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Research Article

POTENTIAL ABILITY OF BACTERIAL ENDOPHYTES ISOLATED FROM MILLETS ON BIOCONTROL OF *SCLEROTIUM ROLFSII* IN FOXTAIL MILLET (*SETARIA ITALICA* L.) UNDER *IN VITRO* CONDITIONS

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Abstract- An investigation was carried out to study the efficiency of bacterial endophytes isolated from small millets for biocontrol of *Sclerotium rolfsii*, a causal organism of sheath blight in foxtail millet (*Setaria italica* variety Si A 3085 TL) grown in seedling trays under glass house conditions. Out of the total isolates obtained from small millets, 12 isolates inhibited mycelial growth of *Sclerotium rolfsii*. Isolates, KMS5 and KMS1 recorded highest antifungal activity (83.33 % and 62.22 % inhibition respectively) and KMS1 took 10.75 and KMS5 took 10.85 days for 50% germination compared to control (13.00 days) which received only pathogen. Further, lowest pre emergence disease incidence was observed with KMS5 (18.33 %) followed by KMS1 (18.75 %) whereas control with pathogen recorded highest pre emergence disease incidence (54.16). Least post emergence disease (13.91) and biocontrol efficiency (72.22 %) was observed with KMS5. Apart from showing antagonistic activity, KMS5 has recorded maximum root length (16.90 cm), shoot length (12.30 cm), root dry weight (0.157 g), shoot dry weight (0.769 g), and maximum seedling vigour index (2384.47) followed by KMS1 isolate.

Keywords- *Endophytic bacteria, Foxtail millet, Sclerotium rolfsii, Antagonistic activity*

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Introduction

Millets includes grasses like finger millet (*Eleusine coracana* (L.) Gaertn), pearl millet (*Pennisetum glaucm* (L.), foxtail millet (*Setaria italica* (L.) P. Beauvois), kodo millet (*Paspalum scorbiculatum* L.), bahiagrass (*Paspalum notatum* Flugge), little millet (*Panicum sumatrense*.), proso millet (*Panicum miliaceum* L.), barnyard millet (*Echinochola crusgalli* L.), guinea grass (*Panicum maximum*), elephant grass (*Pennisetum purpurium* that belong to the family Poaceae of the monocotyledon group.. These crops have traditionally grown in dry land farming system in India and some parts of the world from the dates back. Small millets are known by different vernacular names at different parts of the India [1-2]. Further, these millets are often growing on skeletal soils that are less than 15 cm deep and does not demand nutrient rich soils for their growth. Millets are rich in nutrients, minerals, non-glutinous and non acid forming foods [3-5]. They are also called as nutri - cereals and are a source of nutritious food, feed and fodder. Millets grows in arid and semi arid areas need very little amount of water for their growth. In India, they are grown from sea level to mid hills right from Tamil Nadu in the South to Uttarakhand in the North, and Gujarat in the West to Arunachal Pradesh in the Northeast. These crops are grown in a variety of agro-ecological situations viz., plains, coasts and hills as well as in diverse soils under varying rainfall conditions [6-7]. Endophytes are the microorganisms that present inside the host plant tissues without causing any harm or diseases to the host and have been found in every plant studied and can form different relationships including symbiotic, mutualistic, commensalistic and trophobiotic with the plants. [8-11]. Endophytic bacteria find entry into the plant through stomata, lenticels, wounds, areas of emergence of lateral roots and germinating radicles. Several recent studies confirm that plants host diverse endophytic communities including bacteria, actinomycetes and fungi [12-14] and that endophytic microbial community mostly derive from the rhizosphere [15]. Further, the endophytic bacteria are able to lessen or prevent the deleterious effects of certain pathogenic organisms by employing biocontrol mechanisms [16-18]. The biocontrol activities include antibiosis (antibiotic production), growth promotion, inducing host defenses (induced systemic resistance, ISR), parasitism, competition and signal interference like quorum sensing [19-21]. Foxtail millet (*Setaria italica*. L) also known as German, Italian, Siberian millet is one of the oldest crops cultivated for hay, pasture and grains [22]. It is called by different colloquial names as Kangni, Navane, Tenai, Korra and Rata. It has the longest history of cultivation among the millets, having been grown in china since sixth millennium BC. At present, in India, its cultivation is confined to semi-arid regions in the states of Andhra Pradesh, Karnataka, Chhattisgarh and Tamil Nadu. Under water logging conditions, it was found infected with foot rot disease caused by a soil borne necrotrophic fungi *Sclerotium rolfsii* causing considerable loss in grain yield under favorable environmental conditions [23]. *Sclerotium rolfsii* is a destroying plant pathogen with more than 500 plant species from 100 families, including almost all the agricultural and horticultural crops, which causes seedling damping-off, crown- and root-rot as well as dry rot canker, stem-rot, wilt and foot-rot [9, 34, 35, 40, 3]. Recently, endophytic bacteria have attracted more attention among researchers because of their ability to produce anti-fungal compounds [24, 25]. The role of these endophytic bacteria in the biological control has been demonstrated against different pathogens, such as *Fusarium oxysporum* f. sp. cubense [26], *Pythium* sp. [27] using endophytic *Streptomyces* and *R. solani*, (28) and vascular wilt diseases [29] by endophytic *Bacillus* species. The aim of the present study was to evaluate the application of endophytic bacteria on biocontrol of *S. rolfsii* in foxtail millet grown in seedling trays under green house conditions.

