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NEW RECORD OF BLAST DISEASE IN GRASS FODDER IN TAMIL NADU AND ITS MANAGEMENT UNDER NATURAL FIELD CONDITIONS

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SUMMARY

The fodder crops were found to have blast disease caused by the fungus *Magnaporthe* sp. at the District Livestock Farm in Naduvur, Thanjavur District, during June, 2024. The leaves of the hybrid Napier cultivars, such as CO 4, CO 5, IGFRI 6, and IGFRI 10, exhibited spindle-shaped necrotic gray lesions with distinct brown margins. Blighted leaves turn brown and dry, which can be easily observed from a distance. The middle and lower leaves of the hybrid Napier cultivars were affected by blast disease. They showed a Percent Disease Index (PDI) ranging from 18.7 to 43.6, in which the cultivar CO 4 recorded higher PDI compared to other cultivars. Under microscopic examination, the lesions clearly revealed asexual conidia that were pyriform-shaped, hyaline, two-septate (three-celled), with a hilum at the base, tapering towards the tip. Conidiophores were also observed. The liquid formulation of TNAU *Bacillus subtilis* strain Bbv 57 was sprayed all cultivars and monitored for blast disease. The results revealed that hybrid Napier cultivars treated with *Bacillus* exhibited a significantly reduced incidence of blast (PDI: 8.2 to 12.3). However, plants in the untreated control plots showed a maximum PDI of up to 62.4, especially in the hybrid Napier cultivar CO 4. Increased foliage yield in the range of 74.25 to 75.3 t/ha was observed in the treated plots compared to untreated plots which showed low yield of 39.25 to 56.0 t/ha. Therefore, blast disease on forage crops can be effectively managed through foliar application of *B. subtilis*.

Key words: *B. subtilis*, blast disease, fodder, hybrid napier and management

Forage crops, also known as fodder crops, are a crucial component of livestock-based sustainable farming systems. They are primarily grown for their leaves and stems, which provide high-quality feed for livestock through methods such as grazing or the production of harvested hay or silage. As a result, they serve as a reliable and economical source of animal feed. Additionally, forage crops contribute significantly to sequester carbon in soil, enhancing soil health and biodiversity (Bama and Babu, 2016). Most of them are drought-tolerant and can be grown throughout the year. Of them, hybrid napier (*Cenchrus purpureus* Schumach) is a perennial tropical grass belonging to the Poaceae family, originating from the grasslands of Africa. It is a widely cultivated fodder grass in India. The cross breeding of pearl millet (*Pennisetum glaucum*) and napier grass (*Pennisetum purpurium*) has yielded a robust, rhizomatous, tufted perennial grass known as hybrid napier, hybrid bajra-napier grass, elephant grass, or Uganda grass. However, it is regarded as an environmental weed in some countries. They have broad leaves, succulent stems, and are able to regenerate quickly. It allows multi-cutting thereby produce 50-150 t green forage per hectare in a small field (Peradeniya *et al.,* 2006). Regarding nutritive value, napier hybrid contains crude protein (CP) 7.94%, crude fiber 33.45%, ash 14.11%, Ca 0.41%, P 0.19% and oxalic acid 1.03% in dry matter (DM) (Chandra *et al.* 2019).

While the fodder crop provides a significant source of livestock feed, the occurrence of blast disease can lead to reduced foliage production and a subsequent fodder deficit. The reports of Savitha *et al.,* (2015) and Chandra *et al.,* (2019) were showed the maximum occurrence of blast disease from 91.8% to 100% in the hybrid napier grass. As the fodder crops are forage for livestock, application of chemical fungicides is not advisable for controlling the blast disease. Recently, biocontrol approaches have been pursued as eco-friendly and safer methods of plant

protection that utilize beneficial microbes (Warrior, 2000). Bacteria under the genus *Bacillus* are recognized as among the most widely used biocontrol agents due to their significant antagonistic effectiveness against phytopathogens (Stein, 2005). They can inhibit plant pathogens directly by producing antimicrobial compounds and indirectly by inducing resistance within the plant system. Hence, in the present study, liquid based formulation of bacterial biological control agent, *Bacillus subtilis* was applied to manage the blast disease occurring in different cultivars of hybrid napier.

