Reaction of okra (*Abelmoschus esculentus*) genotypes against *Rhizoctonia solani* inciting root rot disease

Abstract

Okra or lady's finger [*Abelmoschus esculentus* (L.) Moench] is known as "*Bhindi*" in Hindi, is one of the most important summer vegetables of Rajasthan as well as India and belongs to the family *Malvaceae*.This crop suffers harshly from the vagary of diseases caused by fungi and important one is root rot caused by *Rhizoctonia solani*, which is an important constraint to the crop and causes significant economic losses and fungicides are the major tool to overcome the disease incidence. As per environment and health issues and demand of organically produced vegetables, it is a major concerned to control it by eco-friendly approaches. Therefore, developing a resistance variety to disease, provides inexpensive, durable and effective means of plant disease control. The current study aimed to find the resistant germplasm against this dreaded disease through screening under artificial inoculation conditions. Among screened 30 genotypes/varieties for two consecutive years, the root rot incidence was recorded from 16.23 per cent to 60.45 per cent and it waslowest (16.23%) in the varietyRed Ghanawhile it was maximum in Pusa Bhindi-5 (60.45%).None of the genotypes/varieties was found immune and highly resistant. However, one variety was found resistant (Red Ghana) while 14 were moderately resistant (Azad Kranti, Kashi Pragati, Kashi Kranti, Arka Anamika, Arka Anmol, Co-1, Parbhani Kranti, Hisar Unnat, Kashi Satdhari, Kashi Chaman (VRO-19), VROH-12, D-108, Bhanu Priya and Kashi Mohini (VRO-3). Conclusively, as Red Ghana variety showed resistant reaction to the disease, it can be included in cultivation with other managing practices and in further genetic improvement programs.

Keyword: Okra, Root rot,*Rhizoctonia solani*, Screening of genotypes.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] which is known as "*Bhindi*" in Hindi, is one of the most important summer vegetables of Rajasthan as well as India and belongs to the family *Malvaceae*(Tindall, 1983). Earlier, its botanical name was *Hibiscus esculentus* (L.)underthesection*Abelmoschus*of*Hibischus*. The section *Abelmoschus* was subsequently proposed to be raised to the rank of distinct genus. Okra seeds contains

goodsource ofquality edibleoil (20% to 40%) with tryptophan acid up to 47.4 per cent, in the form of unsaturated fatty acid, proteins along with fruits which containvitamins,minerals such as calcium and potassium, calories and amino acids. It also has a therapeutic consequence in the treatment of ulcer and relief of hemorrhoids, and as a substitute for blood plasma, it also useful in the treatment of urinary and reproductive system disorders (Berry*et al.*,1988). In paper industries, the stem of okra plants is used for fiber purposes (Qayyum, 1990 and Mithal, 2006). Martin (1982) has suggested that its roasted and grinded seeds can used as a substitute for coffee. It is also good source of iodine which is useful in the treatment of simple goiter and source of other medically useful compound (Moan ward *et al.*, 1984).

Okra is attacked by several fungal pathogens, which not only reduces the potency of seed, but also degrades the health beneficial and nutritional quality components of the fruits. The important diseases are root rot (*Rhizoctonia solani),* powdery mildew (*Oidium* spp.), Fusarium wilt (*Fusarium oxysporum*), charcoal rot (*Macrophominaphaseolina*), Cercospora leaf spot (*Cercosporaabelemoschi*), yellow vein mosaic (*Bhindi Yellow Vein Mosaic Virus*) and damping off (*Pythium* spp.) of okra (Anonymous, 2003).

Amongst these diseases, root rot caused by *Rhizoctonia solani*, is an important constraint to the crop and causes significant losses.The pathogen mainly attacks the root and underground parts, but it is also capable of infecting the other plant parts like the green foliage parts, the seeds and the hypocotyls (Acharya et al., 2014). Among the initial symptoms of the disease, yellowing of leaves is a firstsymptom which in next two or three days, leaves droop and wither off. Infected plantsmay wilt within a week after the appearance of first symptom. When stem isexamined closely, dark lesions can be observed on the bark near ground level. The roots of infected plants are poorly developed; finer roots are either not formed or rotted. Plants show stunted growth and can easily be pulled out. If the plants are pulled from soil, thebasalstemalongwithmainroot,mayshow symptoms of rotting. The tissues are weakened and break off easily inadvanced cases and sclerotial bodies can be seen scattered on the affectedroots. The fungus is mainly a soil dweller and spreads from plant to plant through irrigation water and implements and cultural operations. The sclerotia and pycniospores may also become air borne and cause further spread of the pathogen (Rangaswami and Mahadevan, 2008).Crop losses by root rot of okra (*Rhizoctonia solani)* is ranged fromnegligible to 50-60 per cent depending on the extent of severity and differentstagesofcrop(Safiuddin*etal.*,2014) and fungicides are

the key tool to overcome this ailment. As per environment and health issues and demand of organically produced vegetables, it is a major concerned to control it by eco-friendly approaches. Therefore, developing a resistance variety to disease, provides inexpensive, durable and effective means of plant disease control.