Material & Methods

The bacterial endophytes were isolated from six small millets and millets samples (Barnyard, foxtail, finger, kodo, little and proso millet) were collected during Kharif and Rabi seasons of 2016-17 from the millet research plots from Zonal Agricultural

Table-1 Antagonistic activity of endophytic bacterial isolates on growth of *Sclerotium rolfsii*

SN	Crop	Parts	Isolates	Percent inhibition (%) on *Sclerotium rolfsii*
1	Barnyard Millet	Root	BMR7	50.00^{f}
2		Leaf	BML1	54.44^{d}
3	Finger Millet	Root	FMR7	50.00^{f}
4		Root	FMR12	44.44^{h}
5	Foxtail Millet	Shoot	FTMS4	53.33^{de}
6		Shoot	FTMS5	35.55^{i}
7	Kodo Millet	Shoot	KMS1	62.22^{b}
8		Shoot	KMS5	83.33^{a}
9	Little Millet	Root	LMR4	53.33^{de}
10		Leaf	LML4	57.77^{c}
11	Proso millet	Root	PMR6	52.22^{e}
12		Leaf	PML3	47.77^{g}

Note: Means with different superscript, in a column differ significantly at P=<0.05 as per Duncan Multiple Range Test (DMRT)

Table-2 Biocontrol efficiency of bacterial endophytes on *Sclerotium rolfsii* in Foxtail millet grown in seedling trays under greenhouse condition

Treatments	Percent Germination	Days taken for 50 percent germination	Pre-emergence disease Incidence (percent)	Post-emergence disease incidence (percent)	Biocontrol Efficiency (percent)
T_1 (*Sclerotium rolfsii*)	45.83^{h}	13.00^{a}	54.16^{a}	47.82^{a}	0.01 (0.100)^{m}
T_2 (*S. rolfsii* + BMR7)	79.16^{b}	12.25^{bcd}	20.83^{i}	27.82^{de}	41.82 (6.46)^{h}
T_3 (*S. rolfsii* + BML1)	70.25^{ef}	11.95^{def}	29.75^{de}	29.56^{c}	38.18 (6.179)^{j}
T_4 (*S. rolfsii* + FMR7)	71.25^{def}	11.75^{efg}	28.75^{ef}	26.96^{ef}	43.64 (6.606)^{g}
T_5 (*S. rolfsii* + FMR12)	72.92^{d}	11.50^{g}	27.08^{g}	18.26^{i}	61.82 (7.862)^{c}
T_6 (*S. rolfsii* + FTMS4)	76.00^{c}	12.00^{def}	24.00^{h}	26.09^{f}	45.46 (6.742)^{f}
T_7 (*S. rolfsii* + FTMS5)	70.00^{ef}	11.85^{efg}	30.00^{cd}	28.69^{cd}	40.00 (6.325)^{i}
T_8 (*S. rolfsii* + KMS1)	81.25^{ab}	10.75^{h}	18.75^{j}	16.52^{j}	65.46 (8.090)^{b}
T_9 (*S. rolfsii* + KMS5)	81.66^{a}	10.85^{h}	18.33^{j}	13.91^{k}	70.91 (8.421)^{a}
T_{10} (*S. rolfsii* + LMR4)	71.66^{de}	12.15^{cde}	28.33^{f}	31.30^{b}	34.55 (5.87)^{k}
T_{11} (*S. rolfsii* + LML4)	69.16^{f}	11.65^{fg}	30.83^{c}	32.17^{b}	32.73 (5.721)^{l}
T_{12} (*S. rolfsii* + PMR6)	73.33^{d}	12.45^{bc}	26.66^{g}	24.34^{g}	49.09 (7.007)^{e}
T_{13} (*S. rolfsii* + PML3)	65.00^{g}	12.55^{b}	35.00^{b}	20.87^{h}	56.36 (7.508)^{d}

