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Screening of South Indian Culinary Melon (*Cucumis melo* subsp. *agrestis* var. *acidulus*) Accessions for Downy Mildew Disease under Natural Epiphytotic Condition

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Abstract

Culinary melon also known as non dessert cucumber (*Cucumis melo* subsp. *agrestis* var. *acidulus*) belongs to the family Cucurbitaceae. It is widely cultivated in Southern parts of Indian subcontinent. It is mainly utilized for preparation of lentil soup, sambar, dosa, palya and chutney. 70 accessions were collected from six South Indian states namely Karnataka, Kerala, Andhra Pradesh, Tamil Nadu, Telangana and Goa. The accessions were evaluated for incidence of downy mildew resistance during *Kharif* 2018 under natural condition. The percent disease index (PDI) for downy mildew ranged from 3.70 to 48.64%. 10 accessions showed resistance to downy mildew. Among them, accession MS21 showed resistance with average least PDI of 3.70 followed by MS 6 (6.54). 50 accessions were found to be moderately resistant with average PDI ranging from 20 to 39.80. 12 accessions were found susceptible with PDI ranging from 41 to 49. None of the accession was found highly susceptible to the disease. The resistant accessions can be utilized as donor parents for resistant breeding in the improvement of culinary melon as well as melon group of vegetables.

Keywords: Accessions, culinary melon, downy mildew, PDI, resistant breeding

1. Introduction

Culinary melon (*Cucumis melo* subsp. *agrestis* var. *acidulus*) is extensively used in western ghats region of India and comes under the melon group of vegetables belonging to the family Cucurbitaceae. The crop is so far called by different vernacular names such as golden melon and Mangalore melon in English. In Karnataka, it is locally named as Sambar southe, Mogge kayi and Mangalore southe. It is an ideal summer vegetable crop mainly growing for culinary purpose (Gondi et al., 2016). The fruits are used in the preparations of an array of traditional vegetarian dishes like chutney, lentil soup, sambar, dosa, palya, pickles etc. It is a highly cross pollinated, due to monoecious nature of flowering. Warm weather and bright sunlight are required for its better growth and development. The crop is prone to many fungal and bacterial diseases. Among the fungal diseases, downy mildew caused by *Pseudoperonospora cubensis* (Berkeley & Curtis) Rostovtsev is considered to be the major constraint in cultivation. Even though the disease can be managed with use of fungicides (Urban and Lebeda, 2006), however, genetic resistance provides more economically sound and environmentally safe approach. Identification of source of resistance is very much needed for any disease resistance breeding program. With this background, germplasm accessions collected from South Indian states *viz.,* Karnataka, Kerala, Andhra Pradesh, Tamil Nadu, Telangana and Goa were evaluated to identify the resistant accessions of culinary melon against downy mildew.

2. Materials and Methods

Field screening of collected culinary melon accessions were evaluated under natural epiphytotic conditions during late *Kharif* 2018 at college of Horticulture, Sirsi farm. The experimental material consisted of 70 accessions obtained from South Indian states *viz*., Karnataka (35), Kerala (11), Andhra Pradesh (17), Tamil Nadu (05), Telangana (01) and Goa (01) (Table 1). These were evaluated for resistance to downy mildew in augmented design along with two Kerala Agriculture University Trissur released varieties (Soubhagya and Mudicode local) as checks. PDI (Per cent Disease Index) of screening data were arc sine transformed for statistical analysis. Randomly five leaves were selected from plants *viz.,* the top, the median and at the base of the plant using 0–9 scale. The scale was recorded based on percentage of symptomatic leaf area covered (0: 0%, 1: 1–3%, 2: 3–6%, 3: 6–12%, 4: 12–25%, 5:

Table 1: South Indian culinary melon accessions used for downy mildew disease evaluation (N=70)

