International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 29-12-2021, Accepted: 13-01-2022, Published: 29-01-2022
Volume 7, Issue 1, 2022, Page No. 597-601

Biocontrol of top rot of bajra by using *Trichoderma spp.*

V V Bhosale, S S Kamble
Department of Botany, Mycology and Plant Pathology Research Laboratory, Shivaji University, Kolhapur, Maharashtra, India

Abstract
Top rot of bajra caused by *Fusarium verticillioides* is one of the destructive disease wherever bajra is grown. In the present study, antagonistic activity of five *Trichoderma* spp. was tested *in vitro* against *Fusarium verticillioides* sensitive and resistant to Roko (Thiophanate methyl 70% WP) in dual culture technique. As compared to other *Trichoderma* spp used, *Trichoderma harzianum* was most effective against *F. verticillioides* controlling the pathogen above 72.84% and 76.17% in sensitive and resistant isolates respectively. Use of *Trichoderma* spp. for controlling top rot of bajra is ecofriendly technique that can serve as the good alternative to avoid harmful effect of chemical fungicides.

Keywords: sensitive, resistant, roko, top rot, *Trichoderma harzianum*

Introduction
Bajra (*Cenchrus americanus* (L.) Morrone) is the most widely grown millet in the Africa and Indian subcontinent since prehistoric times. It is well adapted to growing areas characterized by drought, low soil, fertility and high temperatures. It grows well in soils with high salinity and low pH because of its tolerance to difficult growing conditions where other cereal crops, such as maize and wheat would not survive. India is the largest producer of bajra. It covers an area of about 10 million hectares. Rajasthan is the highest bajra producing state in India followed by Uttar Pradesh, Gujarat, Madhya Pradesh, Haryana, Maharashtra, Karnataka and Tamil Nadu. Most millets have impressive nutritional profiles, including bajra (Bora *et al*., 2019) [1]. Bajra contains plant chemicals like antioxidants, polyphenols, and phytochemicals, all of which are contributing to optimal human health in many ways. (Muthamilarasan *et al*., 2016) [8].
Top rot is one of the major disease affecting bajra production worldwide and it is caused by *Fusarium verticillioides* (Sacc.) Nirenberg. (Wells, 1956) [19]. In India Ramakrishnan (1949) [10] noticed this disease on cumbu (*Pennisetum typhoides*) in Coimbatore. The objective of this research was to study antagonistic action of five *Trichoderma* spp. against *F. verticillioides* sensitive and resistant to Roko *in vitro.*

Materials and Methods
Samples of top rot of bajra were collected from Sangli, Solapur, Belgaum and Vijayapura districts of Maharashtra and Karnataka. These samples were collected in sterile polythene bags and brought to the Mycology and Plant Pathology research laboratory, Department of Botany, Shivaji University, Kolhapur and cut into 2-3mm pieces, surface disinfected with 70% alcohol for 2-3 minutes, washed 3 times with sterile distilled water and inoculated on Czapek Dox Agar (Czapek, 1901-1902)[2] medium amended with streptomycin and incubated for 8 days at 28±2^0 C. Fungal colonies were identified by following monograph on the genus *Fusarium* by Refai *et al*., (2015) [11]. *In vitro* minimum inhibitory concentration (MIC) of *Fusarium verticillioides* to Roko was checked by using food poisoning technique (Dekker and Gielink, 1979) [3]. It was ranged from 20 µg/ml to 60 µg/ml. Isolate Fv-16 was found to be sensitive and isolate Fv-4 was resistant.
Five *Trichoderma* species were used against Roko sensitive and resistant isolates of *F. verticillioides* in dual culture technique (Morton and Stroube, 1955) [7]. Sterilized Czepak dox agar (CDA) medium was poured into petriplates and allowed to solidify. An 8 mm diameter of mycelial disc from the actively growing margins was taken from seven-day old culture of *Trichoderma spp. (T. virens, T. harzianum, T. asperellum, T. viride,* and *T. pseudokoningii)* and an 8 mm discs of *F. verticillioides* were placed on the opposite side of the plate at equal distance from periphery and incubated at 28±2°C. Three replications were maintained for each sensitive and resistant isolate. In control plates a sterile agar disc of *F. verticillioides* was placed at centre. After 8 days of incubation period, radial growth of pathogen was measured. The colony diameter was recorded and inhibition in each treatment was calculated using the formula given by Wonglom *et al*., (2019) [20].