In lieu of this, it was planned to validate some available varieties/genotypes of okra in Semi-arid conditions of Rajasthan for finding disease resistant source.

Materials and Methods

To know the reaction of 30 varieties/genotypes of okra *viz*., Pusa Sawani, Arka Abhay, Azad Kranti, Kashi Pragati, Kashi Kranti, Pusa Bindi-5, DOV-17, Arka Anamika, Punjab Padmini, Arka Anmol, Kashi Lalima, Co-1, Red Ghana, Parbhani Kranti, Punjab-7, Hisar Unnat, Pusa Makhmali, Kashi Mangali, Kashi Vibhuti, Kashi Satdhari, Shitla Uphar, Kashi Chaman (VRO-19), Kashi Ageti, DOV-15, VROH-12, D-108, Bhanu Priya, DOV-77, Kashi Mohini (VRO-3) and Sagun were screened against root rot during *Zaid* 2022and 2023under artificial inoculated conditions in earthen pots (60 cm diam.). The isolate RsJP-17 collected from farmers field of village Gopalgarh, Tehsil Jamwa Ramgarh, Jaipur which was showing 40.74 per cent incidence was used for screening purposes. Inoculum of highly virulent isolate (RsJP-17) multiplied on sterilized sorghum grains was added @ 20 g/pot. Three replications were maintained for each varieties/genotypes. Observations on disease incidence were recorded 75 days after sowing. On the basis of disease incidence, the varieties were categorized as per criterion followed by Nene *et al.* (1981) and Farooq *et al.* (2019) with slight modifications.

List 1 : Varieties of disease incidence

Category	**Per cent disease incidence**
Immune	0
Resistant	0.1-10%
Moderately Resistant	10.1-20%
Moderately Susceptible	20.1-30%
Susceptible	30.1- 50%
Highly Susceptible	More than 50%

Results and Discussion

Thirtyvarieties/genotypes of okra were screened for two consecutive years inpotsunder artificial inoculation conditions against root rot disease. It is evident from the data that all the tested varieties/genotypes had showed variable reaction to the *R. solani* during both the years as well as on pooled basis (Table 1 and 2) and (Plate 1). The average of two years revealed that root rot incidence was ranged from 16.23 per cent to 60.45 per cent among evaluated 30 genotypes/varieties and it waslowest (16.23%) in the varietyRed Ghanawhile it was maximum in Pusa Bhindi-5 (60.45%).

Based on disease reaction, okra genotypes/varieties were grouped into five categories *i.e*. highly resistant (HR), resistant (R), moderately resistant (MR), susceptible (S) and highly susceptible (HS). None of the genotypes/varieties was found immune and highly resistant. However, one variety was found resistant (Red Ghana) while 14 were moderately resistant (Azad Kranti, Kashi Pragati, Kashi Kranti, Arka Anamika, Arka Anmol, Co-1, Parbhani Kranti, Hisar Unnat, Kashi Satdhari, Kashi Chaman (VRO-19), VROH-12, D-108, Bhanu Priya and Kashi Mohini (VRO-3); 13 were susceptible (Pusa Sawani, Kashi Lalima, Arka Abhay, DOV-17, Punjab Padmini, Punjab-7, Pusa Makhmali, Kashi Vibhuti, Shitla Uphar, Kashi Ageti, DOV-15, Kashi Lalima and Sagun) whereas two varieties were highly susceptible (DOV-77 and Pusa Bindi-5) to the *R. solani.* Our findings are in accordance with the results ofGupta *et al.* (1997) who screened 110 lines of fenugreek for resistance to *Erysiphe polygoni*, *Rhizoctonia solani* and *Fusarium oxysporum* in Hisar (Haryana). None of the genotypes were completely resistant to all 3 pathogens, however, GP 75, GP 82, GP 94, GP and PEB were the moderately resistant lines. John *et al.* (2005) evaluated 30 sesame cultivars against *Macrophomina* root rot and observed TLC-246, TLC-279 and TLC-289 as highly resistant to root rot. Benagi*et al.* (2008) tested 12 genotypes and one susceptible check JG-62 of chickpea against *Rhizoctonia bataticola*. Out of these, tested against root rot disease, four were found resistant, two were moderately susceptible, three were susceptible and three were highly susceptible to the disease. Satpathi and Gohel (2018) screened twenty sesame varieties/germplasm against stem and root rot disease by artificial inoculation under field condition along with susceptible check (GT-2). Out of these, four varieties/germplasm *viz.*, AT-343, AT-345, AT-371 and Khadkalu-4 showed resistant reaction, while seven varieties /germplasm *viz.*, Gujarat Til-5, AT-288, AT-314, AT-332, AT-338, AT-364 and Borda-2 showed moderately resistant reaction. However, only one variety *i.e*. Gujarat Til-3 showed highly susceptible reaction. Bedawy and Moharm (2019) were screened eighty-six sesame

genotypes against root rot incidence in season 2017 and 2018, in which they found that the highly significant variation among all the genotype for disease incidence and seed yield. Thus, this study paves for the way to develop a resistant variety using a highly virulent isolate, so that the success of experiments can be guaranteed. Conclusively, as Red Ghana variety showed resistant reaction to the disease, it can be included integrated disease management and in further genetic improvement programs.

