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Occurrence of Banded Leaf and Sheath Blight of Maize in Jharkhand with Reference to Diversity in *Rhizoctonia solani*

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Abstract: Survey during *kharif*, 2005 and 2006 were carried out to record occurrence of disease and diversity in *R. solani* among the naturally occurring populations and revealed that banded leaf and sheath blight incited by *Rhizoctonia solani*, is showing wide spread with the disease severity ranging from 30.30 to 80.46 per cent and gaining the economic importance in the state of Jharkhand. Five isolates from five different locations showed variation in their morphological characters such as abundance of mycelium, colour and location, distribution, size and density of sclerotia etc. Pathogenicity revealed isolate *Hc* most aggressive while isolate *Jr* least aggressive.

Key words: *Rhizoctonia solani*, diversity, maize, banded leaf and sheath blight

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops in the world agricultural economy as food, feed and industrial products. It is a miracle C_4 crop and has a very high yield potential with its world average yield of 47.19q/ha and ranks first among cereals followed by rice, wheat and millets (Anonymous, 2005).

The banded leaf and sheath blight (BLSB) caused by *Rhizoctonia solani* F. sp. *sasakii* Exner, (Tel: *Thanatephorus sasakii* (Shirai) Tu and Kimbro) is a very destructive disease of maize and considered to be the major constraint for limited production. This pathogen causes losses in grain yield ranging from 11.0 to 40.0 per cent (Singh and Sharma, 1976). Lal *et al.* (1985) reported that the losses in grain yield to the extent of over 90.0 per cent. Although, reports on variability in the pathogen based on anastomosis behaviour, cultural and morphological appearance and pathogenicity are available (Talbot, 1970; Ogoshi 1987; Chen *et al*., 1990; Naiki and Kanoh, 1978; Wang and Hsich, 1993). However, diversity in this fungus cannot be completely understood solely in terms of AGs. Hence, the present investigation was carried out to record occurrence and intensity of disease and diversity in *R. solani* among the naturally occurring populations, if any.

MATERIALS AND METHODS

Five blocks including Itki, Bero, Hisri Chauli, Jirabar and Kanke of Ranchi, Jharkhand were surveyed during the *Kharif* season of 2004 and 2005 to record the prevalence and severity of banded leaf and sheath blight disease of maize. Disease severity was recorded using scale given by Ahuja and Payak (1983). A large number of diseased samples of maize plants of different cultivars showing characteristic symptoms of banded leaf and sheath blight were collected from farmer's field from all the locations. The specimens were brought to the Department of Plant Pathology, B. A. U., Ranchi to carry out laboratory experiments. A number of *R. solani* isolates were isolated from infected maize plant parts showing characteristic symptoms of the disease using standard procedure and purified and identified followed by pathogenicity test.

Diseased specimens along with sclerotial mass were thoroughly washed in tap water. Specimens were cut into pieces measuring about 5 mm with healthy portion as well using sterilized blade after washing. Leaf pieces and sclerotia were surface sterilized in 0.1 per cent mercuric chloride solution for about 30-60 sec followed by 3 rinsing in sterilized distilled water. The sclerotia and leaf pieces were placed in between two layers of sterilized blotting sheets to remove moisture and then leaf pieces and sclerotia were transferred ascetically to PDA plates and incubated at 28±1ºC temperature. Inoculated Petriplates were obseved to record mycelial growth of pathogen after every 24 h. Pure cultures of the pathogen isolates were obtained using hyphal tip culture technique for identification. Thereafter, isolates were designated as *Hc*, *It*, *Be*, *Jr* and *Rf* based on locations from where these isolates were isolated for convenience in conducting experiment.

To prove pathogenicity, 40-day old maize plants of var. BVM 5 were inoculated by inserting 2 to 3 grains covered with mycelial growth of each isolate, separately, between the rind and the leaf sheath of test plants in triplicate and un-inoculated plants served as control. High humidity was maintained during disease development by frequent watering. The inoculated plants were regularly observed for development of symptoms. Re-isolations were made from infected plant parts and compared with previous cultures for resemblance (Ahuja and Payak, 1978). The culture plates of isolates of *R. solani* grown on

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PDA medium were observed to study the morphological and cultural characteristics like abundance of mycelium, location, size and distribution pattern of sclerotia, growth rate, angle of branching, septation etc followed by their categorization based on sclerotial and colonial characteristics. At crop maturity, disease severity was recorded using 1-5 scale given by Vimla and Mukherjee (1987).