Inhibition of radial mycelial growth (I) = (C – T)/C × 100.

Where,
C – Radial growth of pathogen in control plate.

T – Radial growth of pathogen in treated plate.
I – Inhibition of radial mycelial growth.

Results and Discussion

In the present investigation it was observed that minimum inhibitory concentration of *Fusarium verticillioides* to Roko ranged from 20 µg/ml to 60 µg/ml (Table-1, Fig-1). All *Trichoderma* spp. were effective against the fungal pathogen *F. verticillioides*. *Trichoderma harzianum* was most effective against *F. verticillioides* inhibiting the pathogen above 72.84% and 76.17% in sensitive and resistant isolate respectively. *T. pseudokoningii* (60.62%, 71.73%), *T. virens* (63.95%, 61.48%), *T. asperellum* (62.72%, 68.40%) and *T. viride* (62.72, 66.17%) inhibiting the sensitive and resistant isolate respectively. Biocontrol of *Fusarium verticillioides* by using *Trichoderma* spp. showed very good result (Table-2, Fig-2).

Weindling (1934) [18] fisrt discovered the genus *Trichoderma* spp. as biocontrol agent and since numerous studies have demonstrated that *Trichoderma* is an effective biocontrol agent for phytopathogenic microorganisms (Harman, 1996) [4]. *Trichoderma* attaches to the host and coil around the host cell and collapses the host hyphae (Steyaert *et al*., 2003) [14].

Results similar to the present findings were recorded by Waghe *et al*., (2015) [16] and reported that *T. harzianum* was found most effective showed 72.22% mycelial growth inhibition in *Alternaria helianthus* causing *Alternaria* blight disease in sunflower.

Patil and Kamble (2019) [9] found that *T. harzianum* and *T. asperellum* species gave inhibition of twelve isolates of *Rhizoctonia solani* causing blight of blackgram. *Trichoderma spp. in vitro* effectively inhibited the growth and sporulation of *F. oxysporum f.sp. cumini* causing cumin wilt through production of volatile and non-volatile antibiotics (Vyas and Mathur,2002) [15]. Korat and John (2015) [5] who studied the antagonistic effect of *Trichoderma* against soil borne pathogens and reported that *T. harzianum* isolate THO showed maximum percent inhibition of mycelial growth of *F. udum* (74.44%) and in case of *F. moniliforme*, *T. viride* isolate TVKN showed maximum growth inhibition (73.33%) against soil borne pathogens.

The present results were also in agreement with Waghmare and Kamble, (2014) [17] who reported that *T. harzianum* showed highest (78.88%) antagonistic potential against the *F. oxysporum* causing wilt of *Dianthus chinensis*. *T. viride* isolated from maize roots was reported to suppress radial colony extension of *F. verticillioides in vitro* (Yates *et al.,* 2000) [21].

Similarly, Singh and Dutta (2017) [13] stated that *in vitro* efficacy of three native and two *Trichoderma* spp. from ICAR laboratory were tested against *Exserohilum turcicum* in response to plant extracts and fungicides. *Trichoderma harzianum* showed 54.14% mycelial inhibition followed by *T. viride*. (53.88%). Kumar and Pandey, (2019) [6] reported *Trichoderma harzianum* @5g/kg seed is very effective biocontrol agents and should be exploited for the control of *Phomopsis* blight of Brinjal. This experimental result suggests that, *Trichoderma harzianum* and other *Trichoderma* spp. can be used to control the top rot disease of bajra.

Table 1: Minimum inhibitory concentration (MIC) of Roko against *Fusarium verticillioides* isolates causing top rot of Bajra.

Locality/s	Isoate/s	*In vitro* MIC in µg/ml
Bhingewadi	Fv-1	50
Ramnagar	Fv-2	50
Vajrachounde	Fv-3	35
Metkarwadi	Fv-4	60
Gomewadi	Fv-5	35
Kole	Fv-6	35
Pachegaon	Fv-7	30
Junoni	Fv-8	30
Chopadi	Fv-9	50
Gaudwadi	Fv-10	35
Abbihal	Fv-11	25
Jambagi	Fv-12	50
Aratal	Fv-13	25
Aralihatti	Fv-14	25
Rampur	Fv-15	25
Daddi	Fv-16	20
Honwad	Fv-17	40
Toravi	Fv-18	35
Rampurphata	Fv-19	25
Jakota	Fv-20	50

Table 2: Biocontrol of *Fusarium verticillioides* by *Trichoderma* spp. in dual culture technique.