Note: Means with same superscript, in a column do not differ significantly at P=<0.05 as per Duncan Multiple Range Test (DMRT), Figures in parenthesis indicate the $\sqrt{x}$ + 0.5 transformed values.

Table-3 Effect of bacterial endophytes on *Sclerotium rolfsii* in enhancing seedling vigour of Foxtail millet grown in seedling trays under greenhouse condition

Treatments	Root length (cm)	Shoot length (cm)	Root dry weight (g)	Shoot dry weight (g)	Vigour index
T_1 (*Sclerotium rolfsii*)	11.50^{j}	8.10^{k}	0.121^{g}	0.474^{j}	898.33^{h}
T_2 (*S. rolfsii* + BMR7)	15.40^{efg}	9.50^{j}	0.142^{cdef}	0.631^{g}	1971.26^{c}
T_3 (*S. rolfsii* + BML1)	16.34^{bc}	10.10^{i}	0.136^{def}	0.681^{de}	1857.43^{ef}
T_4 (*S. rolfsii* + FMR7)	15.30^{fg}	10.50^{gh}	0.148^{bcd}	0.721^{b}	1838.26^{ef}
T_5 (*S. rolfsii* + FMR12)	16.10^{bcd}	11.20^{de}	0.137^{cdef}	0.683^{de}	1990.60^{c}
T_6 (*S. rolfsii* + FTMS4)	14.10^{i}	11.30^{cd}	0.132^{fg}	0.587^{h}	1930.40^{cd}
T_7 (*S. rolfsii* + FTMS5)	15.90^{cde}	10.90^{ef}	0.144^{cdef}	0.696^{cd}	1876.00^{def}
T_8 (*S. rolfsii* + KMS1)	16.50^{ab}	11.90^{b}	0.150^{b}	0.756^{a}	2307.53^{b}
T_9 (*S. rolfsii* + KMS5)	16.90^{a}	12.30^{a}	0.157^{a}	0.769^{a}	2384.47^{a}
T_{10} (*S. rolfsii* + LMR4)	14.70^{h}	11.60^{bc}	0.146^{bcde}	0.712^{bc}	1884.80^{de}
T_{11} (*S. rolfsii* + LML4)	14.90^{gh}	11.40^{cd}	0.138^{cdef}	0.647^{fg}	1819.10^{f}
T_{12} (*S. rolfsii* + PMR6)	15.70^{def}	10.60^{fg}	0.149^{bc}	0.665^{ef}	1928.66^{cd}
T_{13} (*S. rolfsii* + PML3)	15.40^{efg}	10.20^{hi}	0.135^{ef}	0.589^{h}	1664.00^{g}

Note: Means with same superscript, in a column do not differ significantly at P=<0.05 as per Duncan Multiple Range Test (DMRT)

Research Station (ZARS), University of Agricultural Sciences, Bengaluru, India (12.58° North latitude and 77.58° East longitude). Plant tissue samples were surface sterilized with 70% ethyl alcohol for 2 min and shaken in 1.2% (v/v) sodium hypochlorite (NaOCl) solution for 20 minutes. Samples were then washed several times with sterile distilled water and kept on mechanical shaker for 15 minutes. The samples were washed with sterile distilled water for 5-6 times. Surface sterilized plant samples were made into 1 or 2 cm bits by cutting on either sides of root, shoot and leaf bits to remove the traces of sodium hypohlorite solution on the edges of plant parts and to maintain uniformity in sizes of plant parts. The plant parts were impregnated on fresh trypticase soya agar medium (Himedia laboratories, India) and incubated at 30°C. After incubation at 30°C for 2 days, bacterial endophytes present inside plant tissues comes out along with oozing sap and form colonies on the edges of plant parts on trypticase soya agar and the inoculants were purified on fresh nutrient agar medium. The transfer procedure mentioned above was carried out 3–4 times to isolate single colonies. The isolated endophytic bacteria were stored at -70°C in nutrient broth containing 15% (v/v) glycerol for further studies [30].