MATERIALS AND METHODS

Disease assessment on forage crops

Napier grass (grass fodder) cultivars such as CO 4, CO 5, IGFRI 6 and IGFRI 10 grown at the District Livestock Farm in Naduvur, Thanjavur District, were observed to be affected by blast disease during June 2024. The fungus *Magnaporthe* sp. is an incitant of blast disease. These are ratoon crops at two months old showed the blast symptoms. Infected leaves exhibited spindle-shaped necrotic gray lesions with distinct brown margins. These lesions measured between 3 mm and 1 cm in length and 3 mm to 5 mm in diameter, enlarging and coalescing with one another. Finally, the leaves exhibited a blighted appearance and become dried. Disease scoring was done using 0 – 9 scale of IRRI-SES scale as mentioned in the Table 1 (IRRI, 2013; Singh *et al.,* 2013) and per cent disease index (PDI) was calculated using the formula.

PDI = (Sum of individual ratings/total number of plants observed) × (100/maximum grade in the score chart)

Recording weather parameters

Weather parameters such as minimum temperature, maximum temperature, relative humidity, precipitation were recorded from one week before blast disease appearance and mean values were calculated.

Preparation of bioformulation

Liquid-based bioformulation was prepared using TNAU *Bacillus subtilis* strain Bbv 57. The bacterium was streaked on to nutrient agar plate and incubated for 24 hours at room temperature (26±2°C). A loopful of bacteria from 24 hours old culture was inoculated into nutrient broth and incubated in a rotary shaker at 150 rpm for 72 hours at room temperature (26±2°C). After incubation, the broth culture containing 9×10^{-8} cfu ml^{-1}, was used as a liquid formulation.

Foliar spray of bio formulation against blast disease on forage crops

Liquid formulation of TNAU *B. subtilis* strain Bbv 57 at 2. 5 litres per ha was sprayed on the plots with hybrid napier cultivars such as CO 4, CO5, IGFRI 6 and IGFRI 10 at the District Livestock Farm in Naduvur, Thanjavur District. Plots sprayed only with sterile distilled water served as control for each napier grass cultivars. Observed regularly, disease scoring was done and PDI was calculated as mentioned above for blast symptoms. The experiment was repeated twice and the results were interpreted.

Statistical analysis

The present experimental data were analyzed using analysis of variance (ANOVA) by Agres Statistical Software Package Version 3.01.

TABLE 1
Disease severity scale

Scale	Disease severity
0	No lesion observed
1	Small brown specks of pin point size
2	Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin. Lesions are mostly found on the lower leaves
3	Lesions type is same as in scale 2, but a significant number of lesions on upper leaf area
4	Typical susceptible blast lesions, 3 mm or longer infecting less than 4 % of leaf area
5	Typical susceptible blast lesions infecting 4 - 10% of the leaf area
6	Typical susceptible blast lesions infecting 11 - 25% of the leaf area
7	Typical susceptible blast lesions infecting 26 - 50% of the leaf area
8	Typical susceptible blast lesions infecting 51 - 75% of the leaf area and many leaves are dead
9	More than 75% leaf area affected

RESULTS AND DISCUSSION

Blast disease assessment on forage crops

The results showed that the middle and lower leavers of hybrid napier cultivars CO 4, CO 5, IGFRI 6 and IGFRI 10 were observed with blast disease. They showed PDI in the range of 18.7 to 43.6. The hybrid napier cultivar CO 4 recorded maximum PDI of 43.6 compared to other cultivars.

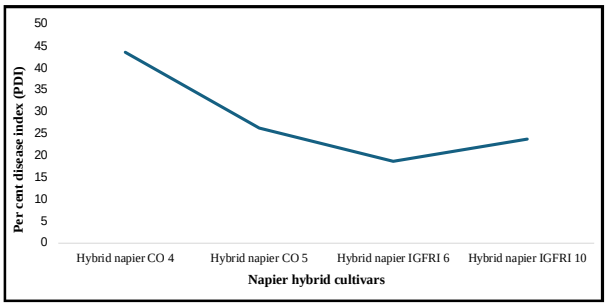


Fig. 1. Occurrence of blast disease in different cultivars of napier hybrid fodder crop.

Weather parameters

The results of weather parameters observed from one week before blast disease appearance during June 2024 showed that a mean minimum temperature, maximum temperature, relative humidity, and total rainfall of 25°C, 35°C, 90% and 8.6 mm respectively. Minimum temperature (mean) Maximum temperature (mean) Relative humidity (%) (mean) Total rainfall (mm) 25°C, 35°C, 90% and 8.6 mm respectively.

Minimum temperature (mean)	Maximum temperature (mean)	Relative humidity (%) (mean)	Total rainfall (mm)
25	35	90	8.6

Management of blast disease on forage crops

The plots of hybrid Napier cultivars, CO 4, CO 5, IGFRI 6 and IGFRI 10 that were sprayed with a liquid formulation of TNAU *B. subtilis* strain Bbv 57 showed a significantly reduced incidence of blast disease (PDI: 8.2 to 12.3). In contrast, the maximum PDI of 62.4 was observed in the control plots of the CO 4 cultivar. Additionally, increased foliage yield, ranging from of 74.25 to 75.3 t h^{-1} was observed in the treated plots compared to the untreated controls which recorded low yield of 39.25 to 56.0 t h^{-1} (Table 2; Fig 2 & 3).