RESULTS

In the crop season 2004 and 2005, a total of five locations including Itki, Bero, Hisri Chauli, Jirabar and Kanke of Ranchi district were surveyed. The result showed that BLSB disease was prevalent with wide spread occurrence in all the areas surveyed.

The intensity of BLSB disease ranged from 28.40 to 79.00 and 32.20 to 81.92 per cent during *Kharif*, 2004 and 2005, respectively. Maximum disease severity of 79.00 and 81.92 per cent in 2004 and 2005, respectively, was recorded at Hisri Chauli block.

On average basis, maximum disease severity of 80.46 per cent was recorded at Hisri Chauli block followed by Jirabar with severity of 50.30 per cent. Intensity of the disease at Kanke was minimum with severity of 30.30 per cent (Table 1).

BLSB disease appears to be an endemic disease in the localities. Similarly, the disease has been reported from Himachal Pradesh, Uttar Pradesh, Haryana, Punjab, Madhya Pradesh, Rajasthan, West Bengal (Payak and Sharma, 1981) and also from different parts of the world (Wiltshire, 1956; Von Eignatten, 1961; Payak, 1988 and Hirel *et al*., 1988).

Out of more than 50 isolations made, finally 5 of them were selected and showed some degree of variation in preliminary studies. Isolation from the infected maize leaves and sheaths showing characteristic symptoms of banded blight produced the characteristic colony growth on PDA and the fungus was identified on the basis of cultural and morphological characteristics as *R. solani.*

The inoculated plants were visually observed daily. Initially in all cases after inoculation and incubation, irregular shaped spots appeared. After sometimes, typical banded blight symptoms were observed as small purplish brown lesions or greenish olive brown large continuous patches on leaf sheath and pale olive brown lesions on stalk as well rotting of ears. Thus, the isolation, inoculation, symptom development and re-isolation proved the Koch's Postulates. The symptoms and morphological characters observed in the present investigations have also been recorded and described by several workers (Duggar, 1915; Reyes, 1941; Sohi *et al.,* 1965; Singh and Sharma, 1976, Maiti, 1978).

It was interesting to note that though identical symptoms were caused by the isolates, the appearance of symptoms in terms of incubation period different significantly. The difference in the amount of disease produced by the pathogen isolates was significantly

Table 1: Intensity of banded leaf and sheath blight disease of maize at different localities of Ranchi district in the year 2004 and 2005.

Location	Disease intensity (%)		
	2005	2006	Mean
Itki	35.10	45.50	40.30
Bero	52.80	57.20	55.50
Hisri Chauli	79.00	81.92	80.46
Jirabar	48.00	52.60	50.30
Kanke	28.40	32.20	30.30

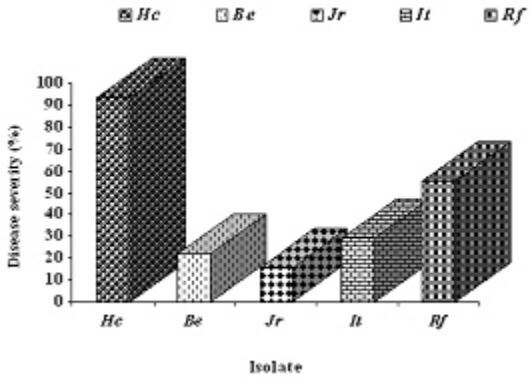

Fig 1: Banded blight severity caused by different *R. solani* isolates on maize genotype BVM 5

different from each other. Isolate *Hc* was recorded as most aggressive isolate as this caused above 90.00 per cent disease severity while isolate *Jr* as least aggressive with disease severity of 15.14 per cent (Fig. 1). Singh *et al*. (2002) have studied differences in aggressiveness within the population of the fungus *R. solani* infecting rice and wheat, so our findings are in accordance with them.

The isolates of *R. solani* grown on PDA different considerably with respect to cultural and morphological characteristics such as abundance of mycelium, colony colour, and growth rate and linear growth, sclerotial distribution and size as well as location of sclerotia.

