Journal of Sugarcane Research (2020) **10**, 198-202
https://doi.org/10.37580/JSR.2020.2.10.198-202

SHORT COMMUNICATION

Pseudomona fluorescens: Potentiality against red rot disease of sugarcane

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(Received 11 August 2020; accepted 20 October 2020)

Abstract
Red rot disease of sugarcane caused by *Colletotrichum falcatum* is one of the oldest known, most widespread and threatening diseases in sugarcane which should be controlled/managed as early as possible before it ruin the crop. There are multifarious strategies for red rot disease management, including chemical, physical methods and use of resistant varieties. Strains of fluorescent *Pseudomonas* are known to suppress the soil borne inoculum of *C. falcatum* surviving in the rhizosphere and to induce systemic resistance against red-rot. Especially *Pseudomonas flourescens* has high efficacy against red rot pathogen and enhances cane and sugar yields. Thus, it is essential to screen and evaluate bacterial strains which could be exploited for the management of red rot disease in sugarcane.

Keywords*:* Red rot; Rhizobacteria; Disease suppression; Rhizosphere; Germination; Induced resistance

In India, sugarcane is being cultivated in major parts of the country. It contributes about 7.5 percent of the gross value of agricultural production in the country (Yonzone and Devi 2018). After Brazil, India is the largest sugar producer (4142 Lakh tonnes) in the world (Anonymous 2019). In India, sugarcane is attacked by more than 50 pathogens caused by fungi, bacteria, viruses, phytoplasma and nematodes. Among all the diseases of sugarcane, red rot, smut, wilt and pineapple disease (sett rot) are the fungal diseases of economic importance (Viswanathan and Rao 2011). Red rot caused by *Colletotrichum falcatum* Went is one of the oldest known, most widespread and threatening disease in sugarcane which should be controlled/managed as early as possible before it ruin the crop (Singh and Lal 2000; Viswanathan 2010). Many diverse strategies are taken up for red rot disease management, including chemical, physical methods and use of resistant varieties. All of these methods have certain merits and demerits (Tariq et al. 2018).

Plant protection using chemicals has ecological drawbacks in terms of pesticide residues (in crop and soil) and non-target action. In this context, there is a requirement for research on eco-friendly methods that could offer multiple barriers to the red rot pathogen, thereby ensuring sustainability of its management. This can be achieved by combining management strategies like cultural methods, biological control methods and host plant resistance. Strains of fluorescent *Pseudomonas* are known to suppress the soil borne inoculum of *C. falcatum a*nd to induce systemic resistance against red-rot (Viswanathan and Samiyappan 1999; 2002). Strains of Plant Growth Promoting Rhizobacteria (PGPR) especially *Pseudomonas fluorescens* has high efficacy against red rot pathogen and enhances cane and sugar yields. Thus, it is essential to screen and evaluate bacterial strains which could be exploited for

the management of red rot disease in sugarcane (Senthil et al. 2003; Hassan et al. 2012).

Talc based formulation of *Pseudomonas fluorescens* commercially available as Pant Bioagent-2 (PBAT2) having 10^8 cfu/g was used for the experiment. Three budded setts of highly susceptible cultivar Co 1148 were used for planting, maintaining the Randomised Block Design. The experiment was laid down in the plot 3x10 m^2 size with the spacing of 30x75 cm. The germination percentage of the setts was recorded 45 days after planting.

Sett treatment with Pseudomonas fluorescens

The talc based formulation of *P. fluorescens* was mixed with water at different rates i.e. 15, 20 and 25 g/L (Viswanathan and Samiyappan 2002). The freshly cut setts were soaked in the suspension for about one hour and later incubated overnight (18 h) before planting.

Soil application of Pseudomonas fluorescens

The talc formulation was mixed with sand (@ 100 g/kg of sand) and applied in the soil at 60 and 120 days after planting in the furrow along the basal portion of the plant at different rates i.e. 50, 75 and 100 g per 3m row (Viswanathan and Samiyappan 2002) in the growing crop maintaining three replications of each treatment.

Artificial Inoculation by standard plug method was done on 180 days after planting using spore suspension of the pathogen *C. falcatum* (Cf09) having concentration of 10^6 spores/ml. Disease scoring was done 60 days after artificial inoculation by splitting open the cane following the standard 0-9 scale (Srinivasan and Bhatt 1961).