Microscopic observation

Microscopic observation under 40x magnification showed asexual conidia of pyriform shaped, hyaline, two septate (three celled), hilum at the base and tapering towards the tip. Conidiophores were also observed (Fig. 4).

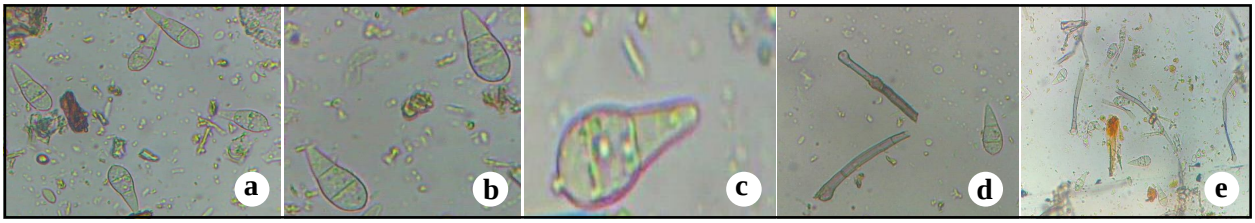
Management of insect pest and diseases is mostly ignored in the forage crops (Ferrell *et al.*, 2002). Regarding blast disease, caused by the fungal pathogen, *Magnaporthe* sp., the infection retards crop growth by reducing photosynthetic area, impairing carbohydrate assimilation and causing leaf death due to toxin production. Hence, in the present study an eco-friendly biological control approach using the bacterial biocontrol agent *B. subtilis* was employed to manage blast disease of forage crops. The fodder crops, including hybrid napier cultivars, CO 4, CO 5, IGFRI 6, and IGFRI 10, showed a significant reduction in blast disease incidence following foliar application of the liquid formulation of TNAU *B. subtilis* strain Bbv 57. The *B. subtilis* is one of widely used bacterial biocontrol agents and is known for its ability to form durable endospores that withstand harsh environmental conditions. These spores and cells adhere to leaf surfaces after application and can produce antibiotics and lytic enzymes that suppress phytopathogens on plant

TABLE 2
Effect of *B. subtilis* (Bbv 57) on blast disease incidence and foliage yield of napier cultivars under field conditions

Fodder cultivars	Per cent disease index (PDI)		Foliage yield (t/h)	
	Sprayed with *B. subtilis* (Bbv 57)	Control	Sprayed with *B. subtilis* (Bbv 57)	Control
Hybrid Napier CO 4	12.3	62.4	74.25	39.25
Hybrid Napier CO 5	9.5	48.7	74.55	49.00
Hybrid Napier IGFRI 6	8.2	38.9	75.30	56.00
Hybrid Napier IGFRI 10	8.6	43.6	75.25	53.20
C.D. (p=0.05%)	2.4		0.84	

Fig. 2. Napier hybrid grass *cv*. CO 4 a. Plants sprayed with *B. subtilis* b, c. Plants in control.

Fig. 3. Napier hybrid grass *cv*. CO 5 a. Plants sprayed with *B. subtilis* b, c. Plants in control.



a. & b Conidia of *Magnaporthe* sp. c. conidia with hilum d, e. conidiophores of *Magnaporthe* sp.

Fig. 4. Conidia and conidiophores of *Magnaporthe* sp.

surfaces. Iturins, surfactins, fengycins, and bacillomycins are important antifungal antibiotics that can directly inhibit fungal pathogens on plant foliage (Ongena *et al.*, 2008). Lytic enzymes such as chitinases, â-1,3-glucanases, proteases, and lysozymes produced by *B. subtilis* can degrade structural polysaccharides in the fungal cell wall, leading to cell lysis (Ajuna *et al.*, 2023). The combined action of these enzymes results in a synergistic antifungal effect. Therefore, significant reduction in the blast incidence observed in the present study may be due to the breakdown of chitin and other cell wall components of *Magnaporthe* sp. by lytic enzymes secreted by *B. subtilis*. Additionally, the antibiotics mentioned above might have directly inhibited the growth of the pathogen. The combined action of antibiosis and enzymatic lysis could cause cytoplasmic leakage and loss of the pathogen's protective and functional properties (Won *et al.*, 2021). Additionally, *Bacillus* species can activate induced systemic resistance (ISR) in plants to enhance their defense against pathogen attacks (Syed-Ab-Rahman *et al.*, 2018b). Improved foliage yield might be due to production of growth hormones such as auxins, cytokinins and gibberellins and suppression of blast fungus, *Magnaporthe* sp. by the bacterial biocontrol agent *B. subtilis*. Hence, blast disease in fodder crops can be sustainably managed through foliar application of *Bacillus subtilis*.

