop plants in India. Prentice Hall of India Private Limited, New Delhi, pp. 60-79.

Sati, C. S., Nitin, S., Vivek, A., Suresh, W. and Sati, O. P. (2013). Chemical composition and antifungal activity of *Artemisia nilagirica* essential oil

growing in northern hilly areas of India. *Natural Product Research*, 27(1): 45-48.

Seem, R. C. (1984). Disease incidence and severity relationships. *Annual Review of Phytopathology*, 22: 133-150.

Siddique, M. N. A., Ahmmed, A. N. F., Mazumder, Md. G. H., Khaiyam, M. O. and Islam, Md. R. (2016). Evaluation of some fungicides and bio-agents against *Sclerotium rolfsii* and foot and root rot disease of eggplant (*Solanum melongena* L.). *The Agriculturists*,14(1): 92-97.

Singh, A. and Singh, D. (1994). Biocontrol of *Sclerotium rolfsii* Sacc. causing collar rot of brinjal. *Journal of Biological Control*,8(2):105-110.

Singh, D. and Dhancholia, S. (1991). A noteworthy disease of brinjal caused by *Sclerotium rolfsii* Sacc. *Himachal Journal of Agricultural Research*. 17: 119-120.

Subhadarshini, A., Tiwari, S. and Mahanthi, K. (2019). First Report on Application of Clove Oil in Combination with *Trichoderma viride* against Stem Rot of Groundnut from Prayagraj (U.P.) India. *International Journal of Current Microbiology and Applied Sciences*, 8(11): 589-595.

Tabing, R. and Tiwari, S. (2018). An eco-friendly approach for the management of collar rot of brinjal caused by *Sclerotium rolfsii* Sacc. *International Journal of Current Microbiology and Applied Sciences*, 7(12): 929-936.

Upadhyay, J. P. and Mukhopadhyay, A. N. (1986). Biological control of *Sclerotium rolfsii* by *Trichoderma harzianum* in sugarbeet. *Tropical Pest Management*, 32(3): 215-220.

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