Accession No.	Botanical Name	State	Fruit characteristics
MS 1	*C. melo* var. *acidulus*	Kerala	Ovate fruit, green to yellow color on maturity
MS 2	*C. melo* var. *acidulus*	Kerala	No stripes, elongated yellow fruit
MS 3	*C. melo* var. *acidulus*	Kerala	Green to yellow color on maturity, elongated fruits
MS 4	*C. melo* var. *acidulus*	Kerala	No stripes, elongated green to yellow color on maturity
MS 5	*C. melo* subsp. *agrestis*	Kerala	Wild species, small seeded, greater number of fruits/vine
MS 6	*C. melo* subsp. *Agrestis*	Kerala	Wild species, striped small to medium size > 10 fruits/vine
MS 10	*C. melo* var. *acidulus*	Kerala	Oblate shape, less prominent stripes orange colour on maturity,
MS 11	*C. melo* var. *acidulus*	Kerala	Oblate shape, green with yellow stripes, matures at 55 DAS
MS 12	*C. melo* var. *acidulus*	Kerala	Ovate shaped, greenish yellow prominent stripes with average fruit weight of 1.5-2 kg
MS 13	*C. melo* var. *acidulus*	Kerala	Oblate shaped, greenish yellow prominent stripes on maturity
MS 15	*C. melo* var. *acidulus*	Kerala	Round, golden yellow color medium fruits
MS 16	*C. melo* var. *acidulus*	Karnataka	Oblate prominent green yellow stripes
MS 17	*C. melo* var. *acidulus*	Karnataka	Pyriform shaped green yellow striped fruits
MS 18	*C. melo* var. *acidulus*	Karnataka	Oblate shaped medium size fruits with patchy green yellow stripes
MS 19	*C. melo* var. *acidulus*	Karnataka	Ovate patchy green yellow striped fruit
MS 20	*C. melo* var. *acidulus*	Karnataka	Dark green oblate shaped fruit
MS 21	*C. melo* var. *acidulus*	Karnataka	Green oblate fruit
MS 22	*C. melo* var. *acidulus*	Karnataka	Oblate shape, green yellow striped fruit
MS 23	*C. melo* var. *acidulus*	Karnataka	White color ovate fruit
MS 24	*C. melo* var. *acidulus*	Karnataka	Oblong shaped striped fruit
MS 26	*C. melo* var. *acidulus*	Karnataka	White color oblong fruit
MS 27	*C. melo* var. *acidulus*	Karnataka	Light green oblate shaped fruit
MS 28	*C. melo* var. *acidulus*	Karnataka	Oblate shaped green prominent ribs on skin
MS 30	*C. melo* var. *acidulus*	Karnataka	>10-month shelf-life striped oblate fruit
MS 31	*C. melo* var. *acidulus*	Karnataka	Oblate shape, patchy green with yellow stripes
MS 32	*C. melo* var. *acidulus*	Karnataka	Oblate shape, patchy green with yellow stripes
MS 33	*C. melo* var. *acidulus*	Karnataka	Oblate shape, patchy green with yellow stripes
MS 34	*C. melo* var. *acidulus*	Karnataka	Oblate shape, patchy green with yellow stripes
MS 35	*C. melo* var. *acidulus*	Karnataka	Oblate shape, patchy green with yellow stripes
MS 36	*C. melo* var. *acidulus*	Karnataka	Oblate shape, orange color fruits on maturity
MS 37	*C. melo* var. *acidulus*	Karnataka	Elliptical, patchy green with yellow stripes on maturity
MS 38	*C. melo* var. *acidulus*	Karnataka	Oblate, green yellow striped fruit
MS 39	*C. melo* var. *acidulus*	Karnataka	Oblate shaped, green with scattered yellow patches
SS11	*C. melo* var. *acidulus*	Karnataka	Ovate, green with yellow stripes on maturity
MS 41	*C. melo* var. *acidulus*	Karnataka	oblate medium sized orange color on maturity fruits
MS 43	*C. melo* var. *acidulus*	Karnataka	Elongated green yellow scattered stripes
MS 44	*C. melo* var. *acidulus*	Karnataka	Oblate shaped, patchy green with yellow stripes on maturity
MS 45	*C. melo* var. *acidulus*	Karnataka	Oblate yellow color with less prominent stripes fruits

Table 1: Continue...

