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Screening of Bitter Gourd (*Momordica charantia* L.) Germplasm against Downy Mildew under Field Conditions

Kishorkumar G K*[1], R S Jawadagi[2], Noorulla Haveri[3], Namita Raut[4], Shashikant Evoor[5], Shivayogi Ryavalad[6] and Sayeed W R Mulla[7]

College of Horticulture Bagalkot, University of Horticultural Sciences, Bagalkot 587 104, Karnataka, India

ABSTRACT

The present study was undertaken to screen various bitter gourd genotypes for resistance against downy mildew caused by *Pseudoperonospora cubensis* under natural field screening conditions. The experiment was laid out in a RCBD with two replications during the 2022–23 season evaluating 75 genetically diverse bitter gourd genotypes including commercial varieties and improved lines. None of the genotypes showed complete resistance to the pathogen. The percentage disease index (PDI) observed under natural conditions ranged between 23.98 to 86.77 per cent. The results indicated that the minimum percent disease index (PDI) of 23.98 per cent was recorded in genotype Green Long followed by 29.46 (IC470565), 34.22 (IC68335), 36.09 (PVIG-2) and 37.33 (IC467681) suggesting moderately resistant to downy mildew. The maximum PDI was recorded in the genotype Kashi Mayuri with 86.77 per cent followed by 86.14 (MC-3), 86.10 (Hirkani), 82.33 (UHSB-025) and 82.28 (IC113875) genotypes were found to be susceptible to downy mildew under field conditions. Thus, the identified bitter gourd genotypes can be used for further breeding programme for the development of new bitter gourd hybrids (or) varieties with downy mildew resistance.

Keywords: Bitter gourd, Downy mildew, PDI, *Pseudoperonospora cubensis*, Resistance

INTRODUCTION

Bitter gourd (*Momordica charantia* L) is a tropical and subtropical vegetable crop belonging to the subfamily *Cucurbitoideae* of the family *Cucurbitaceae*, which comprises 125 genera and approximately 960 species. It is a monoecious and highly cross-pollinated crop, exhibiting a high degree of heterozygosity. Globally, the members of the *Cucurbitaceae* family are widely valued as food crops consumed either raw or cooked. The fruit is an excellent source of essential nutrients, including beta-carotene, vitamin C, folic acid, magnesium, phosphorus and potassium. Additionally, bioactive compounds extracted from bitter gourd seeds have been shown to inhibit the proliferation of human liver cancer cells and breast cancer cells (Adil *et al,* 2024).

Bitter gourd is vulnerable to several fungal diseases including powdery mildew, downy mildew, anthracnose, leaf spot, wilt and charcoal rot. Among these, downy mildew stands out as one of the most serious foliar diseases. The disease is common in warm temperate and tropical climates and causes significant damage in regions such as North America, Europe and Asia. In India, downy mildew is widespread except in the high-altitude temperate zones of the Himalayas, with higher incidence observed in the northern parts of the country. The disease leads to considerable losses in several cucurbit crops including bitter gourd, sponge gourd, watermelon, cucumber, ridge gourd and muskmelon. It is also destructive particularly in bottle gourd, pumpkin and vegetable marrow. Downy mildew is most prevalent during the rainy season, flourishing in high humidity and moderately cool to warm temperatures ranging from 12°C to 27°C (Manjusha *et al,* 2017). Although it can survive during hot days, extended periods of hot and dry weather can significantly reduce its spread. Initial symptoms appear as pale green spots on the leaves, which gradually turn yellow. These lesions are typically angular to irregular in shape and are restricted by the leaf veins.

Corresponding Author's Email - kishoreveg@gmail.com

1. Ph. D Scholar, 2. Professor and Head, Vegetable Science, 3. Assistant Professor, Plant Pathology

4. Assistant Professor, Vegetable Science, AICRP (Vegetables) Dharwad, UHS Bagalkot

5. Associate Professor, Vegetable Science, UHS Bagalkot 6. Associate Professor, Seed Science and Technology, RHREC Kumbapur, Dharwad, UHS Bagalkot

7. Assistant Professor, Biotechnology and Crop Improvement

Table 1. Disease scoring for downy mildew under natural conditions in bitter gourd.

