Biological Forum – An International Journal **15(11): 612-615(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

In vitro Bioefficacy of Bioagents against *Rhizoctonia solani* f. sp. *sasakii*, causing Maize Banded Leaf and Sheath Blight Disease

S.N. Banne[1*] and A.P. Suryawanshi[2]
[1]Department of Plant Pathology,
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (Maharashtra), India.
[2]Ex. Professor (Plant Pathology) and Principal, College of Agriculture, Udgir (Maharashtra), India.

(Corresponding author: S.N. Banne)*
(Received: 13 September 2023; Revised: 15 October 2023; Accepted: 21 October 2023; Published: 15 November 2023)
(Published by Research Trend)

ABSTRACT: Biotic and abiotic stresses are major obstacles in the cultivation and production of maize. Among biotic stresses excluding bacterial and viral diseases, many fungal diseases are of economic importance. Banded leaf and sheath blight (BLSB) appears to be most important and devastating disease of maize. Banded leaf and sheath blight (BLSB) caused by *Rhizoctonia solani* f. sp. *sasakii*, being soil borne is the major threat to successful cultivation and growing of maize. Therefore, various potential biocontrol agents were evaluated *in vitro* against the pathogen *R. solani* f. sp. *sasakii*, at the Department of Plant Pathology, VNMKV, Parbhani. Though all test bioagents were found antagonistic to the test pathogen, but most efficient were, *Trichoderma asperellum*, which resulted with significant highest mycelial growth inhibition (87.42 %), of the test pathogen, followed by *T. harzianum* (86.17 %), *T. virens* (66.36 %) and *Aspergillus niger* (65.16 %).

Keywords: Bioagents, *Rhizoctonia solani*, Banded leaf and sheath blight, *In vitro*, Inhibition.

INTRODUCTION

Maize (*Zea mays* L.), the world's leading crop is widely cultivated as for food, feed and fodder purposes was supposed to be originated from Mexico and Central America and is versatile emerging crops with wider adaptability. Globally, maize is known as "Queen of cereals" because of its highest genetic yield potential and is the Third most important cereal crop after rice and wheat. Maize ranks fourth in production and fifth in the area, among major cereals in India (Kaur *et al*., 2020).

In India, maize is cultivated on an area of 10.10 million hectares with 34.61 million tonnes of production and productivity of 3.40 tonnes during 2022-2023 (Anonymous, 2022). The predominant maize growing states contributing more than 85 per cent of the total maize production in India are: Karnataka, Madhya Pradesh, Bihar, Tamil Nadu, Telangana, Maharashtra, Andhra Pradesh, Rajasthan, Himachal Pradesh and Gujarat (Anonymous, 2021). In Maharashtra, the area under maize crop was 0.93 million hectares with 1.77 million tonnes of production and productivity of 1.90 tonnes, during 2020-2021 (Anonymous, 2021).

Among a number of fungal, bacterial and viral diseases, banded leaf and sheath blight caused by *Rhizoctonia solani* f. sp. *sasakii* Exner (*Thanatephorus cucumeris*), is one of the most destructive disease and commonly prevailing in almost all maize growing pockets of India. Whatever, maize varieties, cultivars, hybrids and composites under cultivation are more or less prone to BLSB. Hence, employing biocontrol agents to manage the diseases seems to be eco-friendly, cost-effective and promising option, over chemical disease management. Therefore, present study was undertaken to evaluate *in vitro* efficacy of efficient biocontrol agents against *R. solani* f. sp. *sasakii*, causing BLSB disease of maize.

MATERIALS AND METHODS

A total of nine biocontrol agents were evaluated *in vitro* against *R. solani* f. sp. *sasakii* (Rs-3 isolate), applying Dual Culture Technique (Dennis and Webster 1971). Seven days old cultures of the test bioagents and test pathogen were grown on respective culture media and used in present study. One each culture disc (5 mm) of the test pathogen and the test fungal bioagent (cut using sterilized cork borer) were placed at equidistance and exactly opposite to each other, on autoclaved and solidified PDA medium in sterilized glass Petri plates (90 mm). For bacterial bioagents, a culture disc (5 mm) of the test pathogen was placed along periphery of the PDA plate and exactly opposite to it pure cultures suspension of the test bacterial bioagent was streaked with wire loop/inoculation needle. For each test bioagent, three PDA plates were inoculated and all the treatments replicated thrice. The PDA plates inoculated (in the centre) alone with pure culture disc of the test pathogen were maintained as untreated control. The experimental details were as given below.