Percent Inhibition

Antifungal activity was screened using dual culture method in which both endophytic bacteria and test fungi (*Sclerotium rolfsii*) were inoculated in single Potato Dextrose Agar (PDA) media plate. The test fungi, *Sclerotium rolfsii* was obtained from the Department of Plant Pathology, University of Agricultural Sciences, Banglore, India. Further, the zone of inhibition was measured and the percent inhibition of the pathogen (*Sclerotium rolfsii*) was calculated. The endophytic isolates showing high inhibition of the pathogen in plate assay were tested in liquid potato dextrose broth (Himedia laboratories, India). Each flask containing 100 ml broth was inoculated with 8 mm disc of the pathogenic fungi along with 1 ml of 24-hour old endophytic bacterial culture. One control flasks for the fungus (*Scleroyium rolfsii*) and other flask for endophytic bacteria were

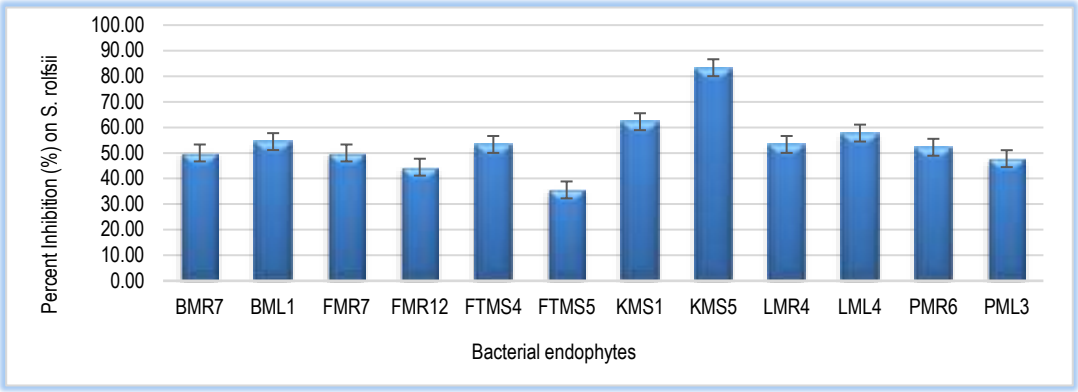

Fig-1 Antagonistic activity of endophytic bacterial isolates on growth of *Sclerotium rolfsii* in liquid culture

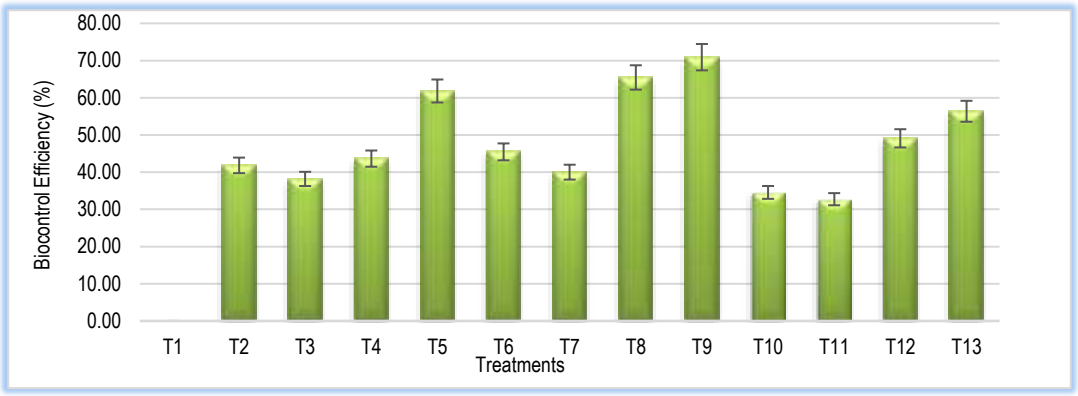

Fig-2 Biocontrol Efficiency of bacterial endophytes against *Sclerotium rolfsii* in Foxtail Millet grown in seedling trays under green house conditions

