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Uzma Rashid
Division of Plant Pathology, FoA, SKUAST-K, University in Srinagar, Jammu and Kashmir, India

Mohammad Najeeb Mughal
Division of Plant Pathology, FoA, SKUAST-K, University in Srinagar, Jammu and Kashmir, India

Tanveer Ahmad Wani
Division of Plant Pathology, FoA, SKUAST-K University in Srinagar, Jammu and Kashmir, India

Reyaz-ul-Rouf Mir
Division of Genetics and Plant Breeding, FoA, SKUAST-K University in Srinagar, Jammu and Kashmir, India

Ali Anwar
Division of Plant Pathology, FoA, SKUAST-K, University in Srinagar, Jammu & Kashmir, India

Shaheen Kausar Jan
Division of Plant Pathology, FoA, SKUAST-K, University in Srinagar, Jammu and Kashmir, India

Mushtaq Ahmad Malik
Division of Basic Science and Humanities, FoA, SKUAST-K University in Srinagar, Jammu and Kashmir, India

Mohammad Irfan
Division of Genetics and Plant Breeding, FoA, SKUAST-K University in Srinagar, Jammu and Kashmir, India

Corresponding Author:
Mohammad Najeeb Mughal
Division of Plant Pathology, FoA, SKUAST-K, University in Srinagar, Jammu and Kashmir, India

Evaluation of mungbean (*Vigna radiata* L. Wilczek) germplasm against *Boeremia exigua* var. *exigua*

Uzma Rashid, Mohammad Najeeb Mughal, Tanveer Ahmad Wani, Reyaz- ul-Rouf Mir, Ali Anwar, Shaheen Kausar Jan, Mushtaq Ahmad Malik and Mohammad Irfan

Abstract
Boeremia exigua var. *exigua syn. Phoma exigua* var. *Exigua* formerly known as *Ascochyta phaseolorum*, one of the most devastating pathogens causing Ascochyta blight and resulting in severe yield losses in legume crops. In this study, 70 genotypes were screened against B. Exigua for development of management strategies and to identify resistant genotypes. However, neither of the genotypes was found completely resistant to this destructive disease and only 4 genotypes viz., SKUA-WMB-11, SKUA-WMB-37, SKUA-WMB-53,SKUA-WMB-77were found moderately resistant. The genotype SKUA-WMB-105 was found to exhibit maximum disease intensity (63.14%) and SKUA-WMB-11 was found to have lowest disease intensity (5.58%). These genotypes could be used as a source for disease resistance in future and in developing specific breeding procedures for crop improvement.

Keywords: *Boeremia exigua*, genotypes, mungbean, resistant, susceptible

1. Introduction
Mungbean (*Vigna radiata* L.) belongs to family Leguminosae and is widely grown as *Kharif* season crop. Asia is a largest producer of mungbean and it is believed to produce 90% of total global mungbean production. However, from last few decades the yield is hampered due to number of biotic and abiotic factors. Among biotic factors it is believed that there is 40-60% yield loss in mungbean due to fungal infection (Kaur *et al.*, 2011) [1]. In recent years leaf blight disease caused by *Boeremia exigua (Ascochyta phaseolorum)*, has been seen previously reported as a major disease in several legume crops, has attained the status of major disease in north western Himalayas of India due to its polycyclic nature and presence of abundant inoculum and collateral hosts. Ascochyta blight significantly reduces the productivity of pulse crops globally (Davidson *et al.*, 2007) [2]. The *Boeremia exigua* syn. *Phoma exigua* previously known as *Ascochyta phaseolorum* has been reported to cause severe damage in common beans, soya bean and cowpea.
Ascochyta blight initially appears as grey spot on the leaves, stems or pods, transforms into brown lesions with dark brown borders. Small circular brownish black specks (pycnidia) resembling bull's eye with the advancement of disease. The most diagnostic characteristic of the disease are pycnidia arranged in concentric rings. Ascochyta blights spread quickly in cool and wet environmental conditions and gets easily spread by high humidity and morning dew periods (Markell, 2008) [3].

2. Materials and Methods
Major headings are to be column centered in a bold font without underline. They need be numbered. "2. Headings and Footnotes" at the top of this paragraph is a major heading.

2.1 Isolation
Mungbean leaves exhibiting typical disease symptoms on susceptible plants, collected during survey of different mungbean fields, were used for pathogen isolation.

