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Survey for blast disease incidence in major pearl millet growing areas of northern Karnataka

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Abstract
Pearl millet blast caused by ascomycete fungus *Magnaporthe grisea* (Herbert) (anamorph: *Pyricularia grisea* (Cook) Sacc.) has become a disease of economic importance in pearl millet cultivation in India. The use of resistant cultivars is the best approach to combat yield losses by *M. grisea*. However, the pathogen overcomes the resistance in a few years of releasing a resistant variety, making resistance breeding a constant challenge. To mitigate this, regular monitoring of virulence pattern and distribution of the disease is essential. A roving survey was conducted in the major pearl millet growing areas of northern Karnataka. Result revealed that a total of Seventy-four blast infected leaf samples were collected from the major pearl millet growing regions of north Karnataka. Maximum disease incidence was recorded from Eradoni, Raichur district followed by Kamalapura, Medanapura, Kalaburgi district. Whereas the minimum disease incidence was recorder from the pearl millet fields belong to Bavi kodi, Vijayapura. This clearly indicates that pearl millet growing in and around Raichur region is more susceptible to the blast disease and the disease is wider spread in that particular location that leads to complete crop loss. This alarms that need to development of blast resistant verity/hybrids to overcome this disease.

Keywords: Pearl millet blast, survey, *M. grisea*

Introduction
Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is an important nutri-cereal crop grown for grain, stover and green fodder in arid and semi-arid regions of Africa, America and Asia (Thakur *et al.*, 2009) [9]. It is the sixth most important cereal crop in the world next to maize, rice, wheat, barley, and sorghum. In India, pearl millet is the fourth most widely cultivated food crop after rice, wheat and maize. It occupies an area of 6.93 million ha with an average production of 8.61 million tones with a productivity of 1243 kg/ha during 2018-19 (Directorate of Millets Development, 2020; Project Coordinator Review, 2020). It excels all other cereals due to its unique features – the C4 plant with high photosynthetic efficiency and high dry matter production capacity. It is grown under the most adverse agro-climatic conditions where other crops like sorghum and maize fail to produce economic yields.

Pearl millet encounters a number of diseases that attack the crop during its growth, cause low yield and economic loss to the peasant and finally to the nation as a whole (Kaurav *et al.*, 2018) [3]. Over the past 7-8 years, foliar blast disease caused by *Magnaporthe grisea* in pearl millet has increased in the semi-arid regions by significantly reducing grain and fodder yields (Singh *et al.*, 2020) [10]. In India, this disease has been sporadically observed on high-yielding cultivars from 1953 onwards in the pearl millet growing regions belonging to northern parts of India. However, the blast disease severity increased under drizzling rain, wet and high humid conditions in the newly released hybrids cultivated in Gujarat, Maharashtra, Uttar Pradesh, Rajasthan and Madhya Pradesh (Sharma *et al.*, 2013; Nayaka *et al.*, 2017) [8, 5]. The disease has been reported to affect various developmental stages: from seedlings to tillering stage on leaves, stem and boot leaf, which ultimately affect grain yield (Shetty *et al.*, 2009) [9].

M. grisea is a heterothallic, filamentous, ascomycete fungus that causes blast disease on a broad range of hosts including, rice, wheat, pearl millet, finger millet, foxtail millet, and several grasses (Ou, 1985; Prabhu *et al.*, 1992; Takan *et al.*, 2012) [6, 7, 12]. The pathogen is highly variable but specialized in its host range.

Utilization of resistant cultivars with major blast resistance (R) genes is an economical and environment friendly method to control the blast disease rather than relying on more expensive fungicides. However, resistance breakdown is a big challenge in managing blast disease due to the dynamic evolution of virulence against specific host cultivars and less exposure of breeding material to a full range of virulence present in the pathogen populations (Zeigler *et al.*, 1995) [14].