Sr. No	*Trichoderma* spp.	Isolate	Control	Radial growth of pathogen in treated plate				% Inhibition
				1	2	3	Mean	
1	*Trichoderma virens.*	Sensitive	90	32.33	34.66	30.33	32.44	63.95%
		Resistant	90	34.66	34.66	34.66	34.66	61.48%
2	*Trichoderma harzianum.*	Sensitive	90	24.33	22.66	26.33	24.44	72.84%
		Resistant	90	20.33	23.66	20.33	21.44	76.17%
3	*Trichoderma asperellum.*	Sensitive	90	33.66	33.33	33.66	33.55	62.72%
		Resistant	90	28.33	26.66	30.33	28.44	68.40%
4	*Trichoderma viride.*	Sensitive	90	34.33	33.66	32.66	33.55	62.72%
		Resistant	90	30.33	30.66	30.33	30.44	66.17%
5	*Trichoderma pseudokoningii.*	Sensitive	90	35.33	35.33	35.66	35.44	60.62%
		Resistant	90	25.33	27.66	23.33	25.44	71.73%

Conclusion

Trichoderma harzianum showed maximum inhibition of sensitive and resistant isolates of *Fusarium verticillioides*. *T. harzianum* was effective in controlling growth of pathogen causing top rot of bajra. Application of *Trichoderma* spp. for controlling top rot of bajra is ecofriendly technique. It is one of the good alternatives to avoid harmful effect of chemical fungicide application.

Acknowledgment

Authors are thankful to Council of Scientific and Industrial research (CSIR) for providing financial assistance and also thankful to Professor and Head, Department of Botany, Shivaji University, Kolhapur for providing necessary laboratory facilities and help.

