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Namita Soni
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Kushal Raj
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

DS Duhan
Department of Vegetable Science, Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Rakesh Kumar Chugh
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Namita Soni
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Screening of bottle gourd [*Lagenaria siceraria* (Molina) Standl.] germplasm for resistance against anthracnose caused by *Colletotrichum lagenarium*

Namita Soni, Kushal Raj, DS Duhan and Rakesh Kumar Chugh

Abstract
Bottle gourd is an important annual summer cucurbit and a herbaceous climber native to tropical Asia and Africa. The crop remained prone to a number of fungal, bacterial and viral diseases, out of which important and devastating ones are mainly seed borne diseases incited by fungi. Anthracnose disease caused by *Colletotrichum lagenarium* (pass) Ellis and Halstd is an important fungal disease in bottle gourd crop growing areas of Haryana, which imposed losses to the extent of 25%. In order to manage seed borne pathogens of bottle gourd, resistant varieties serve as an eco-friendly approach. For screening of bottle gourd genotypes against this disease a study was conducted in research farm & laboratory of Department of Plant Pathology. Bottle gourd germplasm lines *viz.*, GH 32, GH 33, GH 34, GH 35, GH 36, GH 37, GH 38 & local variety were screened to find out resistant sources against anthracnose of bottle gourd. Disease intensity (%) for bottle gourd germplasm lines was calculated 60 days after sowing. Screening of germplasm lines revealed that minimum disease intensity of 23.33% was observed in GH 35 followed by 37.04, 44.44 and 44.44%, GH 32, GH 36 and local variety, respectively. None of the line was found completely resistant against anthracnose.

Keywords: Anthracnose, bottle gourd, cucurbits, germplasm, screening, resistance

Introduction
Cucurbits consist of largest group of economical vegetables belonging to family *Cucurbitaceae* distributed in tropical and subtropical regions being cultivated throughout the world in rainfed as well as irrigated conditions (Avinash and Rai, 2013) [4]. *Cucurbitaceae* family is reported to possess 118 genera comprising of 825 species of fruits and vegetables with high nutritive value due to presence of high proteins, fibres, water, carbohydrates, minerals and vitamins (Abushaala *et al.*, 2016) [2]. Amongst cucurbits, Bottle gourd is important annual herbaceous climber and a summer vegetable native to Africa and tropical Asia (Saha *et al.*, 2016) [14]. It is a paratropical species with high yield potential and steady market place throughout the season and widely cultivated in India, China, Sri Lanka and Bangladesh (Maheshwari *et al.*, 2013) [10]. Bottle gourd has high nutritive value and the fruit contains 96.3% water, 2.8% carbohydrates, 0.5% fats and 0.5% minerals in addition to traces of vitamin A and vitamin B (Abdelwehab *et al.*, 2014) [1]. The oil extracted from bottle gourd is considered to be the most nutritive oils available (Hegazy and Kinawy, 2011) [9]. Despite of high economic and medicinal importance, the crop is prone to a number of fungal, bacterial and viral diseases due to high moisture content in fruit (Chauhan, 2002) [7]. Amongst various diseases, important and devastating ones are mainly seed borne diseases incited by fungi where seed acts as primary source of inoculum (Ali *et al.*, 2010) [3]. The disease was earliest reported by Mundkur (1937) [11] from Punjab and later by Rangaswami *et al.*, (1970) [12] in South India. Farmers are facing severe losses ranging from 15-25% in rainy season crop due to anthracnose caused by *Colletotrichum lagenarium* (pass) Ellis and Halstd. (Bharath *et al.*, 2005) [5]. The characteristic symptoms of bottle gourd anthracnose manifest as small circular sunken yellowish to brown spots in earlier stage and large brown to black coalesced areas with dead cracked centres covered with pink spore masses at later stage of disease development (Gupta *et al.*, 2009) [8]. In order to manage seed borne pathogens of bottle gourd, farmers rely on systemic and non-systemic fungicides but increased use of chemicals pose serious threat to health and leads to hazards of bioaccumulation (Rathod *et al.*, 2010) [10]. Keeping in view of an eco-friendly approach, the present study was conducted to explore the resistance source among various genotypes for management of bottle gourd diseases.

Materials and Methods

Bottle gourd germplasm lines *viz.*, GH 32, GH 33, GH 34, GH 35, GH 36, GH 37 & GH 38 procured from Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana and one local variety were subjected to *in-vivo* screening against anthracnose disease (Plate 1). The experiment was laid out in separate plots of 5m × 2m each with RBD (Randomized block design) with 250 cm row-to-row spacing, 60 cm plant-to-plant spacing and three replications. All the recommended agronomic practices were followed during screening process.