Accession No.	Botanical Name	State	Fruit characteristics
MS 46	*C. melo* var. *acidulus*	Karnataka	Pyriform, green with yellow stripes on maturity
SS 1	*C. melo* var. *acidulus*	Karnataka	Elongated, small prominent stripes with orange color on maturity
MS 48	*C. melo* var. *acidulus*	Telangana	Round, orange color fruit
MS 49	*C. melo* var. *acidulus*	Andhra Pradesh	Round, orange color fruit
MS 50	*C. melo* var. *acidulus*	Andhra Pradesh	Round, golden yellow color fruit
MS 51	*C. melo* var. *acidulus*	Andhra Pradesh	Round, orange color fruit
MS 52	*C. melo* var. *acidulus*	Andhra Pradesh	Round, golden yellow color fruit
MS 53	*C. melo* var. *acidulus*	Andhra Pradesh	Round, yellow color fruit
MS 54	*C. melo* var. *acidulus*	Andhra Pradesh	Round, yellow color fruit
SS 16	*C. melo* var. *acidulus*	Karnataka	Ovate, green with yellow stripes on maturity
MS 56	*C. melo* var. *acidulus*	Andhra Pradesh	Round, orange color fruit
MS 57	*C. melo* var. *acidulus*	Andhra Pradesh	Round, orange color fruit
MS 58	*C. melo* var. *acidulus*	Karnataka	Elliptical, green with scattered yellow patch on skin
MS 59	*C. melo* var. *acidulus*	Andhra Pradesh	Round, golden yellow color fruit
MS 60	*C. melo* var. *acidulus*	Andhra Pradesh	Round, orange color fruit
SS 14	*C. melo* var. *acidulus*	Karnataka	Ovate green with white to yellow stripes on maturity
MS 63	*C. melo* var. *acidulus*	Andhra Pradesh	Oblate, orange color patches on fruit
MS 64	*C. melo* var. *acidulus*	Andhra Pradesh	Round, patchy green with orange fruit
MS 65	*C. melo* var. *acidulus*	Andhra Pradesh	Round, orange with yellow stripes on fruit
MS 66	*C. melo* var. *acidulus*	Andhra Pradesh	Round yellow color fruit
IIHR 381	*C. melo* var. *acidulus*	Karnataka	Small oblate striped fruits
MS 68	*C. melo* var. *acidulus*	Andhra Pradesh	Round yellow color fruit
MS 69	*C. melo* var. *acidulus*	Andhra Pradesh	Round orange patches on fruit skin
MS 70	*C. melo* var. *acidulus*	Andhra Pradesh	Round yellow to orange color fruit
MS 71	*C. melo* var. *acidulus*	Tamil Nadu	Round orange color fruit
MS 72	*C. melo* var. *acidulus*	Tamil Nadu	Round yellow color fruit
MS 73	*C. melo* var. *acidulus*	Tamil Nadu	Oblate golden yellow color fruit
MS 74	*C. melo* var. *acidulus*	Tamil Nadu	Elliptical Stripe fruit
MS 75	*C. melo* var. *acidulus*	Tamil Nadu	Pyriform shaped striped fruit
SS 6	*C. melo* var. *acidulus*	Karnataka	Ovate striped fruit, resistance to DM
SS 7	*C. melo* var. *acidulus*	Karnataka	Ovate striped fruit, resistance to DM
MS 78	*C. melo* var. *acidulus*	Goa	Oblate, striped big sized fruits
MS 79	*C. melo* var. *acidulus*	Karnataka	Ovate dark green fruit

25–50%, 6: 50–75%, 7: 75–87%, 8: 87–99% and 9: 100%) as described by Jenkins and Wehner (1983). Using symptomatic leaf area data, PDI was calculated using the formula given by Wheeler (1969). All the genotypes were categorized into four groups namely resistant (0–20% PDI), moderately resistant (21–40% PDI), susceptible (41–60% PDI) and highly susceptible (>60% PDI) (Reddy, 2002).

PDI={(Sum of numerical values/Number of leaves Observed) ×(100/Maximum rating)}

3. Results and Discussion

3.1. Screening of culinary melon accessions under natural epiphytotic conditions

Screening of 70 culinary melon accessions collected from south Indian states (Table 1) against downy mildew disease indicated significant variation among the accessions. Among the 70 accessions and two checks screened against the disease, none of the accession was found to be immune

against the disease. However, 10 accessions showed resistance to downy mildew. Among them, accession MS21 showed resistance with average PDI of 3.70 followed by MS 6 (6.54). 50 accessions were found moderately resistant with average PDI ranging from 20 to 39.80. Whereas, 12 accessions recorded susceptibility with PDI ranging from 41 to 49 (Table 2 and 3). The highest average PDI was observed in accession MS-52 (48.64). This might be due to grand growth stage coincidence with less temperature coupled with high relative humidity and genotypic performance resulted in occurrence of diseases (Thomas et al., 2000 and Shruti et al., 2017). The significant variation in disease incidence may be due to the differential expression of accessions for pathogen. Petrov et al. (2000) observed that the resistant plants exhibit small, chlorotic, water-soaked lesions and most susceptible plants showed yellowing and chlorosis. The observation recorded during our findings were similar to those reported from Shruti et al. (2017) in 24 oriental pickling melon genotype evaluation for downy mildew disease. Twenty out of 1300 tested cucumber cultigens were highly resistant to downy mildew and none was found immune (Call, 2012). Bhutia et al. (2005) screened 114 cucumber genotypes and results showed that ten were resistant, 18 were moderately resistant, 37 were moderately susceptible and 49 genotypes with susceptible reaction. Criswell et al. (2008) and Wan et al. (2010) identified resistant sources for downy mildew pathogen in cucumber.