Experimental Details:

Design: Completely Randomized design (CRD)
Replications: Three
Treatments: Ten

Treatment details:

Tr. No.	Treatments	Tr. No.	Treatments
T_1	*Trichoderma asperellum*	T_6	*Verticillium lecanii*
T_2	*T. harzianum*	T_7	*Paecilomyces lilacinus*
T_3	*T. virens*	T_8	*Pseudomonas fluorescens*
T_4	*Aspergillus niger*	T_9	*Bacillus subtilis*
T_5	*Metarhizhium anisopliae*	T_{10}	Control (untreated)

Observations on linear colony growth/diameter (mm) of the test pathogen and the test bioagent were recorded at an interval of 24 hrs of incubation and continued up to seven days or till the untreated control plates were fully covered with mycelial growth of the test pathogen. Based on cumulative data, per cent mycelial growth inhibition of the test pathogen with the test bioagents, over untreated control was calculated by applying following formula (Arora and Upadhay 1978). The data was statistically analysed at 1 per cent C.D.

$$\text{Per cent Growth} = \frac{\text{Colony growth in control plate} - \text{Colony growth in Intersecting plate}}{\text{Colony growth in control plate}} \times 100$$

RESULTS AND DISCUSSION

The results obtained on mycelial growth and inhibition of *R. solani* f. sp. *sasakii* with seven fungal and two bacterial antagonists is presented in Table 1.

Results (Plate I, Table 1 and Fig. 1) revealed that all of the bioagents evaluated exhibited antagonistic activity against the test pathogen and significantly inhibited its mycelial growth, over untreated control. However, *Trichoderma asperellum* was found most effective with significantly least colony growth of the pathogen (11.32 mm) and its significantly highest mycelial growth inhibition (87.42 %), which was on par with *T. harzianum* (12.44 mm and 86.17 %). These were followed by *T. virens* (30.27 mm and 66.36 %), *Aspergillus niger* (31.35 mm and 65.16 %) and later both were on par, *Metarhizhium anisopliae* (36.22 mm and 59.75 %), *Pseudomonas fluorescens* (55.30 mm and 38.55 %), *Bacillus subtilis* (59.44 mm and 33.95 %), *Verticillium lecanii* (69.37 mm and 22.92 %) and *Paecilomyces lilacinus* (69.61 mm and 22.65 %), respectively of the pathogens colony growth and its inhibition.

Table 1: *In vitro* bioefficacy of the bioagents against *R. solani* f. sp. *sasakii*, causing maize banded leaf and sheath blight.

Tr. No.	Treatments	Colony Diam. of test pathogen * (mm)	% Inhibition
T_1	*Trichoderma asperellum*	11.32	87.42 **(69.22)**
T_2	*T. harzianum*	12.44	86.17 **(68.16)**
T_3	*T. virens*	30.27	66.36 **(54.54)**
T_4	*Aspergillus niger*	31.35	65.16 **(53.82)**
T_5	*Metarhizhium anisopliae*	36.22	59.75 **(50.62)**
T_6	*Verticillium lecanii*	69.37	22.92 **(28.60)**
T_7	*Paecilomyces lilacinus*	69.61	22.65 **(28.41)**
T_8	*Pseudomonas fluorescens*	55.30	38.55 **(38.38)**
T_9	*Bacillus subtilis*	59.44	33.95 **(35.63)**
T_{10}	Control (untreated)	90.00	00.00 **(00.00)**
S.E. ±		**0.60**	**0.52**
C.D. (P = 0.01)		**1.79**	**1.55**

*Mean of three replications. Figure in parenthesis are arc sine transformed values.
Diam.: Diameter.

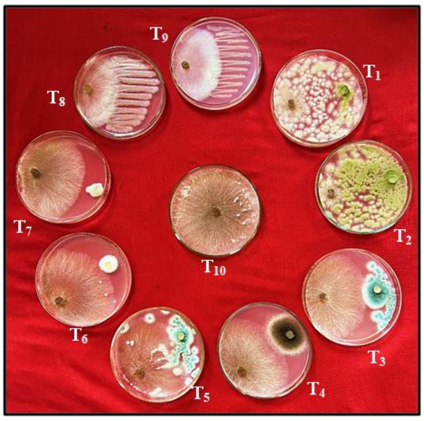

Plate I. *In vitro* bioefficacy of the bioagents against *R. solani* f. sp. *sasakii*, causing maize banded leaf and sheath blight.