All the treatments with PBAT2 showed moderately susceptible disease reaction as compared to the untreated check that showed susceptible reaction. Out of the three methods of application, combination of the sett treatment at the time of planting with two soil applications in the field

Table 1**.** Disease reaction and germination percentages of sugarcane in response to PBAT2 applications

Treatments	Disease score	Disease reaction	Germination percentage
Sett treatment @ 15 g/L	5.2	MS	51.87
Sett treatment @ 20 g/L	5.3	MS	52.89
Sett treatment @ 25 g/L	5.3	MS	53.20
Soil application @ 50 g/row	5.4	MS	46.03
Soil application @ 75 g/row	5.3	MS	46.13
Soil application @ 100 g/row	5.0	MS	46.20
Sett treatment @ 15 g/L+ Soil application @ 75 g/row	4.2	MS	51.80
Sett treatment @ 20 g/L+ Soil application @ 75 g/row	4.2	MS	52.70
Sett treatment @ 25 g/L+ Soil application @ 75 g/row	4.2	MS	53.00
Untreated Control	8.0	S	45.97
SEm ±	0.11		0.71
CV	3.76		2.453
CD 5%	0.34		2.103

*MS= Moderately Susceptible; S= Susceptible

showed the least disease. In the combination of sett treatment with soil applications, all the three dosages i.e. 15, 20 and 25 g/L used for sett treatments with 75 g/row for soil applications were at par and showed the least disease score (4.2). The next lowest disease score was recorded where soil application of PBAT2 was done @ 100 g/row (5.0), sett treatment @ 15, 20 and 25 g/L with 5.2, 5.3 and 5.3 disease score, respectively and soil application alone @ 75 g/row (5.3) which did not differ significantly with each other. The highest disease score was recorded in soil application @ 50 g/row (5.4). The check showed a disease score of 8.0 which was significantly higher than all the PBAT2 treatments (Table 1).

The data collected on 45th day after planting to calculate the germination percentage per treatment showed that the highest germination percentage was found in the treatments that involved sett treatment with PBAT2. Sett treatment alone @ 15, 20 and 25 g/L, and combination of sett treatment @15, 20 and 25 g/L with soil application @ 75 g/row were all at par and showed significantly higher germination percentage than the treatments involving soil applications alone. The germination percentage of the treatments involving soil applications alone was at par with that of the check.

The results obtained in this study are similar to that obtained by Viswanathan (1999) in which he observed that sett treatment followed by two soil applications in the field showed maximum reduction in red rot disease severity and sett treated canes had the maximum germination percentage. Since the crop is of 10-12 months duration, application of *P. fluorescens* at the time of planting has positively influenced the germination percentage and subsequent soil applications (i.e. 60 and 120 days after planting) during the red rot vulnerable cane development period may have contributed to the reduction in disease severity. In his study, the effective dosage for sett treatment using talc based formulation (2.5 to 3 x 10^8 cfu/g) of the PGPR strains was identified as 10 to 20 g/L; but in present study all the three dosages of PBAT2 (10^8 cfu/g) i.e. 15 g/L, 20 g/L and 25 g/L were found to be at par with respect to both disease suppression and improving germination of setts. Also, among the methods of application Viswanathan (1999) had observed that sett treatment @ 20 g/L with two soil applications at 60 and 120 days after planting @ 100 g/4m row was found ideal for maximum reduction in red rot disease severity. But, in this study, all the three dosages i.e. 15, 20 and 25 g/L for sett treatments with two soil applications @ 75g/row were at par among themselves and showed the least disease severity and highest germination percentage. Since all the three dosages gave the same result, opting for the lowest dosage i.e. 15 g/L for sett treatments with two soil applications @ 75g/row would be advantageous from the cost:benefit point of view. Viswanathan and Samiyappan (2002) had observed the highest reduction in red rot disease severity in response to PGPR application was in susceptible cultivars as compared to the moderately resistant or moderately susceptible cultivars. Similar to their observation of susceptible sugarcane cultivar (CoC 671) which showed disease rating of 5.33 in PGPR treated canes and 8.20 in PGPR untreated canes, in this study, the cultivar Co 1148 showed disease rating of 4.2 in PGPR treated canes and 8.0 in PGPR untreated canes. Senthil et al. (2003) pointed out that the disease suppression by *P. fluorescens* was cultivar specific, hence there is a need for further trials to confirm that the results obtained in variety Co 1148 can be applicable to other commercially prominent cultivars as well. Viswanathan and Samiyappan (2008) had suggested the role of ISR in red rot suppression by *P. fluorescens* strains. The PGPRs are useful for the betterment of plants because they have capability to work as biofertilizers. They can intensify crop