Plate 1: Seeds of germplasm lines screened for anthracnose resistance

Per cent disease intensity for bottle gourd germplasm lines was calculated as per Chauhan, (2002) [7]. The observations were recorded 60 days after sowing for each plot by tagging 3 vines randomly and three leaves from each vine were observed for the number of anthracnose spots. The scale used for the calculation of disease intensity is represented in table 1:

Table 1: Disease rating scale used for screening of bottle gourd germplasm

Rating		No. of spots
0	:	no spots per leaf
1	:	1- 10 spots per leaf
2	:	11- 20 spots per leaf
3	:	21- 50 spots per leaf
4	:	> 50 spots per leaf

Number of lesions on each leaf were counted and per cent disease intensity was calculated from the data recorded using the following formula:

$$\text{Per cent disease intensity} = \frac{\text{Sum of all numerical ratings}}{\text{Total leaves observed} \times \text{Maximum rating}} \times 100$$

Based on the per cent disease intensity, the various germplasm lines were placed into different categories (Table 2) as per Chauhan and Bhatia (2013) [6]:

Table 2: Categorization of germplasm lines based on disease intensity (%)

Disease Intensity (%)	Category
0-5	Resistant
6-20	Moderately susceptible
21-50	Susceptible
51-100	Highly susceptible

Results

Screening of eight germplasm lines of bottle gourd against anthracnose (*Colletotrichum lagenarium*) carried out under *in vivo* revealed that the minimum disease intensity of 23.33% was observed in GH 35 followed by 37.04, 44.44 and 44.44%, in local variety, GH 32 and GH 36 respectively, while it was recorded maximum in case of GH 34 with 64.81 disease intensity.

Table 3: Per cent disease intensity in different bottle gourd germplasm lines screened against anthracnose

Sr. No.	Germplasm line	% Disease intensity(60 DAS)
1	GH32	44.44
2	GH33	58.52
3	GH34	64.81
4	GH35	23.33
5	GH36	44.44
6	GH37	51.11
7	GH38	52.22
8	Local variety	37.04
C.D. at 5%		12.86
S.E. (m)		4.20

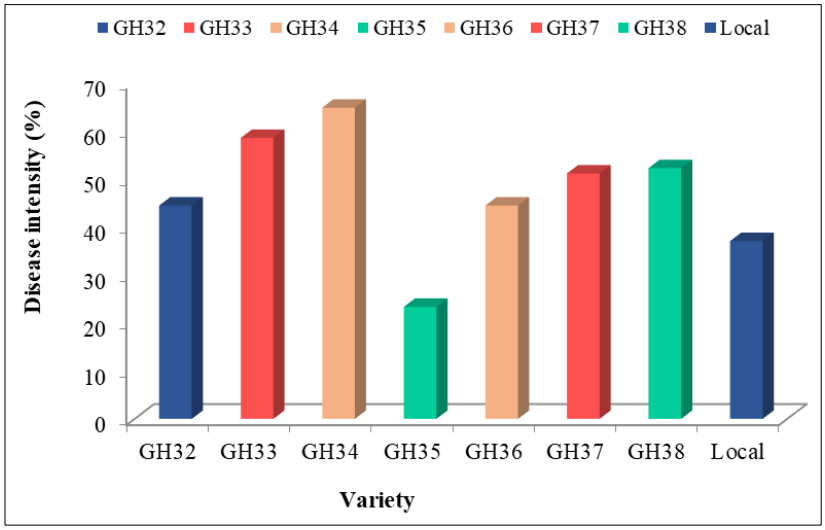

Fig 1: Disease intensity (%) at 60 DAS

Disease intensity was recorded to be intermediate in GH 37 and GH 38 which were 51.11 and 52.22 %, respectively (Table 3; Fig.1). None of the line was found completely resistant against anthracnose though GH 35 and local variety exhibited significantly low disease intensity as compared to other germplasm lines revealing wider adaptability of the pathogen.

Discussion

Screening of various germplasm lines is essential to find out the potential resistance source. Though there are reports indicating use of resistant varieties against a number of diseases in many crops, a meager information is available with respect to bottle gourd. In the present investigation, screening of various germplasm lines of bottle gourd against anthracnose under *in vivo* conditions indicated maximum disease intensity of 64.81 in GH 34 while a minimum of 23.33% disease in GH 35. Chauhan and Bhatia (2013) [6] screened twenty-two germplasm lines of bottle gourd against anthracnose under natural and artificial inoculation conditions and reported that four germplasm lines, *viz.*, two being GH 3 and GH 9 were resistant under field as well as artificial inoculation conditions while the other two GH 10 and GH 25 were resistant under field conditions and moderately susceptible under artificial inoculation conditions. Out of remaining eighteen lines, seven were moderately susceptible, six were susceptible and five were highly susceptible. Winter Ghiya-1 was moderately susceptible under natural conditions while resistant under artificial inoculation conditions.

Conclusion

Infection of fruits and seeds of bottle gourd reduces its market value. The information so generated through current research work on screening aspects of bottle gourd lines may be helpful in devising resistant sources against the disease.

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