Because of their race specificity and the rapid change in pathogenicity of the blast fungus, most of the resistance genes in rice break down in a few years (Suh *et al.*, 2009) [11]. Although substantial work has been done in the rice–blast pathosystem (Zeigler *et al.*, 1995) [14], limited information is available for the pearl millet–blast pathosystem (Sharma *et al*., 2013) [8]. The high polymorphic character of the pathogen can lead to regular withdrawal of the pearl millet hybrids from cultivation (Shetty *et al.,* 2009) [9]. Variations in pathogen fitness have been repeatedly investigated for numerous agricultural pathosystems using controlled cross-inoculation experiments or inoculation on a series of differential hosts (Liao *et al*., 2016) [4]. Availability of limited information on the pearl millet–Magnaporthe pathosystem has impeded efforts to develop blast-resistant cultivars adapted to different agro-ecological conditions.

Management of disease through host plant resistance needs prior information about the change in virulence/virulence diversity adapted by pathogen over time and periodical monitoring of the disease status in a particular area is essential for the development and deployment of the disease-resistant cultivars. Therefore, the present study was conducted to collect the *M. grisea* from the major pearl millet growing areas in Karnataka.

Material and Methods

Survey for blast disease incidence in major pearl millet growing areas of northern Karnataka

Roving survey was conducted during 2019-2020 at different places of northern Karnataka *viz*., Raichur, Kalaburgi, Bagalkot and Vijayapura districts. Major pearl millet growing talukas were selected for the survey. Totally 120 fields were surveyed in 50 villages. Observations were recorded with respect to incidence of blast disease. In each plot random samples were made, from which the number of plants affected over the total number of plants were counted and expressed as per cent disease incidence as per the formula given by Vernell and Hecloud (1975) [13].

During the survey, observations were recorded with respect to soil type, cultivar, agricultural practices and stem infection and also samples were collected for isolation of pathogens.

Results and Discussion

Roving survey was carried out to know the severity and prevalence of blast disease of pearl millet growing areas of northern Karnataka districts (Raichur, Bagalkot, Vijayapura and Kalaburgi) during August to December 2019. Totally 120 fields belonging to 50 villages in four districts were surveyed. The data pertaining to survey is presented in Table 1.

From the survey, it is evident that the incidence of the disease ranged from 10-80 per cent in different parts of northern Karnataka surveyed. Out of four districts surveyed, the maximum percent disease incidence was recorded in Yaradoni (80%) village of Lingasuguru taluk and the lowest disease incidence was noticed in Bavikodi (10%) village of Vijayapura district.

Out of four major betelvine growing districts, survey result revealed that, the maximum per cent disease incidence of wilt / foot rot complex of betelvine was recorded in Raichur district (49.5%) and the lowest per cent disease incidence was noticed at Vijayapura district (28.06%).

Recently, the severity of the blast disease on commercial hybrids of pearl millet has been drastically increasing in India due to the occurrence of emerging isolates causing breakdown of resistance (Prabhu *et al.,* 1992) [7]. Therefore, regular screening of newer isolates of *Magnaporthe grisea* in pearl millet growing regions is essential to trap its virulence on commercial genotypes or hybrids. In the past, an enormous amount of information on the pathogenic races of Pyricularia grisea on other host crops such as rice, wheat and grass species (Takan *et al.,* 2012) [12], *Magnaporthe oryzae* on finger millet (Takan *et al*., 2012) [12]; and foxtail millet (Prabhu *et al.,* 1992) [7] were documented. Usually, it is proposed that pathogen variability plays a key role in the resistance breakdown particularly in rice plant (Liao *et al.*, 2016) [4].

Understanding the pathogenic diversity or distribution of different pathotypes in pathogen populations will aid in the development of a framework for pearl millet blast management strategies, particularly in terms of host plant resistance. This information is used to screen the breeding material bred for target ecologies for resistance against specific pathotypes, and eventually develop the varieties/hybrids resistant to pathotype(s) present in those ecologies.

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