**SHORT COMMUNICATION**

# A case report on Blast disease in Rice and Finger millet in Sri Lanka

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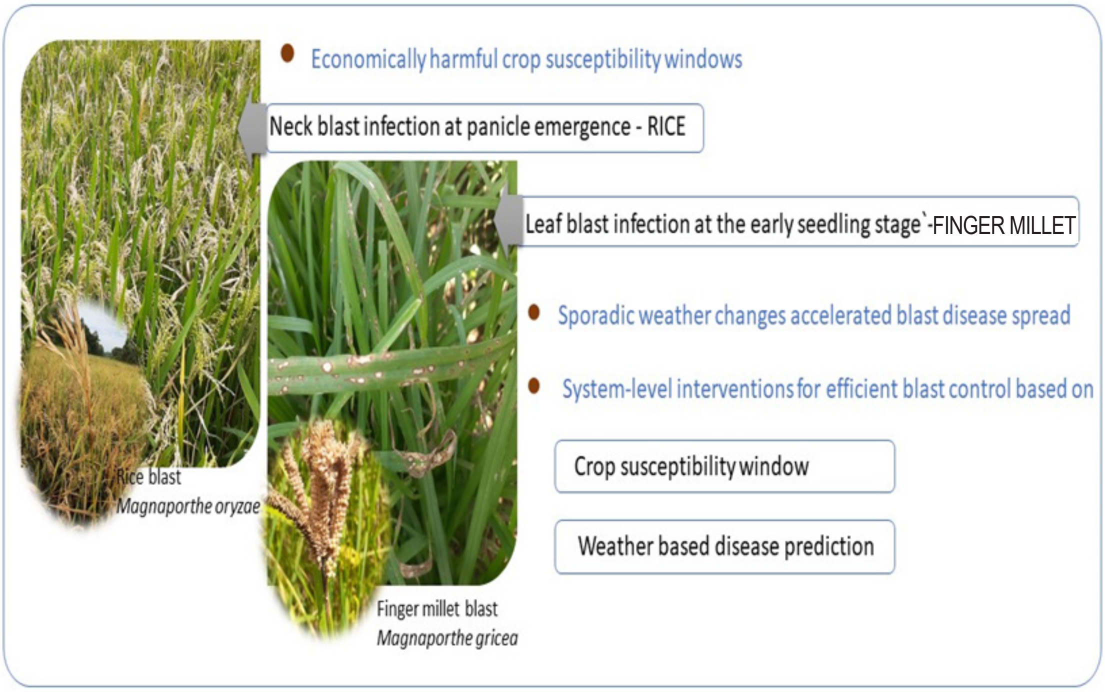


## Highlights

- Neck blast infection at panicle emergence and leaf blast infection at early seedling stage identified economically harmful crop susceptibility windows in rice and finger millet farmer fields, respectively
- Sporadic weather changes accelerated the blast disease infection and spread
- Curative fungicide application was not effective in controlling blast due to rapid disease development
- System level interventions by analyzing crop susceptibility windows and prevailing weather can increase efficacy of control measures

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# A case report on Blast disease in Rice and Finger millet in Sri Lanka

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**Abstract:** Blast disease caused by *Magnaporthe* sp. is one of the most destructive diseases in cereal crops. Disease infection was studied in farmer fields. Field data was recorded and further information was gathered by interviewing the farmers and agrarian extension officers. Blast infections were assessed in the fields using a standard evaluation system for rice (SES IRRI, 1996). Although symptoms were not observed in seedlings when mature rice fields were infected farmers experienced 100% yield loss. There were no or few leaf symptoms in blast infected mature rice fields yet neck infections were scored as 9 in SES. Unlike rice, leaf blast at seedling stage caused economic losses in finger millet. Mature finger millet fields were susceptible to neck and finger blast. Due to rapid disease development curative fungicide treatment was ineffective in controlling blast. Farmers reported sudden changes in the weather during infections whereby gloomy weather caused a spike in humidity and low temperatures that coincided with the infection. Host susceptibility window synchronized with conducive environments result in severe blast infections therefore, blast disease management needs a coordinated effort and system level interventions whereby control measures and use of resistant germplasm can be combined with climate-based disease predictions to increase the efficiency of disease control.