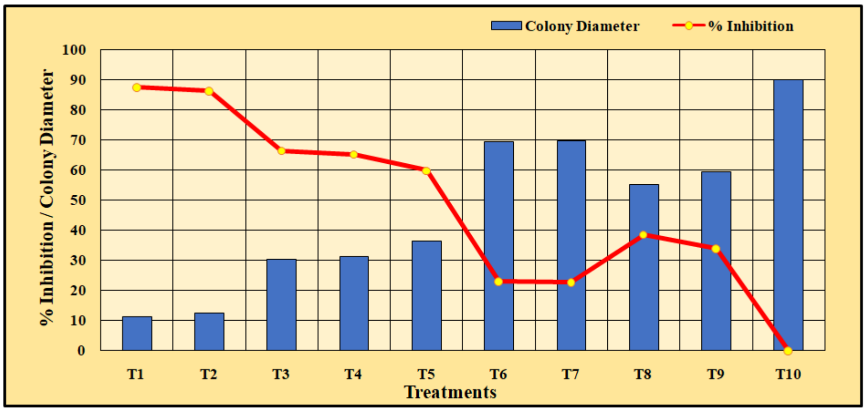

Fig. 1. *In vitro* bioefficacy of the bioagents against *R. solani* f. sp. *sasakii*, causing maize banded leaf and sheath blight.

Thus, the bioagents *viz*., *Trichoderma asperellum*, *T. harzianum*, *T. virens* and *A. niger* were found most potential antagonists against *R. solani* f. sp. *sasakii*.

These results of the present study are in consonance with the reports of several earlier workers. Seema and Devaki (2012) reported *T. viride* as most effective bioagent causing highest mycelial growth inhibition (70.00 %) of *R. solani* (tobacco sore shin), *T. harzianum* (67%) and *A. niger* (57%). Srinivas *et al*. (2013) reported *T. viride* as most effective with highest mycelial growth inhibition (72.65%%) of *R. solani* (rice sheath blight); Ambhore (2015) reported *T. viride* as most effective with highest mycelial growth inhibition (74.15 %) of *R. solani* (chickpea wet root rot); Yadav (2016) reported *T. viride* as most effective with highest mycelial growth inhibition (76.32 %) of *R. solani* (okra root rot), followed by *T. harzianum* (63.10 %); Shrishti and Vishwanath (2018) reported maximum mycelial growth inhibition of *R. solani* (rice sheath blight) with *Trichoderma* spp. (77.03- 100 %); Sharma *et al*. (2019) reported maximum mycelial growth inhibition of *R. solani* (rice sheath blight) with *Trichoderma viride* (74.44 %), followed by *T. harzianum* (68.14 %); Venkateswarlu and Beura (2020) reported *T. harzianum* as most effective with highest mycelial growth inhibition (68.80 %) of *R. solani* f. sp. *sasakii* (maize BLSB), followed by *T. viride* (62.20 %); Roy *et al*. (2022) reported maximum mycelial growth inhibition of *R. solani* (rice sheath blight) with *Trichoderma* spp. (62.96-75.55 %).

Similarly, the bioagents *viz*., *Trichoderma asperellum*, *T. harzianum*, *T. virens* and *A. niger* had significantly inhibited mycelial growth of *R. solani*f. sp. *sasakii* infecting maize (Rajput *et al*., 2016; Sharma *et al*., 2020), Rice (Chaudhary *et al*., 2020; Usendi *et al*., 2020; Kabdwal *et al*., 2023), Blackgram (Sangappa and Mallesh 2016), Pigeonpea (Maruti *et al*., 2017).

Mycelial growth inhibition of *R. solani* by *Trichoderma* spp. may be attributed to the secretion of extracellular cell wall degrading enzymes such as chitinase β-1, 3-glucanase, cellulose and lectin etc., production of secondary metabolites such as glioviridin, viridian and gliotoxin, also various mechanisms such as competition, lysis, antibiosis, production of volatile / non-volatile substances.

Thus, biocontrol agents such as *Trichoderma asperellum*, *T. harzianum*, *T. virens* and *A. niger* proved to be potential antagonist could be extensively employed to manage several plant diseases/pathogens, including *R. solani* f. sp. *sasakii.*

CONCLUSIONS

Biocontrol agents such as *Trichoderma asperellum*, *T. harzianum*, *T. virens* and *A. niger* proved to be potential antagonist could be extensively employed to manage several plant diseases/pathogens, including *R. solani* f. sp. *sasakii.*

Acknowledgement. We are thankful to the Head of the Department of Plant Pathology, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani for providing the research facilities.

REFERENCES

Ambhore, P. K. (2015). Investigation on wet root rot of chickpea incited by *Rhizoctonia solani* (kuhn). The*sis submitted to Vasantarao Naik Marathwada Krishi Vidyapeeth, Parbhani*, (M.S.), India. pp. 47.

Anonymous, (2021). https://www.indiastatagri.com/

Anonymous, (2021). https://www.usda.gov/

Anonymous, (2022). https://www.usda.gov/

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

Chaudhary, S., Sagar, S., Lal, M., Tomar, A., Kumar, V. & Kumar, M. (2020). Biocontrol and growth enhancement potential of *Trichoderma* spp. against *Rhizoctonia solani* causing sheath blight disease in rice. *Journal of Environmental Biology*, *41*, 1034-1045.