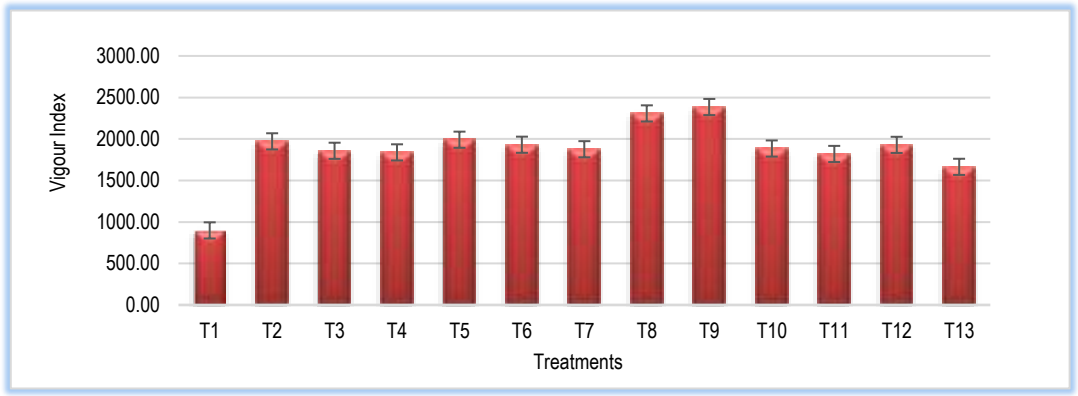

Fig-3 Vigour Index of bacterial endophytes against *Sclerotium rolfsii* in Foxtail Millet grown in seedling trays under green house conditions.

maintained separately. The flasks were incubated at 300C under static conditions for 10 days. After the incubation period, the contents were filtered through a pre-weighed whatman no.1 filter paper and the fresh weight was recorded. The filter papers were dried in an oven at 1050C for 48 hours and reweighed along with the mycelium to get the dry weight. The weight of the mycelium was calculated by subtracting the weight of the filter paper from the weight of the filter paper + mycelium. The reduction in weight of co inoculated flasks was determined by comparing with the control flasks [31].

Seedling tray experiment

A seedling tray experiment was conducted to evaluate the antagonistic and growth promoting effect of bacterial endophytes in substrate enriched with bacterial endophytes as biocontrol agents against pathogen under greenhouse condition in the Department of Agricultural Microbiology. The substrate for the experiment included 10 kilograms of coir pith enriched with 2.5 kilograms each of red earth, vermi compost and pongamia cake, which were sterilized before using for the experiment. Selected bacterial endophytes were grown in sterile nutrient broth in one litre conical flask containing 500 ml of the medium aseptically and placed on rotary shaker for 24 hours. Bacterial inoculum was added at the rate of 10 ml/kg of substrate.

Preparation of pathogen inoculums

A mixture of 940 g sand and 60 g crushed sorghum (94:6) were mixed polybags (9 X 12 inches size and 50 microns thickness) and the mixture was sterilized. Five mycelial discs of 5 mm size of pathogen (*Sclerotium rolfsii*) was taken from the potato dextrose agar (PDA) plates and transferred aseptically to the polybags containing sterilized sorghum and sand mixture and incubated at 27 ± 1 °C for 15 days.

Preparation of seedling trays and sowing

The mass multiplied pathogen inoculum of *Sclerotium rolfsii* was added to substrate mixture @ 100 grams/kg to each polybags and bacterial endophytes were added @ 100 ml per kg of seedling mixture and mixed properly one week prior to sowing. The mixed substrate was added at the rate of 100g per tray at the time of sowing. Foxtail millet seeds (variety: Si 3085 TL) was surface sterilized and sown ten seeds in each tray.

During the experimental period, the observations regarding germination percentage, percent pre and post emergence disease incidence, vigour index, biocontrol efficiency, shoot and root length at 30 days of germination and root and shoot dry weights are recorded

Statistical Analysis

All treatments in the experiment are replicated thrice and the experimental data generated in lab studies and seedling tray studies were subjected to (Complete randomized design) CRD analysis. The analysis of variance and interpretation of the data were done [32] and means were separated by Duncan Multiple Range Test (DMRT).

Results & Discussion

Millets also susceptible to diseases caused by soil borne and air borne plant pathogens. Currently, management of soil and air borne diseases in field crops is through the spraying of chemical fungicides and cultural practices. Chemical fungicides not only create problems of fungicide resistance in fungal pathogens and increases accumulation of chemical contaminants in the soil years together and leads to adverse high toxicity on microbial communities. To avoid these negative effects, biological control of foot rot using endophytic antagonistic microorganisms is an alternative method under integrated pest management practices.