2.2 Purification and maintenance of isolates
Single spore technique was adopted for the purification and maintenance of fungal cultures (Johnston and Booth, 1983) [4].

2.3 Pathogenicity test
Pathogenicity test was done according to methodology adopted by Bassalote-Ureba *et al.* (1999) [5].

2.4 Evaluation of germplasm
Seeds of 70 mungbean germplasm lines procured from the Division of GPB, FoA, SKUAST-K, Wadura, were studied against the pathogen. The lines were sown in pots under controlled conditions. Observations on the reaction of each germplasm line to the disease were recorded after 15days of artificial inoculation of the pathogen**.** 0-5 scale of Onfroy *et al*. (1999) [6] was used for calculation of disease intensity and the disease reaction of germplasm lines were evaluated by following modified scale of Sindhan *et al.* (1999) [7]. Six categories were made on the basis of percent leaf area involved as per the following key given in Table 1. The disease reaction of germplasm lines were evaluated on the basis of following modified scale of Sindhan *et al*. (1999) [7] as shown in Table 2.

3. Results and Discussion
Symptoms of *Boeremia exigua* var. *exigua causing leaf blight* of mungbean begin to appear in the first week of July and periodical observations on symptomatological development were recorded weekly. The disease first appeared on lower leaves. The lesion diameter of 2-4 mm was recorded in the second week of July which expanded upto the size of 9-19 mm after the fourth week of July. A maximum lesion size of 31 mm was observed in third week of August. Latter the spots coalesce together and cause withering of whole leaf (plate1). The lesions were light to dark brown in colour with concentric zones and dark brown margins. Pycnidia were pin head sized, brown to black in colour and usually scattered irregularly, sometimes arranged concentrically, which began to appear after one month of disease development i.e., in the second week of August. The lesions on pods were sunken and darker than those on leaves and appeared later in season and the scale for calculation of disease intensity is given in Plate 2. Screening under controlled conditions shows a variable response of interaction (Table 3). Disease intensity ranges from 5.58-63.19 percent and the highest disease intensity was observed in genotype SKUA-WMB-105, lowest in SKUA-WMB-11. No genotype was found resistant however, four genotypes viz., SKUA-WMB-11, SKUA-WMB-37, SKUA-WMB-53, and SKUA-WMB-77 were found moderately resistant with disease intensity ranging from 5.58-9.41 percent. 32 were susceptible, 26 as moderately susceptible and eight genotypes as highly susceptible (Plate 3).

Plate 1: Symptoms of *Boermia Exiguab* Leaves And C) POD

Plate 2: Scale used for scoring of disease intensity Ascochyta blight caused by *Boeremia exigua* on Mungbean leaves.