Table 2: Downy mildew disease incidence of South Indian culinary melon accessions under field condition

Sl. No	Accessions	PDI	Sl. No	Accessions	PDI
1.	MS 1	30.12 (33.18)	31.	MS 37	41.98 (40.31)
2.	MS 2	16.54 (23.89)	32.	MS 38	25.59 (31.55)
3.	MS 3	39.51 (38.90)	33.	MS 39	19.44 (26.12)
4.	MS 4	34.32 (35.84)	34.	MS 41	30.37 (33.41)
5.	MS 5	23.95 (29.24)	35.	MS 43	37.53 (37.72)
6.	MS 6	6.54 (14.17)	36.	MS 45	30.62 (33.58)
7.	MS 10	33.58 (35.38)	37.	MS 46	29.88 (33.07)
8.	MS 11	21.30(27.40)	38.	MS 48	44.44 (41.78)
9.	MS 12	16.79 (23.99)	39.	MS 49	44.38 (41.74)
10.	MS 13	19.07 (25.88)	40.	MS 50	34.88 (36.15)
11.	MS 15	27.90 (31.87)	41.	MS 51	39.26 (38.78)
12.	MS 16	28.15 (31.95)	42.	MS 52	48.64 (44.20)
13.	MS 17	45.68 (42.49)	43.	MS 53	40.74 (39.64)
14.	MS 18	35.31 (36.42)	44.	MS 54	39.51 (38.90)
15.	MS 19	36.54 (37.17)	45.	MS 56	46.67 (43.07)
16.	MS 20	19.00 (24.53)	46.	MS 57	42.96 (40.94)
17.	MS 21	3.70 (11.05)	47.	MS 59	25.68 (30.43)
18.	MS 22	19.26 (25.96)	48.	MS 60	24.26 (29.42)
19.	MS 23	8.89 (16.97)	49.	MS 63	40.99 (39.78)
20.	MS 24	16.54 (23.95)	50	MS 64	34.44 (35.89)
21.	MS 26	22.96 (28.55)	51.	MS 65	35.19 (36.34)
22.	MS 27	36.30 (36.98)	52.	MS 66	41.98 (40.32)
23.	MS 28	39.51 (38.92)	53.	MS 68	38.52 (38.30)
24.	MS 30	25.93 (30.55)	54.	MS 69	29.94 (33.12)
25.	MS 31	31.36 (33.97)	55.	MS 70	31.85 (34.24)
26.	MS 32	25.93 (30.56)	56.	MS 71	24.94 (29.93)
27.	MS 33	32.84 (34.87)	57.	MS 72	24.20 (29.37)
28.	MS 34	19.75 (26.29)	58.	MS 73	23.70 (29.07)
29.	MS 35	46.67 (43.04)	59.	MS 74	39.51 (38.90)
30.	MS 36	38.02 (38.00)	60.	MS 75	9.88 (18.01)

Table 2: Continue...

Sl. No	Accessions	PDI
61.	MS 78	39.26 (38.75)
62.	MS 79	33.58 (35.34)
63.	MS 58	38.27 (38.20)
64.	SS14	21.79 (27.77)
65.	IIHR381	38.27 (38.17)
66.	SS 6	41.23 (39.93)
67.	SS 7	29.88 (33.12)
68.	SS1	39.75 (39.90)
69.	SS 11	21.48 (27.54)
70.	SS 16	32.10 (34.47)
71.	Soubhagya	35.93 (36.80)
72.	Mudicode local	38.95 (38.49)
	Range	3.70-48.64
	CD (p=0.05)	5.265**
	SEm±	1.881
	C.V.	9.676

Note: Figures in the parentheses are arc sine transformed values

Table 3: Classification of culinary melon accessions for different resistance levels to downy mildew under field condition

Sl. No.	Accessions	No.	Disease reaction
1.	MS 6, MS 21, MS 22, MS 23, MS 24, MS 75, MS 34, MS 2, MS 12, MS 13	10	Resistant
2.	Soubhagya, MS 70, Mudicode local, MS 69, MS 26, MS 71, MS 72, MS 73, MS 74, MS 79, MS 36, MS 33, MS 32, MS 31, MS 30, MS 28, MS 27, MS 1, MS 78, MS 38, MS 3, MS 4, MS 5, MS 39, MS 41, MS 10, MS 43, MS 11, MS 45, MS 46, MS 15, SS 7, MS 16, MS 18, MS 50, MS 19, MS 51, MS 54, SS 1, MS 68, IIHR381, MS 65, MS 64, SS 16, MS 58, SS14, MS 60, MS 59, SS 11, MS 20	50	Moderately resistant
3.	MS 66, MS 37, MS 35, SS 6, MS 48, MS 17, MS 49, MS 52, MS 53, MS 57, MS 56, MS 63	12	Susceptible
4.	NIL	0	Highly susceptible

4. Conclusion

Out of 70 accessions screened, 10 namely MS 6, MS 21, MS 22, MS 23, MS 24, MS 75, MS 34, MS 2, MS 12 and MS 13 showed resistant against downy mildew with PDI score of less than 20%. These accessions can be used for further crop improvement programs of culinary melon as well as other melon species.

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