All the 5 isolates of *R. solani* shared typical characteristics like right angle branching near the distal septum of the cells in young vegetative hyphae, formation of a dolipore septum in the branch near the point of origin, constriction of the branch near the point of origin, no clamp connection, no condium except moniliod cells. All the five isolates showed differences in mycelial growth. *Hc* isolate showed highest growth after 72 hours of incubation. The least growth was observed in the isolate *Rf*. Three isolates including *It*, *Be* and *Hc* exhibited aerial growth of their culture plate and 2 of the isolates *Jr* and *Rf* produced sub-aerial colonies. The colony colour of *Hc* and *It* isolates was brown while that of isolates *Be*, *Jr* and *Rf* was white. Growth of isolates *It* and *Hc* was fast. *Be* and *Rf* isolates were placed under the category of moderate growth and isolate *Jr* grew slowly. The radial growth of *Hc* isolate was significantly superior (87.76 mm) followed by isolate *Rf* (84.63 mm). The radial growth of *Jr* isolate was distinctly least as compared to

Table 2: Morphological characteristics of different isolates of *R. solani*

Isolate	Colony characters					Sclerotial characters		
	Abundance	Colour	Type	Growth	Diameter (mm)	Location	Distribution	Size
It	Abundant	Brown	Aerial	Fast	76.46	Surface	Through out plate	Micro
Be	Moderate	Black	Aerial	Moderate	81.20	Embedded	Near inoculation point	Macro
Hc	Abundant	Brown	Aerial	Fast	87.76	Subsurface	Through out plate	Micro
Jr	Slight	White	Sub-aerial	Slow	61.40	Embedded	Near inoculation point	Macro
Rf	Moderate	White	Sub-aerial	Moderate	84.63	Surface	Through out plate	Macro

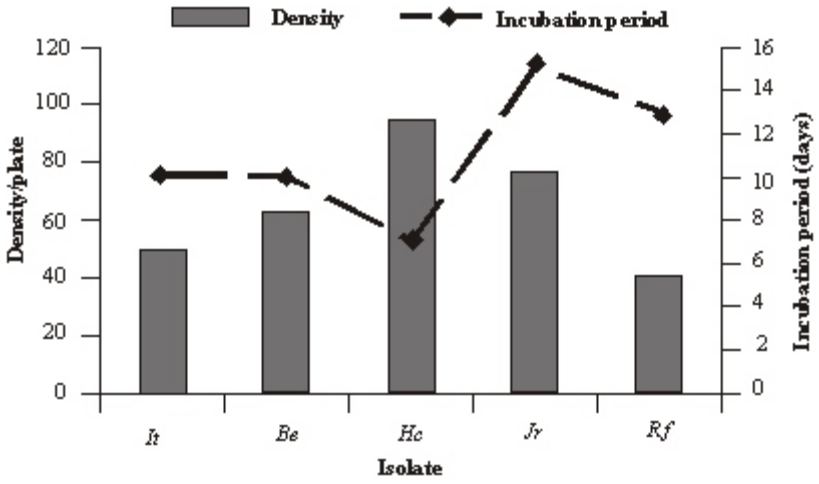

Fig 2: Sclerotial density and incubation period of sclerotial formation of different isolates of *R. solani*

other four isolates. Culture plates of the isolates were observed for sclerotial location revealed that in *It* and *Rf* isolates sclerotia were located on surface of colony. Sub-surface location of sclerotia was observed in *Hc* isolate and in isolates *Be* and *Jr* sclerotia were embedded inside medium (Table 2).

Result showed that in three isolates distribution pattern of sclerotia was through out plate, while, distribution of sclerotia near inoculation point was recorded in *Be* and *Jr* isolates. Sclerotial size invariably was macro in *Hc* isolate and in *It* isolate micro sclerotia were recorded. Highest sclerotial production was observed in *Hc* isolate (95.33 / plate) whereas, the least sclerotial production (39.66/plate) was recorded in *Rf* isolate (Fig. 2). Moreover, all the isolates took variable time in producing sclerotia. Isolate *Hc* took minimum time (7 days) to produce sclerotia and isolate *Jr* took maximum time (15 days). These differences do indicate that there is existence of variability among the isolates of *R. solani*. Therefore, in totality, all the five isolates that were selected for the study did different from each other on certain parameters. In their similar studies, Ogoshi (1987), Meena *et al.* (2005) and Singh *et al.* (2002) too have observed differences in colony characters of the isolates when raised on culture medium.

Banded leaf and sheath blight disease was found to be prevalent showing the wide spread occurrence in the localities. Differences in disease severity at different locations could possibly be due to variation in the pathogen as high variability has been reported in *R. solani* of maize. This finding will offer a lot of discussions on management strategies. Variability within pathogen is an important consideration for breeding for resistance, particularly while screening for the resistance or while testing sensitivity of the pathogen towards different chemicals. If different isolates are found in a region, integrated approach should be adopted for an effective disease management.

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