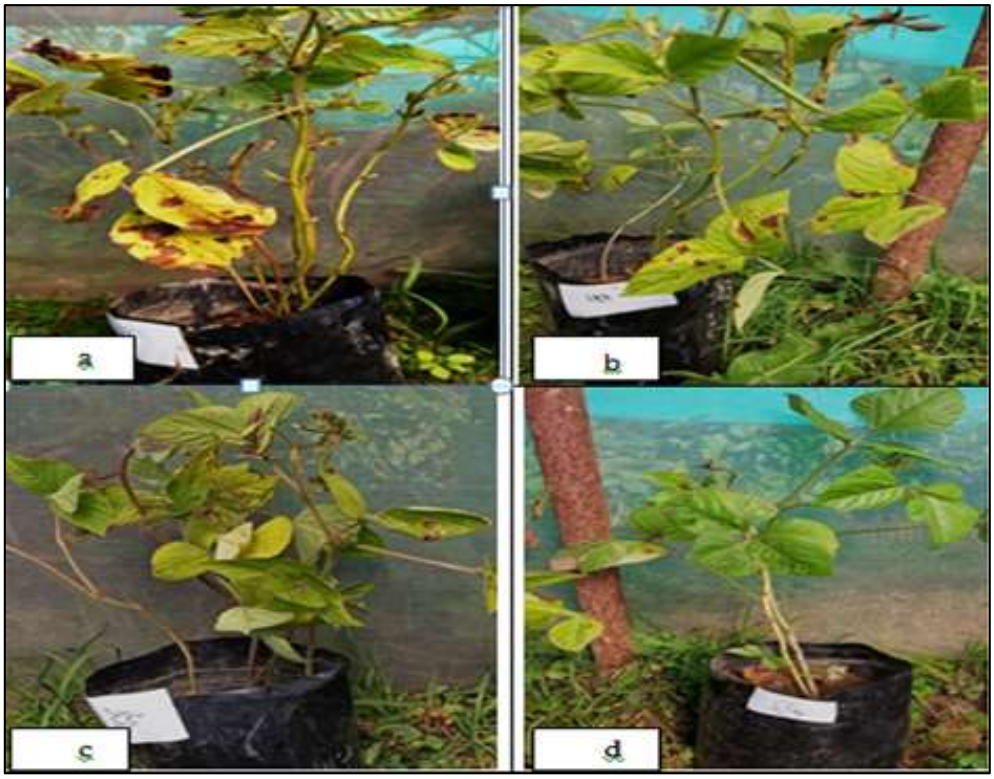

Plate 3: Screening of Germplasm under Artificially inoculated condition A) Highly susceptible B) susceptible C) moderately susceptible D) moderately resistant

Table 1: Percent intensity using 0-5 scale given by Onfroy *et al.* (1999)

Disease rating	Symptoms	Area covered
0		**No disease**
1	Few scattered flecks	up to 5 % leaf area
2	Numerous flecks	5.1- 10% leaf area
3	Necrotic and appearance of coalesced necrosis	10.1 to 25.0 % leaf area
4	Lesions on leaves	25.1 – 50 % of the leaf area
5	Necrotic	Above 50 % of the leaf area

Table 2: Disease reaction based on modified scale of Sindhan*et al*. (1999)

S. No	Reaction	Disease (%)
1.	Resistant	0-5.0
2.	Moderately Resistant	5.1-10.0
3.	Moderately Susceptible	10.1-25.0
4.	Susceptible	25.1-50.0
5.	Highly Susceptible	>50

Table 3: Categorization of Mungbean genotypes after screening under artificially inoculated conditions

Reaction	No. of genotypes	Genotype code	Disease incidence
Resistant	0	Nil	
Moderately Resistant	4	SKUA-WMB: 11,37,53,77	5.58-9.41
Moderately Susceptible	26	SKUA-WMB: 1,5, 7, 12, 13, 14, 15, 21, 22, 25, 31, 32, 44, 48, 49, 52,55, 63, 68, 71, 74, 78, 92, 94, 99, 102	10.2-23.55
Susceptible	32	SKUA-WMB: 2, 4, 8, 9, 10, 16, 17, 18,20, 24,26, 34, 36, 38, 40, 42, 43, 47, 50, 54, 59, 60, 64, 65, 70, 81, 84, 88, 89, 93, 96, 97	26.46-49.24
Highly Susceptible	8	SKUA-WMB: 23,27,51,79,86, 87, 103,105	50.88-63.14

The most realistic approach for the management of Ascochyta blight rely on identification of resistant genotypes through screening in field and under controlled conditions. In the present investigation, only 4 genotypes were found moderately resistant, 32 genotypes as susceptible, 26 moderately susceptible, 8 highly susceptible and the disease intensity varied from 5.58 to 63.14 percent. This was the first report on screening of mungbean genotypes against Ascochyta blight and from earlier studies, there was no report of resistance found against the same pathogen *viz*., *Ascochyta* sp. or *Boeremia exigua* on other legumes (Kraft *et al*., 1998) [8]. Similarly other workers like Ferreira *et al*. (2016) [9]; Parveen *et al.* (2021) [10] and Urinzwenimana *et al*. (2017) [11] have found low level of resistance against Ascochyta blight.

4. Conclusions
Variable response was found against *Boeremia exigua* var *exigua*. It was concluded that *Boeremia exigua* thrives under warm and humid conditions, typically between 20 to 30 °c. Excessive moisture, dew and prolonged leaf wetness can contribute to disease development. Number of genotypes found moderately resistant could be used as a source for resistance in future studies.

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6. Author contributions
All authors read, reviewed, agreed and approved the final manuscript. All authors agreed that-Witten informed consent was obtained from all participants prior to publish/enrolment.

7. Conflict of interest
The authors declare no known conflict of interests that could have appeared to influence the work reported in this paper.

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