Antagonistic activity of bacterial endophytes on growth of *Sclerotium rolfsii* in liquid culture

The bacterial endophytes and pathogenic fungi (*Sclerotium rolfsii*) are co inoculated in potato dextrose broth and incubated for 10 days at 30 °C under static conditions. It is clearly observed that there is a reduction in fungal mycelial weight and the growth of fungal mycelium was inhibited by bacterial endophytes may be due to the production of antagonistic substances. Maximum percent inhibition of *Sclerotium rolfsii* is observed in isolate KMS5 (83.33 %) on *S. rolfsii* in plate assay followed by KMS1 (62.22 %) and LML4 (57.77 %) [Table-1] [33, 34].

Biocontrol of *Sclerotium rolfsii* by bacterial endophytes by enhancing germination and disease incidence in Foxtail Millet grown in seedling trays under green house condition

The bacterial endophytes from small millets as biocontrol agents against *Sclerotium rolfsii* in Fox tail millet variety Si A 3085 TL under green house conditions [Table-2], [Fig-2] have positive effect on percent germination. Highest percent germination (81.66 %) was recorded with the isolate KMS5 (T9) followed by T8 (81.25 %) and T2 (79.16 %). Lowest percent germination (45.83 %) was recorded with the control (T1). Significant differences were observed between the treatments over control regarding days taken for 50 percent germination. T8 supplemented with KMS1 recorded less number of days taken for 50 percent germination (10.75 days) followed by T7 with KMS5 (10.85 days) and were on par with each other. Uninoculated control without any bacterial isolate (Control) recorded maximum days for 50 percent germination (13.00 days). Consequently, disease incidence showed that seedlings inoculated with endophytic bacteria were less affected than control. Lowest pre-emergence disease incidence (18.33 %) was observed with T9 with KMS5 followed by T8 with KMS1 (18.75%) and T9 and T8 are on par with each other. Control (T1) recorded the highest pre emergence disease incidence (54.16 %). T9 with KMS5 recorded lowest post emergence disease incidence (13.91 %) followed by T8 with KMS1 (16.52 %) and it was significantly less compare to other treatments. Control (T1) recorded maximum post emergence disease incidence (47.82 %). Highest biocontrol efficiency (70.91%) was recorded in T9 with KMS5 followed by T8 with KMS1 (65.46 %). Uninoculated control did not show any biocontrol efficiency and this may be due to lack of bacterial isolates in the treatments. The endophytic bacterial isolates KMS5 and KMS1 are efficient in controlling foot rot caused by *Sclerotium rolfsii*. This may be due to bacterial endophytes (KMS5 and KMS1) able to colonize an ecological niche similar to that of plant pathogens, which can favor them as potential biocontrol agents against foot rot [20-33]. Many biocontrol bacterial endophytes display a combination of several mechanisms [35]. Further, the observations recorded were on par with the other findings [36] where different endophytic bacterial isolates from surface disinfected seeds obtained from commercial companies, plants in the field and tissue culture. *Bacillus cereus* from Sinapis inhibited growth of *Rhizoctonia solani, Pythium ultimum* and *Sclerotium rolfsii* and also exhibited chitinase activity. *B. pumilus* from sunflower inhibited growth of *R. solani* and *S. rolfsii*. Bean seedlings inoculated with *B. subtilis, B. cereus* or *B. pumilus*, disease incidence caused by *Sclerotium rolfsii* was reduced by 72%, 79% and 26%, respectively as compared to control. Some bacterial endophytes isolated from kodo millet recorded highest antifungal activity (62.22 and 60.00% inhibition) on *Rhizoctonia solani* and took 10.95 and 11.55 days for 50 percent germination compared to control (only inoculated with fungal pathogen, *Rhizoctonia solani*) [34]. Lowest pre emergence disease incidence was observed with KMS5 (11.16 %) followed by KMS1 (12.50 %) whereas control with pathogen recorded highest pre emergence disease incidence (44.44). Least post emergence disease was observed with KMS5 (11.36) and highest biocontrol efficiency with KMS5 (72.22%). Apart from showing antagonistic activity, KMS5 has recorded maximum vigour index (2670.33) followed by KMS1 (2527.87) compared to other treatments. However, the results presented here demonstrate that endophytic bacteria isolated from different small millets are capable of residing in other plants and have the ability to inhibit different fungal species when grown under controlled greenhouse conditions.