Score	Symptoms
0	Leaf area without infection
1	1 % leaf area infected
2	10 % leaf area infected
3	25 % leaf area infected
4	50 % leaf area infected
5	More than 50 % leaf area infected

Yellow spots on the upper surfaces of leaves initially resemble an indefinite mosaic-like pattern. As these spots expand, the affected leaves begin to yellow uniformly, eventually leading to tissue death. The leaves then wither and die. During periods of high moisture, the lower surface of the infected leaves develops a downy mildew, varying in color from pale gray to purple and, in some cases, white to nearly black (Bommesh *et al,* 2018). Infected leaves generally wither and die but often remain upright, with their margins curling inward. The disease usually initiates in the leaves near the center of a plant hill or row and progressively spreads outward. This leads to defoliation, impaired fruit development and a significant reduction in yield. Under conditions of high humidity and frequent rainfall, the infection can become severe enough to destroy entire leaf veins, exacerbating the damage. Early onset of downy mildew can result in crop yield losses of up to 60% whereas late infections are comparatively less harmful (Prashanth *et al,* 2019). Given the significant impact of this disease, the role of the pathogen in disease development was a key focus of the present study.

MATERIALS AND METHODS

The screening of bitter gourd genotypes under natural field conditions was undertaken during the *Kharif* season of 2023 at the Vegetable Block, College of Horticulture, University of Horticultural Sciences, Bagalkot, Karnataka, India. A total of 75 genetically diverse genotypes were evaluated, sourced from the National Bureau of Plant Genetic Resources (NBPGR), New Delhi; Kerala Agricultural University (KAU), Thrissur; local collections; the Indian Institute of Vegetable Research (IIVR); along with several improved varieties. Assessment for resistance to downy mildew began one month after transplanting, with disease scoring conducted weekly over a period of seven weeks, continuing until the completion of the crop's growth cycle. The experiment was conducted in a RCBD with two replications for each genotype. The incidence of downy mildew was measured under natural condition with the help of the scoring system (Mayee and Datar, 1986) as per Table 1.

Disease incidence in the field was assessed by evaluating the severity of symptoms on five leaves each from the top, middle and basal portions of the plant, by using a 0–5 rating scale (Table 1). Based on the observed symptomatic leaf area, the Percent Disease Index (PDI) was calculated using the standard formula. Genotypes were classified into four categories according to their PDI values: resistant (0-20 %), moderately resistant (21-40 %), susceptible (41-60 %) and highly susceptible (>60 %). The percent diseases index (PDI) using the formula (Wheeler, 1969) was computed

RESULTS AND DISCUSSION

All seventy five bitter gourd genotypes were evaluated for resistance to downy mildew under natural field conditions during *Kharif* 2023. None of the genotypes exhibited complete resistance, indicating the considerable impact of downy mildew across the tested cultivars. However, the genotypes Green Long and IC-470565 demonstrated moderate resistance, with average PDI values of 23.98 and 29.46, respectively. A total of 34 genotypes were classified as susceptible, exhibiting PDI values between 41 and 60. The remaining genotypes, with PDI values exceeding 60, were categorized as highly susceptible to downy mildew (Table 2). Among them, some of the improved genotypes like Preethi, Kashi Pratishta and PVIG-2 were identified as susceptible, with a PDI values of 57.64, 47.95 and 42.50 respectively. The genotypes like Phule Green Gold, Kashi Mayuri, Pant Karela-1, Pant Karela-2, Hirkani and Katali Vaibhav resulted in highly susceptible to downy mildew with PDI values of 69.87, 86.77, 64.81, 71.78, 86.10 and 66.96, respectively.

The results indicated that among seventy five genotypes, only six genotypes categorized under moderately resistant (MR) cultivars against downy mildew. The minimum percent disease index (PDI) of 23.98 percent was recorded in genotype Green Long followed by 29.46 (IC470565), 34.22 (IC68335), 36.09 (PVIG-2), 37.33 (IC467681) and 39.66

Table 2. Reaction of different bitter gourd genotypes for downy mildew under natural conditions.

Sr. No.	Genotype	Scoring	PDI
1.	IC-505630	1.20	23.98
2.	IC-418486	1.47	29.46
3.	IC68335	1.71	34.22
4.	IC505632	1.80	36.09
5.	IC-264770	1.87	37.33
6.	IC-68275	1.91	38.30
7.	IC541218	1.98	39.66
8.	IC505629	2.08	41.53
9.	IC-541218	2.09	41.85
10.	UHSBP-215	2.10	42.02
11.	IC-44413	2.11	42.17
12.	IC-505637	2.11	42.25
13.	IC-66023	2.18	43.69
14.	IC68232	2.19	43.85
15.	IC-470943	2.27	45.31
16.	IC-50524A	2.29	45.72
17.	IC-427694	2.29	45.83
18.	IC-44418	2.29	45.74
19.	IC-450520	2.31	46.21
20.	IC-505632	2.34	46.71
21.	IC-45351	2.36	47.23
22.	Kashi Pratishta	2.40	47.95
23.	IC-85603A	2.48	49.68
24.	IC427694	2.48	49.65
25.	IC264699 - 2	2.48	49.51
26.	TCR-332 IC 505639	2.51	50.13
27.	IC-68309	2.53	50.55
28.	TCR-75 IC50527	2.53	50.51
29.	IC-50527	2.54	50.73
30.	IC470550	2.69	53.76
31.	IC-505621	2.71	54.25
32.	Mrutyeenjaya Green	2.71	54.22
33.	IC-398610	2.74	54.75
34.	IC-505639	2.80	56.08
35.	PVIG-2	2.83	56.67
36.	IC-85649	2.84	56.75
37.	Preethi	2.88	57.64
38.	IC68294	2.90	58.03
39.	IC68295	2.91	58.15