***Keywords*:** Neck blast; blast disease; finger millet

## INTRODUCTION

The study focused on two economically important cereal blast pathosystems. More than three billion people worldwide consume rice (*Oryza sativa* L.) and it is the second most widely grown cereal in the world (Van Nguyen & Ferrero, 2006). In Sri Lanka rice is the main staple and the main cereal crop. Finger millet is the third most important cereal in Sri Lanka (Weerakoon et al., 2011). Different strains of *Magnaporthe* sp. cause blast disease, and economic losses in several cereal crops including rice and finger millet (Kumar & Srivastava, 2020, Seneviratne et al., 2004). Although local statistics are not available, on a global scale blast causes 30% (Nalley et al., 2016) and 28- 36 % (Nagaraja et al., 2007) crop losses in rice and in finger millet respectively. Blast disease severity is affected by prevailing environmental conditions specifically ambient temperature and humidity (Hunjan & Lore, 2020). Rice and finger millet blast is cased by M. oryzae (Neupane & Bhusal, 2021). Typical blast disease symptoms on leaf include spindle shape lesions with gray middle region and brown margin. Other symptoms include neck, stem and panicle blast on rice and neck, stem and finger blast on finger millet (Neupane & Bhusal, 2021). Blast disease damages all stages of the crop in rice and in finger millet (Sitther & Gnanamanickam, 1996). However, impact of the disease in farmer fields at different crop stages can vary. The objective of this study was to evaluate blast disease severity in rice and finger millet farmer fields based on field observations and farmer interviews using a cohort of selected sampling sites that were distributed island wide.

## MATERIALS AND METHODS

Rice blast was studied in all districts where the blast disease was reported during the 2020-2021 “Maha” season (Pabasara et al., 2021). Data on disease reports were obtained from the Department of Agriculture. Finger millet blast disease was studied in 43 fields from major finger millet production areas in the country located in different agro-ecologies and dry, wet and intermediate climate zones. Finger millet cultivation data was obtained from the National Agriculture Information and Communication Center at Gannoruwa, Department of Agriculture (https://doa.gov.lk/ICC/images/publication/Crop_English/fingerMillet_dryinter.jpg).

Field data were recorded and further information was gathered by interviewing the farmers and agrarian instructors serving in the relevant agrarian service divisions based on pre-designed questionnaires.

Leaf blast and panicle blast symptoms in rice were assessed in the fields using the standard evaluation system for rice (SES IRRI, 1996). Disease scale consists of 0-9 including 0 = No lesions and 9= complete lesions on panicles or 75 % leaf area affected due to lesions. Finger millet blast disease infection was assessed in the fields following blast disease severity scales for leaf blast and neck blast (Babu et al., 2013). Leaf blast disease scale consists of 0-9 including 0= No lesions and 9= more than 75 % leaf area affected due to lesions**.** Neck blast scale rating from 0- 5, where 0 for no lesions and 5 for lesions with more than 6 cm length. Thirty random samples were selected per site and mean

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rating for 30 plants was calculated for each field (Ngugi et al., 2002) for both leaf and neck blast disease. Leaf blast disease severity was analyzed in both seedling fields (<45 days old) and mature farmer fields.

## RESULTS AND DISCUSSION

### Rice blast infections

Rice blast was studied from eight agro-ecologies in Sri Lanka during the 'Maha' season 2020-2021 (Figure 1).

Although no symptoms were observed in seedling rice fields, farmers experienced 100% yield loss at the panicle stage due to neck blast. Infected fields from Anuradhapura, Kandy, Gampaha, Kilinochchi, Ampara districts recorded 100% yield loss whereas infected field at Moneragala recorded 95 % yield loss (Figure 1) however, there were a few days difference in the crop growth stage in different fields. Affected rice cultivars were BG 359 (Kandy), BG 300, "Attakkari" (Kilinochchi, Anuradhapura), BG 1/94 (Moneragala, Ampara, Kandy), BW 367 (Gampaha) and BG 357 (Ampara). There were no or few leaf blast symptoms in blast infected mature fields. Neck infections were scored as 9 (9= complete panicle blast lesions; Figure 1, A). These results indicate that, all observed rice cultivars, although resistant to leaf blast were highly susceptible to neck blast.