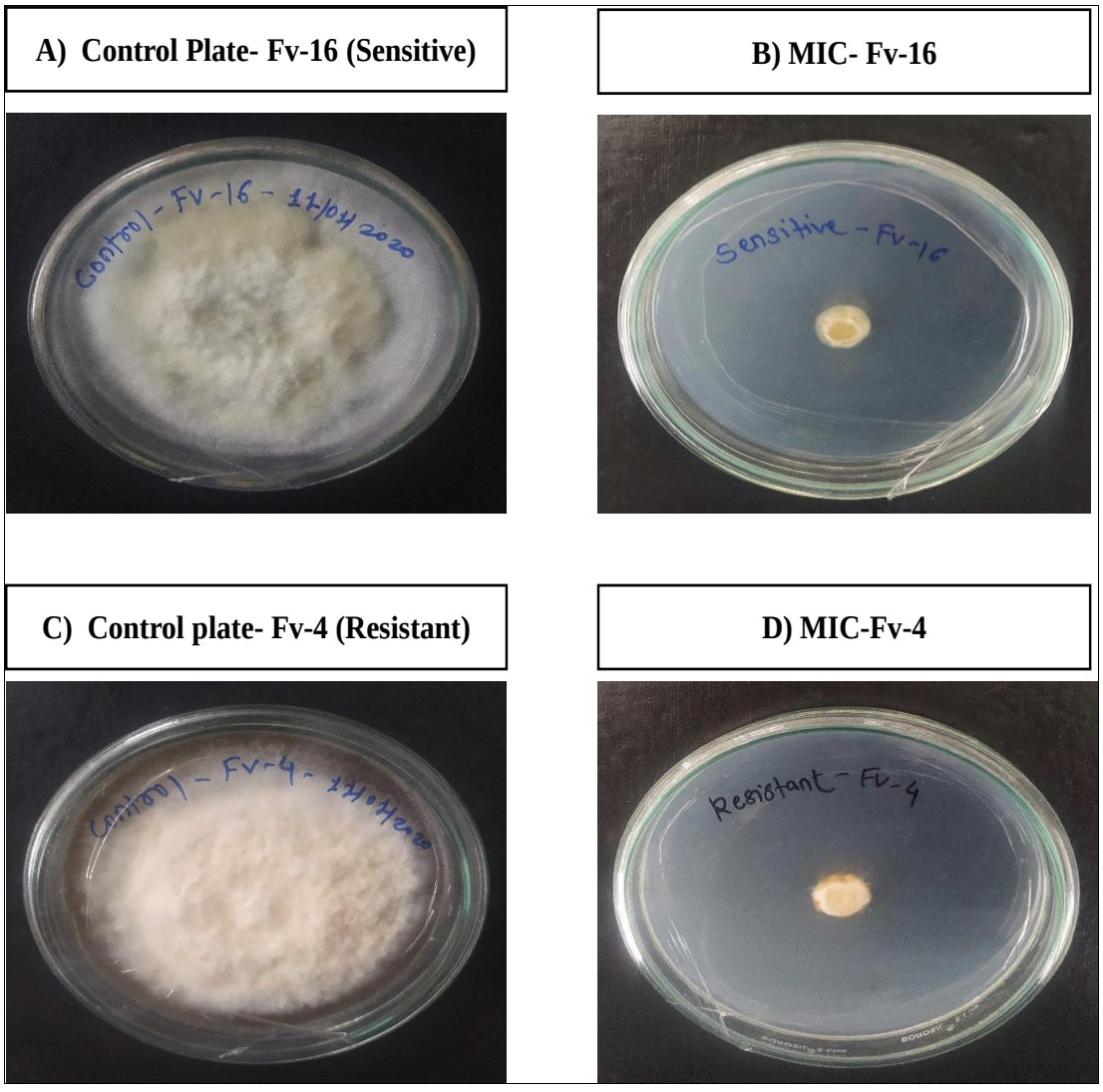

Fig 1: Minimum inhibitory concentration (MIC) of Roko sensitive (Fv-16) and resistant (Fv-4) isolate of *Fusarium verticillioides*.

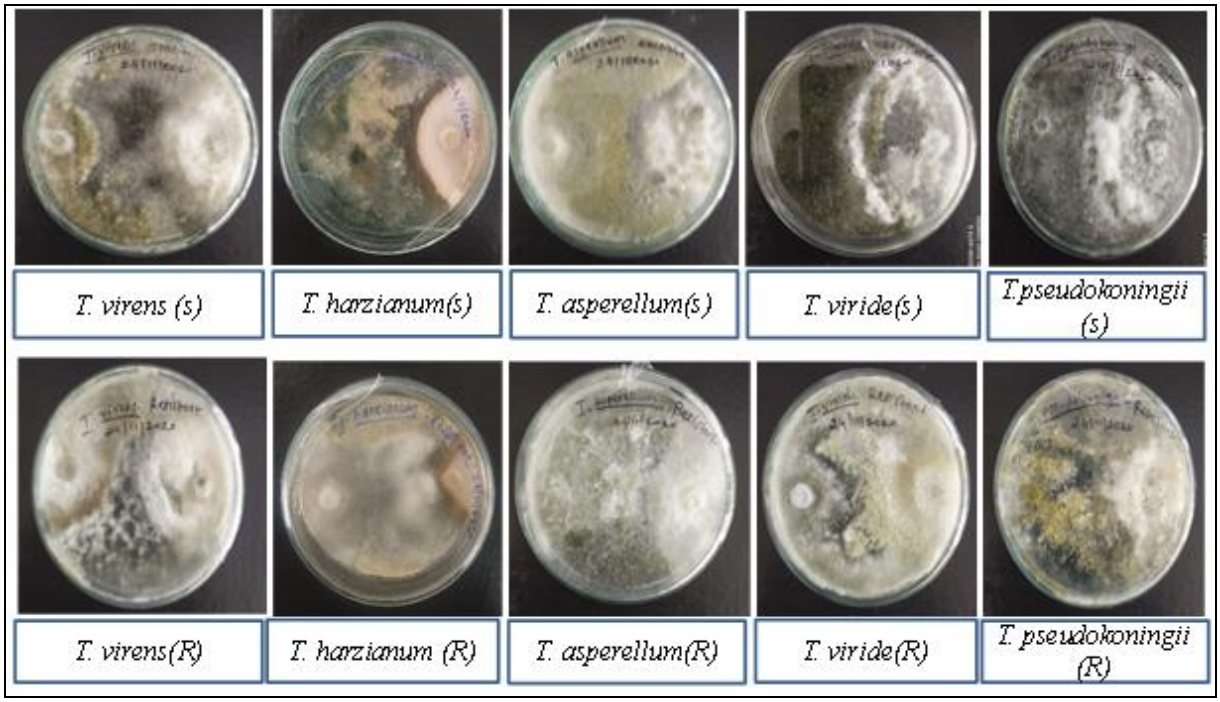

Fig 2: Biocontrol of *Fusarium verticillioides* by using *Trichoderma* spp.