Dennis, K. L. & Webster, J. (1971). Antagonistic properties of species group of *Trichoderma* and hyphal interaction. *Transactions of the British Mycological Society*, *57*, 363- 396.

Kabdwal, B. C., Sharma, R., Kumar, A., Kumar, S., Singh, K. P. & Srivastava, R. M. (2023). Efficacy of different combinations of microbial biocontrol agents against sheath blight of rice caused by *Rhizoctonia solani*. *Egyptian Journal of Biological Pest Control*, *33* (29), 1-18.

Kaur, H. S. K., Hooda, K. S., Gogoi, R., Bagaria, P., Singh, R. P., Mehra, R. & Kumar, A. (2020). Leaf stripping: an alternative strategy to manage banded leaf and sheath blight of maize. *Indian Phytopathology*, *73*, 203-211.

Maruti, Savitha, A. S., Sunkad, G. & Amaresh, Y. S. (2017). *In vitro* efficacy of fungicides and bioagents against dry root rot of Pigeonpea Caused by *Rhizoctonia bataticola* (Taub.) Butler. *International Journal of Pure and Applied Biosciences*, *5*(6), 1341-1347.

Rajput, L. S., Harlapur, S. I., Venkatesh, I., Aggarwal, S. K. & Choudhary, M. (2016). *In-vitro* study of fungicides and an antibiotic against *Rhizoctonia solani* f. sp. s*asakii*, causing banded leaf and sheath blight of maize. *International Journal of Agricultural Sciences*, *8*(54), 2846-2848.

Roy, M. K., Kotasthane, A. S. & Kumar, S. (2022). *In vitro* management of *Rhizoctonia solani*, causing sheath blight disease of Rice in North Bihar. *Biological Forum – An International Journal*, *14* (4), 432-435.

Sangappa, G. and Mallesh, S. B. (2016). Effect of bioagents and chemicals for the management of aerial blight and dry root rot of blackgram incited by *Rhizoctonia bataticola*. *International Journal of Plant Protection*, *9*(2), 424- 429.

Seema, M. & Devaki, N. S. (2012). *In vitro* evaluation of biological control agents against *Rhizoctonia solani*. *Journal of Agricultural Technology*, *8*(1), 233-240.

Sharma, B. C., Singh, R. P., Singh, R. & Kumar, P. (2020). Efficacy of bioagents and fungicides against banded leaf and sheath blight of maize caused by *Rhizoctonia solani* f. sp. *sasakii* Kuhn. *Journal of Pharmacognosy and Phytochemistry*, *9* (5), 2065-2071.

Sharma, K. K., Patil, V., Nayak, D. & Gupta, S. K. (2019). Evaluation of efficiency of bio-control agents against *Rhizoctonia solani* Kuhn, an incitant of sheath blight of rice. *Journal of Pharmacognosy and Phytochemistry*, *8* (6), 1365-1368.

Shrishti, L. & Vishwanath (2018). *In vitro* evaluation of bio agents against rice sheath blight pathogen *Rhizoctonia solani* Kuhn. *International Journal of Plant Protection*, *11* (2), 146-150.

Srinivas, P., Ratan, V., Reddy, P. N. & Bindu, M. G. (2013). *In-vitro* evaluation of fungicides, biocontrol agents and plant extracts against rice sheath blight pathogen *Rhizoctonia solani*. *International Journal of Applied Biology and Pharmaceutical Technology*, *5*(1), 121-126.

Usendi, P. N., Giri, G. K. & Kabade, S. H. (2020). Evaluation of fungicides, bioagents and botanicals against *Rhizoctonia* spp., incitant of sheath blight of rice. *International Journal of Current Microbiology and Applied Sciences*, *9* (8), 3039-3046.

Venkateswarlu, B. & Beura, S. K. (2020). Evaluation of selective fungicides and biocontrol agents for suppression of banded leaf and sheath blight of Maize (*Zea mays*). *Current Journal of Applied Science and Technology*, *39* (15), 140-146.

Yadav, R. K. (2016). Activation of resistance in okra against *Rhizoctonia solani* and its management. *M.Sc. (Agri.) Thesis Sri Karan Narendra Agriculture University*, Jobner.

How to cite this article: S.N. Banne and A.P. Suryawanshi (2023). *In vitro* Bioefficacy of Bioagents Against *Rhizoctonia solani* f. sp. *sasakii*, causing Maize Banded Leaf and Sheath Blight Disease. *Biological Forum – An International Journal*, *15*(11): 612-615.