Only four out of the seventeen farmers interviewed had prior experience with severe rice blast infections despite the farmers interviewed had years of experience in rice cultivation indicating a low prevalence of outbreaks. Out of the total, 59% of the farmers did not have any knowledge on blast infections in their fields. Twenty-four percent (24 %) of the farmers had previously observed blast infection in their fields, while 12 % were aware about the disease. However, none of the farmers had ever observed yield losses of such high magnitude (100%). It is interesting to note that all farmers reported sudden changes in weather when gloomy weather caused a spike in humidity and low temperatures that coincided with the epidemic.

Based on farmer experience, the initial symptom was a few panicles with white unfilled grains ("Sudu Karal") that cropped up sporadically in the field. The symptoms spread and fields were completely affected within 48 to 72 hours after onset of initial symptoms, resulting in 100% yield loss. Eight of the farmers applied systemic fungicides, including Carbendazim and Folicur© (Tebuconazole) at the initial symptomatic stage i.e. upon observation of a few "Sudu karal" but none of them were able to recover the crop. This indicates that curative application of fungicides was not effective in controlling blast.

### Finger millet blast infection

Finger millet blast was studied in 6 districts representing the main climatic zones of the country (Figure 2). Blast disease symptoms were observed at all crop stages of finger millet.

According to the results given in Figure 2, local finger millet varieties were susceptible or moderately resistant at seedling stage while resistant or moderately resistant at reproductive stage to leaf blast. Twenty-eight percent of the farmers interviewed cultivated "Oshada" which is recommended as a moderately blast resistant cultivar. The rest of the farmers cultivated farmer varieties using farmer seeds. Therefore, large majority of farmers cultivated unimproved land races using farmer seeds. Similar observations concerning cultivar preference of farmers were reported by other authors (Bandula et al., 2023). Presence of high humidity and low temperature conditions at the seedling stage resulted in disease scores of 9 (more than 75 % leaf area affected) based on scales described in Babu et al. (2013) in cultivar 'Oshada'. Field susceptibility of cv. Oshada was reported previously (Kumari et al., 2022). However, susceptibility to blast disease was reduced with the plant development stage and unlike rice, neck or finger blast did not cause total yield losses in finger millet fields. The level of infection in mature fields was moderately resistant in majority (64 %) of the fields (Figure 2: E).

Eleven percent of the farmers reported that blast disease caused economic losses in finger millet and the losses were severe in "Maha" season cultivations. During "Maha" in low temperature and high rainfall conditions, high frequency of leaf blast disease occurred in seedling fields. Reports by Kumari et al. (2022) and Esele (2003) observed similar phenomena whereby high precipitation resulting


**Figure 1:** Rice blast sampling sites, blast disease symptoms and severity A: Sampling sites, B: Neck blast symptoms, C: Blast infected white panicles "Sudu Karal" and light green healthy panicle