References

1. Bora P, Ragaee S, Marcone M. Characterization of several types of millets as functional food ingredients. Int J Food Sci Nutr,2019:70(6):714-724.
2. Czapek F. Untersuchungen über die Stickstofffgewinnung und Eiweifsbildung der Pflanzen. [Studies on nitrogen production and protein formation of plants] Beiträge zur chemischen Physilogie und Pathologie (in German),1901-1902:1(12):538-560.
3. Dekker J, Gielink AJ. Acquired resistance to pimaricin in *Cladosporium cucumerinum* and *Fusarium oxysporum* f.sp. *narcissi* associated with decreased virulence. Neth. J. Plant Pathol,2016:85:67-73.
4. Harman GE. *Trichoderma* for biocontrol of plant pathogens: From basic research to commercialization product. www.entomology. Cornell edu. Shelton / Cornell, 1996. Accession on October, 2013.
5. Korat CG, John P. Antagonistic effect of *Trichoderma* against soil borne pathogens. Bioinfolet,2015:12(1):110-112.
6. Kumar V, Pandey T. Evaluation of different bioagents against *Phomopsis* blight in Brinjal caused by *Phomopsis*. (Sacardo and Syndow). The Bioscan, 14(3), 2019, Pages-237-239.
7. Morton DT, Stroube NH. Antagonistic and stimulatory effects of microorganism upon *Sclerotium rolfsii*. Phytopathology,1955:45:419-420.
8. Muthamilarasan M, Dhaka A, Yadav R, Prasad M. Exploration of millet models for developing nutrient rich graminaceous crops. Plant Sci,2016:242:89-97.
9. Patil SS, Kamble SS. Ecofriendly management of blight of black gram caused by *Rhizoctonia solani* Kuhn. International journal of research,2019:8(6):5602-5608.
10. Ramakrishnan TS. top- rot ('twisted top' or 'Pokkah Boeng') of sugarcane, sorghum, and Cumbu. Curr. Sci,1941:10:406-408.
11. Refai M, Hassan A, Mamed, M. Monograph on the genus *Fusarium*, 2015.
12. Seifert KA, Aoki T, Baayen RP, Brayford D, Burgess LW, Chulze S, *et al*. "The Name *Fusarium Moniliforme* should no longer be used". Mycological Research,2003:107(6): Pages-643.
13. Singh LS, Dutta R. *In vitro* efficacy of native bio-control agents from maize regime against *Exserohilum turcicum* in response to botanicals and fungicides. The Bioscan,2017:12(2):775-779.
14. Steyaert JM, Ridgway HJ, Elad Y, Stewart A. Genetic basis of mycoparasitism. A mechanism of biological control by species of *Trichoderma. J. crop.* Horticul, Sci,2003:31:281-291.
15. Vyas RK, Mathur K. Distribution of *Trichoderma spp*. in cumin rhizosphere and their potential on suppression of wilt. Indian Phytopathology,2002:55(44):451-457.
16. Waghe KP, Wagh SS, Kuldhar DP, Pawar DV. Evaluation of different fungicides, bioagents and botanicals against *Alternaria* blight caused by *Alternaria healianthi* (Hansf) of sunflower. African J. of Agri.Research,2015:10(5):351-358.

17. Waghmare RR, Kamble SS. Evaluation of *Trichoderma* spp. against *Fusarium oxysporum* causing wilt of *Dianthus chinensis*. Bioinfolet,2014:11(3):847-848.
18. Weindling R. Studies on lethal principle effective in the parasitic action of *Trichoderma lignoru*m on *Rhizoctonia solani* and other soil fungi. Phytoathol,1934:24:1153-1179.
19. Wells HD. Top rot of Pearl millet caused by *Fusarium moniliforme*. Plant Disease Reporter,1956:40(5):387.
20. Wonglom P, Daengsuwan W, Ito S, Sunpapao A. Biological control of *Sclerotium* fruit rot of snake fruit and stem rot of lettuce by *Trichoderma* sp. T76-12/2 and the mechanisms involved. Physiological and Molecular Plant Pathology,2019:107:1-7.
21. Yates IE, Meredith F, Bacon CW, Jaworski AJ. *Fusarium moniliforme* production of fumonisin B1 suppressed by *Trichoderma viride.* J. Food Protect,2000:62:1326-1332.