yield through nutrient absorption and by regulating plant growth promoters. PGPR could also act as biocontrol agents by the production of antibiotics, triggering induced local or systemic resistance. As the sustainable agriculture is based on environment friendly methods so the application of *P. fluorescence* may be a good choice to manage the diseases by making the plants capable of defending themselves.

Since the challenge inoculation with *C. falcatum* (Cf 09) was done 180 days after planting *viz*. thirty days after the last PBAT2 application in the field, we can suspect the role of ISR by PBAT2 in the disease suppression and improvement in germination percentage. The high germination percentage that was found in treatments involving sett treatment may be due to the bio priming effect. The difference in effect of germination percentage and disease severity during this experiment and the findings of earlier workers may be due to the changes in environmental conditions, the soil type, cultivars of sugarcane and strain of *P. fluorescens* used.

Acknowledgement

The authors are grateful to the Head, Division of Plant Pathology and Director, Experiment Station for providing necessary help during the course of present investigation.

References

Anonymous 2019. Indian Sugar Mills Association (ISMA) statistics 2018-19. www.indiansugar.com.

Hassan MN, Afghan S, Hafeez FY. 2012. Biological suppression of sugarcane red rot by *Bacillus* sp. under field conditions. Journal of Plant Pathology. 94(2): 325-329.

Senthil S, Raghuchander T, Viswanathan R, Samiyappan R. 2003. Talc formulated fluorescent pseudomonas for sugarcane red rot suppression and enhanced yield under field conditions. Sugar Tech. 5(1): 37-43.

Singh RP, Lal S. 2000. Red rot. In: Rott P, Bailey Comstock JC, Croft BJ, Saumtally AS (editors). A guide to sugarcane diseases. 153-158.

Srinivasan KV, Bhat NR. 1961. Red rot of sugarcane: Criteria for grading resistance. Journal of Indian Botanical Society. 40:566-77.

Tariq M, Khan A, Tabassum B, Toufiq N, Bhatti MU, Riaz S, Nasir IA, Husnain T. 2018. Antifungal activity of chitinase II against *Colletotrichum falcatum* Went. causing red rot disease in transgenic sugarcane. Turkish Journal of Biology. 42:1-9.

Viswanathan R.1999. Induction of systemic resistance against red rot disease in sugarcane by plant growth promoting rhizobacteria. Ph.D. Thesis. Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 278.

Viswanathan R. 2010. Plant Disease: Red Rot of Sugarcane; New Delhi, Anmol Publishers, 306.

Viswanathan R, Rao GP. 2011. Disease scenario and management of major sugarcane diseases in India. Sugar Tech. 13(4):336-353.

Viswanathan R, Samiyappan R. 1999. Induction of systemic resistance by plant growth promoting rhizobacteria against red rot disease caused by *Colletotrichum falcatum* in sugarcane. Proceedings of Sugar Technologists Association of India 61:24-39.

Viswanathan R, Samiyappan R. 2002. Induced systemic resistance by *Pseudomonas flourescens* against red rot disease of sugarcane caused by *Colletotrichum falcatum*. Crop Protection. 21(1): 1-10.

Viswanathan R, Samiyappan R. 2008. Bio-formulation of fluorescent *Pseudomonas* sp. induces systemic resistance against red rot disease and enhances commercial sugar yield in sugarcane. Archives of Phytopathology and Plant Protection. 41:377-388.

Yonzone R, Devi MS. 2018. red stripe/top rot disease of sugarcane: A Review. International Journal of Current Microbiology and Applications in Sciences. 7(1):1469-1478.