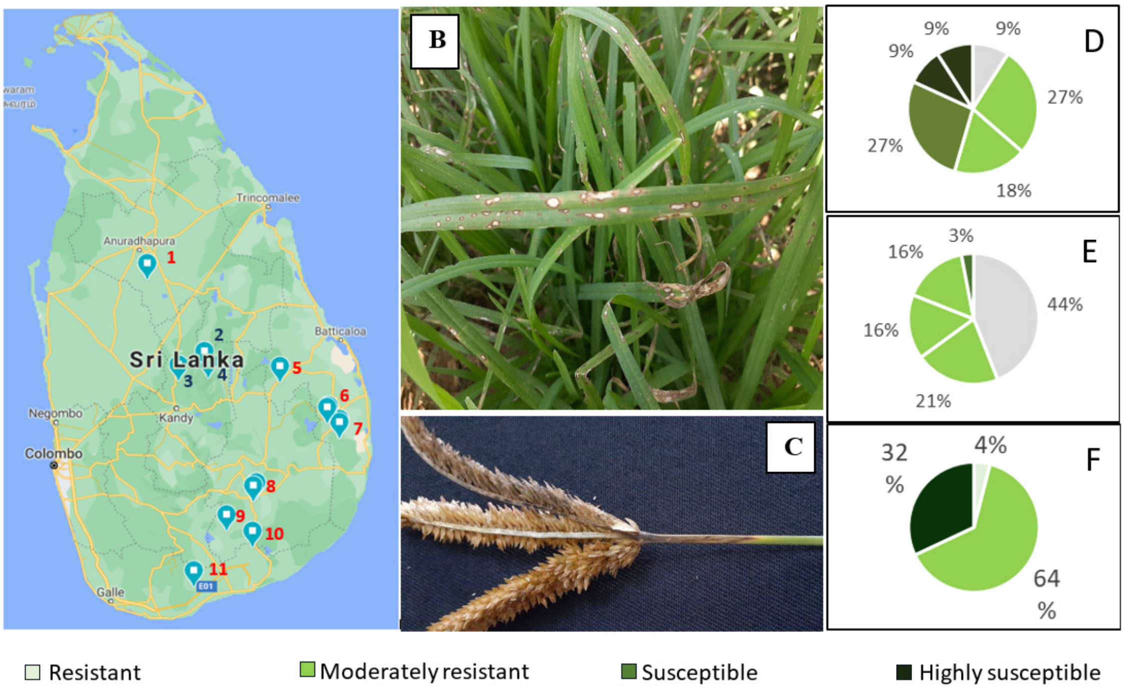


**Figure 2 :** Disease severity of leaf and neck blast in finger millet farmer fields. A: Sampling sites; B leaf blast in seedlings, C: finger and neck blast D: leaf blast severity in seedling stage given as a pecentage of fields affected; E:leaf blast severity in mature feilds given as a pecentage of fields affected, F: neck blast severity given as a pecentage of fields affected . Leaf blast rating scale: Resistant (=1.0 to 3.0), Moderately resistant (=3.1 to 5.0), Susceptible (=5.1 to 7.0) and Highly susceptible (=7.1 to 9.0). Neck blast rating scale: Resistant 1.0 to 2.0), Moderately resistant (=2.1 to 3.0), Susceptible (=3.1 to 4.0) and Highly susceptible (=4.1 to 5.0).

in increased humidity and optimal day night temperature difference that result in blast disease spread. Farmers successfully used systemic fungicides to manage blast in seedling fields. However, in majority of fields no other preventive or curative measures, such as use of resistance varieties or maintaining crop density, were in place. Fungicide application was effective when it was applied at the early stages of the symptom occurrence in cultivar "Oshada". Application of fungicide was not effective in disease control in susceptible land races like "Kiri-Kurahan". Although farmers were able to identify leaf blast symptoms, they did not identify neck or finger blast symptoms highlighting the need for building awareness. Despite losses, none of the farmers used fungicides or other measures to control the disease in mature fields.

## CONCLUSION

The onset and quick spread of blast diseases are accelerated by abrupt changes in environmental conditions. Recommended rice varieties are susceptible to neck blast consequently, conducive weather imposed by high humidity and low temperature when coincided with panicle immergence resulted in 100% yield loss. Leaf blast caused economic losses in finger millet at seedling stage. Based on the observations neck blast at panicle emergence implicate a rice crop susceptibility window in farmer fields causing economic losses. Whereas in finger millet, although the crop is susceptible at all stages, high economic losses were incurred due to leaf blast infections during early seedling stage. Due to rapid disease development, curative fungicide treatment was ineffective. With the adverse impacts of climate change frequency and scale of sporadic whether phenomena will increase resulting in more frequent crop disease outbreaks. Therefore, blast disease management needs coordinated efforts whereby application of fungicides or other control measures and use of resistant planting material, can be combined with the knowledge in host susceptibility windows, pathogen diversity and prevailing weather conditions to increase efficiency of disease control.

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## DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interests.

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