Table-1: Reaction of different varieties/genotypes against root rot of okra under pot conditions

S. No.	Name of variety/genotype	Per cent disease incidence*		Pooled	Hostreaction
		2022	2023		
1.	Pusa Sawani	35.42 (36.52)	40.20 (39.35)	37.81 (37.94)	S
2.	Arka Abhay	39.14 (38.73)	45.40 (42.36)	42.27 (40.54)	S
3.	Azad Kranti	25.29 (30.19)	32.58 (34.81)	28.94 (32.50)	MR
4.	Kashi Pragati	17.92 (25.04)	22.12 (28.06)	20.02 (26.55)	MR
5.	Kashi Kranti	24.09 (29.39)	27.30 (31.50)	25.70 (30.45)	MR
6.	Pusa Bindi-5	58.12 (49.67)	62.78 (52.40)	60.45 (51.04)	HS
7.	DOV-17	35.14 (36.36)	40.35 (39.44)	37.75 (37.90)	S
8.	Arka Anamika	25.04 (30.03)	31.19 (33.95)	28.12 (31.99)	MR
9.	Punjab Padmini	40.10 (39.29)	45.40 (42.36)	42.75 (40.83)	S
10.	Arka Anmol	26.16	32.92	29.54	MR

		(30.76)	(35.01)	(32.89)	
11.	Kashi Lalima	36.89 (37.40)	40.78 (39.69)	38.84 (38.54)	S
12.	Co-1	24.67 (29.78)	29.27 (32.75)	26.97 (31.27)	MR
13.	Red Ghana	13.77 (21.78)	18.69 (25.61)	16.23 (23.70)	R
14.	Parbhani Kranti	24.97 (29.98)	28.16 (32.05)	26.57 (31.02)	MR
15.	Punjab-7	42.56 (40.72)	48.73 (44.27)	45.65 (42.50)	S
16.	Hisar Unnat	23.56 (29.04)	28.22 (32.09)	25.89 (30.56)	MR
17.	Pusa Makhmali	38.69 (38.46)	42.73 (40.82)	40.71 (39.64)	S
18.	Kashi Mangali	43.69 (41.37)	47.44 (43.53)	45.57 (42.45)	S
19.	Kashi Vibhuti	44.99 (42.12)	50.17 (45.10)	47.58 (43.61)	S
20.	Kashi Satdhari	27.11 (31.38)	32.69 (34.87)	29.90 (33.12)	MR
21.	Shitla Uphar	33.01 (35.07)	37.77 (37.92)	35.39 (36.49)	S
22.	Kashi Chaman (VRO-19)	27.44 (31.59)	31.33 (34.04)	29.39 (32.81)	MR
23.	Kashi Ageti	41.00 (39.82)	45.53 (42.44)	43.27 (41.13)	S
24.	DOV-15	28.79 (32.45)	33.56 (35.40)	31.18 (33.93)	S
25.	VROH-12	21.17 (27.39)	26.16 (30.76)	23.67 (29.08)	MR
26.	D-108	24.49 (29.66)	29.44 (32.86)	26.97 (31.26)	MR

27.	Bhanu Priya	24.12 (29.41)	30.25 (33.37)	27.19 (31.39)	MR
28.	DOV-77	54.92 (47.82)	58.44 (49.86)	56.68 (48.84)	HS
29.	Kashi Mohini (VRO-3)	21.68 (27.75)	26.17 (30.77)	23.93 (29.26)	MR
30.	Sagun	39.83 (39.13)	45.79 (42.58)	42.81 (40.86)	S
	SEm±	0.62	0.69	0.46	
	CD (P=0.05)	1.88	2.07	1.40	
	CV (%)	3.15	3.18	2.24	

*Average of three replications, Values in parentheses are angular transformed values

Table-2: Categorization of different varieties/genotypes of okra against root rot

S. No.	Disease reaction	Disease incidence (%)	Varieties/genotypes	Total
1.	HR- Highly Resistant	0-10%	Nill	0
2.	R- Resistant	11-20 %	Red Ghana	1
3.	MR – Moderately Resistant	21-30%	Azad Kranti, Kashi Pragati, Kashi Kranti, Arka Anamika, Arka Anmol, Co-1, Parbhani Kranti, Hisar Unnat, Kashi Satdhari, Kashi Chaman (VRO-19), VROH-12, D-108, Bhanu Priya, Kashi Mohini (VRO-3)	14
4.	S- Susceptible	31-50%	Pusa Sawani, Arka Abhay, DOV-17, Punjab Padmini, Punjab-7, Pusa Makhmali, Kashi Mangali, Kashi Vibhuti, Shitla Uphar, Kashi Ageti, DOV-15, Sagun, KashiLalima	13
5.	HS- Highly susceptible	(>50%)	Pusa Bindi-5, DOV-77	2

Plate 1: Screening of different varieties/genotypes against *Rhizoctonia solani*

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