CONCLUSION

The hybrid Napier cultivars, such as CO 4, CO 5, IGFRI 6, and IGFRI 10, were observed to be affected by blast disease at the District Livestock Farm in Naduvur, Thanjavur District. To the best of our knowledge, this may be a new record of blast disease in fodder grass in Tamil Nadu. In the field experiments, cultivars treated with a liquid formulation of TNAU *B. subtilis* strain Bbv 57 exhibited a significantly reduced incidence of blast disease and increased foliage yield compared to untreated ones. Based on the results, the bacterial biocontrol agent *B. subtilis* has proven to have the ability to improve plant growth and reduce disease occurrence in fodder grass. Therefore, blast disease in forage crops can be effectively managed through foliar application of *B. subtilis* in an eco-friendly manner.

REFERENCES

Agres., 1994: Statistical Software Version 3.01. Pascal International Software Solutions, USA.

Ajuna, H.B., H. Lim, J. Moon, S. Won, V. Choub, S. Choi, J. Yun, and Y.S. Ahn, 2023: The Prospect of Hydrolytic Enzymes from Bacillus Species in the Biological Control of Pests and Diseases in Forest and Fruit Tree Production. *Inter. J. Mol. Sci.*, 24.

Bama, S., and C. Babu, 2016: Perennial forages as a tool for sequestering atmospheric carbon by best management practices for better soil quality and environmental safety. *Forage Res.*, **42**: 149-157.

Chandra, V., S. Singh, G. Prakash, K. D. Tiwari, and R. Sahay , 2019: Estimation of fungal blast disease in hybrid Napier grass (*Pennisetum purpuriam)* in Indian condition. *Indian Phytopathol.*, **72**, 243–251. https://doi.org/10.1007/s42360-019-00127-8

Farrell, G., S.A. Simons, and R.J. Hillocks, 2002: Pests, diseases, and weeds of Napier grass, *Pennisetum purpureum*: a review. *Int. J. Pest Manag.*, **48**(1):39–48.

IRRI., 2013: Standardization evaluation system for rice. International Rice Research Institute, P.O. Box 933, 1099 Manila, Philippines **5**: 18.

Jang, W.J., K.B. Lee, M.H. Jeon, S.J. Lee, S.W. Hur, S. Lee, B.J. Lee, J.M. Lee, K.W. Kim and E.W. Lee, 2022: Characteristics and biological control functions of *Bacillus* sp. PM8313 as a host-associated probiotic in red sea bream (*Pagrus major*) aquaculture. *Anim. Nutr.*, **12**. 10.1016/*j.aninu. 2022.08.011*.

Ongena, M., and P. Jacques, 2008: *Bacillus* lipopeptides: versatile weapons for plant disease biocontrol. *Trends Microbiol.*, **16**(3): 115-25. https://doi.org/10.1016/j.tim.2007.12.009

Peradeniya, L., S. Premaratne, and G. Premalal, 2006: Hybrid Napier (*Pennisetum perpureum* X *Pennisetum americarnum*) VAR. CO-3: a resourceful fodder grass for dairy development in Sri Lanka. *J. Agric. Sci.*, 2. 10.4038/jas.v2i1.8110.

Savitha, A., T. C. George, and S. Beena, 2020: Occurrence of blast disease in hybrid napier. IGC proceedings, (1989 to 2023). 18

Singh, M.K., P. Singh, R.P. Singh, C. Mohapatra, 2013: Association analysis for yield and quality attributes in Indica rice and screening of hybrids against blast disease (*Magnaporthe griesea* Barr.). *J. Plant Sci.*, **8**: 45-56.

Stein, T., 2005: *Bacillus subtilis* Antibiotics: Structures, Syntheses and Specific Functions. *Mol. Microbiol.*, **56**, 845-857. https://doi.org/10.1111/j.1365-2958.2005.04587.x

Syed Ab Rahman, S.F., E. Singh, C.M.J. Pieterse, and P.M. Schenk, 2018: Emerging microbial biocontrol strategies for plant pathogens. *Plant Sci.*, **267**: 102-111. *https://doi.org/10.1016/j.plantsci. 2017.11.012*

Warrior, P., 2000: Living systems as natural crop-protection agents. *Pest Manage. Sci.*: Formerly *Pest. Sci.*, **56** (8): 681-687.