Sr. No.	Genotype	Scoring	PDI
40	IC-505623	2.93	58.50
41	IC-541429	2.95	58.96
42	IC-45350	3.05	60.93
43	IC505623	3.07	61.33
44	IC-622910	3.08	61.68
45	IC467681	3.08	61.68
46	IC-541435	3.14	62.71
47	IC-85634	3.17	63.30
48	IC-620908	3.23	64.55
49	IC-470556	3.24	64.84
50	Pant Karela 1	3.24	64.81
51	Ranebennur Local 2	3.25	65.01
52	IC-213307	3.26	65.26
53	TCR-505 IC622910	3.26	65.23
54	IC470943	3.28	65.51
55	IC-505629	3.30	66.00
56	IC-469512	3.32	66.45
57	Katali Vaibhav	3.35	66.96
58	Davanagere Local	3.42	68.36
59	Phule Green Gold	3.49	69.87
60	IC-470550	3.51	70.11
61	IC68294	3.51	70.19
62	Pant karela 2	3.59	71.78
63	MC-11	3.68	73.59
64	IC-599429	3.76	75.11
65	MC-10	3.76	75.22
66	IC450520	3.88	77.65
67	IC-622911	3.90	77.96
68	IC-470553	3.91	78.23
69	IC-505640	3.92	78.44
70	IC264699-3	4.00	80.07
71	IC-33275	4.11	82.28
72	UHSB-025	4.12	82.33
73	Hirkani	4.30	86.10
74	IC-44426	4.31	86.14
75	Kashi Mayuri	4.34	86.77

(IC541218) were moderately resistant to downy mildew. The highest average PDI was observed in genotype Kashi Mayuri (86.77) followed by 86.14 (MC-3), 86.10 (Hirkani), 82.33 (UHSB-025) and 82.28 (IC113875) genotypes and were found to be susceptible to downy mildew under field conditions.

The findings were in agreement with those reported by Wairs *et al* (2014) who screened nineteen bitter gourd varieties for resistance to downy mildew. Among these, two varieties were classified as highly resistant, three as moderately resistant, thirteen as moderately susceptible and one variety (VNR-22) was identified as susceptible. Similarly, Pandey *et al* (2005) evaluated 148 bitter gourd germplasm lines for resistance against *Pseudoperonospora cubensis*. Of these, two lines exhibited moderate resistance and a high degree of tolerance, while seven cultivars were found to be moderately susceptible. The remaining lines were categorized as either susceptible or highly susceptible to the disease.

Thampi *et al* (2024) conducted a study on 22 genotypes of *Momordica charantia* and *Momordica charantia* var. *muricata,* screening them under natural field conditions for resistance to downy mildew caused by *Pseudoperonospora cubensis.* Six genotypes (three most resistant and three highly susceptible), including Priya, Preethi, Priyanka, MC-48, MC-49 and MC-50 were further evaluated during the monsoon season. None of the genotypes exhibited complete resistance to the pathogen. Genotypes MC-50 and MC-48 recorded the lowest PDI values of 11.04 % and 11.98 % ,respectively and were classified as moderately resistant. On the other hand, Priyanka with a PDI of 85.22 % was categorized as susceptible. In a similar study, Bhutia *et al* (2005) screened 114 cucumber genotypes and found that ten were resistant, 18 moderately resistant, 37 moderately susceptible and 49 susceptible. Furthermore, studies by Criswell *et al* (2008) and Wan *et al* (2010) also identified resistant sources for downy mildew in cucumber.

CONCLUSION

Among the tested bitter gourd varieties, the genotypes Green Long, IC470565, IC68335, PVIG-2, IC467681 and IC541218 genotypes were moderately resistant to downy mildew under natural field conditions. The identified bitter gourd genotypes can be used for further breeding programme for the development of new bitter gourd hybrids (or) varieties with downy mildew resistance. However, further research is necessary to validate these findings with artificial screening methods under different changing environmental conditions.

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