Vigour Index of bacterial endophytes against *Sclerotium rolfsii* in Foxtail Millet grown in seedling trays under green house conditions

Further, the bacterial endophytes not only have significant biocontrol efficiency, but also enhanced seedling vigour and growth parameters of foxtail millet in seedling trays grown under green house conditions [Table-3], [Fig-3]. Significant highest root length (16.90 cm) was recorded inT9 (*S. rolfsii* + KMS5) followed by T8 (16.50 cm). Lowest root length (11.50 cm) was recorded in control which was treated with only pathogen (*Sclerotium rolfsii*). Highest shoot length (12.30 cm) was recorded in treatment T9 (*S. rolfsii* + KMS5) and it was significantly higher than T8 (*S. rolfsii* + KMS1) which recorded a shoot length 11.90 cm. Lowest shoot length (8.10 cm) was recorded in T1 (control). Maximum root dry weight (0.157 g) was observed in T9 followed by T8 (*S. rolfsii* + KMS1) which recorded 0.150 g. Control T1 which received with only pathogens recorded less root dry weight (0.121 g). Highest shoot dry weight (0.769 g) was noticed in T9 (*S. rolfsii* + KMS5) followed by T8 (0.756 g) and there is no significant difference between T9 & T8. Least shoot dry weight (0.474 g) was observed in control (T1). Consequently, maximum vigour index (2384.47) was observed in T9 (*S. rolfsii* + KMS5) followed by T8 (2307.53). Control (T1) recorded lowest vigour index (898.33).

It has been shown that resistant or asymptomatic plants in disease-infected areas are more likely to lodge endophytes with biocontrol potential than other plants which are susceptible. The plausible explanation for disease resistance of foxtail plants against pathogen in seedling trays may be due to endophytic bacterial communities occupying unique ecological niche, and growing in seedling trays may possess unique strategies for survival which make them better target for biocontrol activity studies and this is supported by many investigations [37, 38]. The results were in accordance with other workers [39], where they isolated endophytic bacteria from bean farms and among these bacterial isolates, four isolates from *Bacillus* genera and four isolates from *Streptomyces* genera were selected for evaluation of their ability for biocontrol of *Sclerotium rolfsii* in glass house conditions. They reported that, all isolates except *S. acrimycini* and *S. flavofuscus* significantly increased the root and shoot length, the fresh weight root, stem and leaves as well as the dry weight root, stem, leaves and volume of root bean seedlings compared with the positive control with *S. rolfsii*. Also, reported that B. subtilis [45] is capable of inhibiting damping-off caused by *Sclerotium rolfsii* in tomato seedlings by 80, 47 and 33%, respectively. In addition, they indicated that *Streptomyces* sp. and *S. aureofaciens* reduce tomato seedling damping-off rate by 20 and 33%. Generally, present data suggests that this bacterial endophytes from small millets might be effective antagonists which are suitable for controlling the root-rot caused by *S. rolfsii*.

Conclusion

Bacterial endophytes have potential ability to control fungal pathogens because they colonize an ecological niche similar to that of pathogens. From many scientific studies, it is known that field crops harbored efficient and competent endophytic bacterial endophytes and isolation, evaluation and screening and identification of such endophytes for plant growth promotion and biocontrol activities, plays an important role in sustainable agriculture. Further, these endophytes may be used as bio inoculants in single or consortium to achieve yield sustainability. However, in order to use these agriculturally important microorganisms, several challenges such as influences from the indigenous microflora, the environmental conditions or the inherent characteristic of the bacterial endophytes should be faced. Better understanding of the mechanisms involved in the antagonistic abilities of bacterial endophytes will possible by employing several approaches like use of genomics, in vivo expression technology, fluorescence experiments and model plants can help to achieve this objective.

Application of research: The research is applied in biocontrol of fungal pathogens in field crops and could develop as microbial inoculants for suppression of *Sclerotium rolfsii* in field crops.

Research Category: Microbiology, Biocontrol

Abbreviations: PDA-Potato Dextrose Agar, CRD-Complete randomized design, DMRT- Duncan's Multiple Range Test

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Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Department of Agricultural Microbiology, University of Agricultural Sciences, GKVK, Bengaluru, 560 065

Cultivar / Variety / Breed name: Foxtail Millet (variety - Si3085TL)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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