

Original Research Article

Field Assessment of Resistance in Okra [*Abelmoschus esculentus* (L.) Moench] Genotypes to Powdery Mildew

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ABSTRACT

Field screening of okra [*Abelmoschus esculentus* (L.) Moench] genotypes against powdery mildew was carried out at the Horticultural Farm of Indira Gandhi Krishi Vishwavidyalaya Raipur, Chhattisgarh during *kharif* (2019-20), under natural epiphytotic condition. Out of 37 okra entries evaluated, none were found with completely immune or highly resistant disease reaction, as well as none of the genotype was found with highly susceptible disease reaction. Fourteen okra entries namely 2018/OKYVRES-1, 2018/OKYVRES-2, 2018/OKYVRES-4, 2018/OKYVRES-8, 2017/OKYVRES-1, 2017/OKYVRES-2, 2017/OKYVRES-5, 2017/OKYVRES-9, 2017/OKYVRES-10, 2017/OKHYVRES-2, 2017/OKHYVRES-3, 2017/OKHYVRES-6, 2017/OKHYVRES-9, 2017/OKHYVRES-10 were recorded with moderately resistant reaction and rest twenty three genotypes along with local susceptible check showed moderately susceptible or susceptible reaction against the disease. Apparent rate of infection was observed higher during 60-75 days after sowing. AUDPC was recorded highest in local susceptible check.

Keywords

Powdery mildew,
Okra, AUDPC,
Apparent rate of
infection

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench], also known as Lady's finger or Bhendi in India is a major vegetable crop grown under tropical and sub-tropical conditions. It belongs to Malvaceae family. The crop is known to be infected by various fungal, bacterial and viral diseases in India. Diseases are one of the major constraints for low yield of okra (Sastry, 1974). Fungal diseases namely powdery mildew (*Erysiphe cichoracearum* DC), leaf spot (*Cercospora belmoschi*), leaf blight (*Rhizoctonia solani*),

damping off (*Pythium* spp., *Rhizoctonia* spp. and *Fusarium* spp.) and viral diseases such as yellow vein mosaic, *Enation leaf curl virus* diseases are commonly observed.

Among them powdery mildew is an important fungal diseases and of common occurrence and reduces the yield considerably (Khalikar, 2011; Dahivelkar *et al.*, 2017).

Powdery mildew disease appears as white powder like spots on the surface of the leaf and stem. As the disease processes, the spots

get larger and thicker as a large numbers of spores form and the mildew spread to the whole length of the plant (Kothari and Shekhawat, 1972; Singh *et al.*, 1988; Vijaya, 2004; Stephen and Chatfield, 2005; Adam, 2012; Bam *et al.*, 2013). Powdery mildew caused by *Erysiphe cichoracearum* DC in okra is an economically important disease. It affects most of the commercial varieties of okra. The disease occurs in almost all the season leading to lower yield and resulting in high economic losses (Siddappa *et al.*, 2013). Powdery mildew is a serious disease of okra in India and it affects all stages of growth leading into premature defoliation and about 17–86.6% loss in yield due to the disease (Prabhu *et al.*, 1971; Sridhar and Sinha, 1989), and losses are significant in case of favourable weather conditions if the infection occur at early stage of crop growth (Gupta and Thind, 2006). Though there are chemicals that can reduce development of disease, they are not economical and may cause environmental pollution. Development of resistant varieties is the most appropriate approach to the disease.

Materials and Methods

The experiment was carried out at the Horticultural Farm of Indira Gandhi Krishi Vishwavidyalaya Raipur, Chhattisgarh during *kharif* (2019). Total of 37 entries of okra were evaluated against powdery mildew disease under natural conditions to find out resistant genotype. Field trials were laid out in randomized block design with replicated thrice. Okra entries (Group 1, Group 2, Group 3 and Group 4) were taken for the study. The seeds of okra genotypes were sown at a spacing of 60 x 30 cm with the plot size 3.0 x 2.7m. The crop was raised as per recommended package of practice. Sowing was done in the last fortnight of July and crop raised with good agronomic practices.

Method of observations

Per cent disease index (PDI)

Different Okra entries (Group 1, 2, 3, 4) against powdery mildew were screened under natural epiphytotic condition. Five plants from each plot were randomly selected and tagged. Total number of leaves was counted and the leaves were examined individually. Severity of the disease was recorded at an interval of 15 days from the first appearance of the disease. The varieties were graded on the basis of their powdery mildew disease severity (PDI). The percentage of disease severity was recorded by employing disease severity scale from 0 to 5 given by (Shivanna, 2003). Where: 0 = No leaf lesions, 1 = 1-10% leaf area affected, 2 = 11-25% leaf area affected, 3 = 26-50% leaf area affected, 4 = 50-75% leaf area affected and 5 = more than 75% area of plant leaf infected.

These rating were used to calculate the Per cent Disease Index (PDI) as follows (Wheeler, 1969).

$$\text{PDI} = \frac{\text{Sum of all the numerical values}}{\text{Total no. of leaves observed} \times \text{Maximum grade}} \times 100$$

Area under disease progress curve (AUDPC)

AUDPC was computed for each genotype at 15 days interval using the formula given by (Wilcoxson *et al.*, 1975), who quantified the AUDPC as A-value:

$$\text{AUDPC} = \sum_{i=1}^k \frac{1}{2} (y_i + y_{i-1}) \times d$$

Where, y_i is the disease incidence at i th day of evaluation, k is the number of successive evaluations and d is the interval between i and $i-1$ evaluation of the disease.

Apparent rate of infection (r)

The apparent rate of infection (r) is a measure of the speed at which an epidemic develops, the formula for computing apparent rate of disease development was given by (Vanderplank, 1963) and calculated as r - value:

$$r = 2.3/t_2 - t_1 \{ \log x_2/1 - x_2 - \log x_1/1 - x_1 \}$$

Where, r is the apparent infection rate in non-logarithmic phase, x₁ is the disease index at initial week time (t₁), x₂ is the disease index at subsequent week time (t₂). The apparent rate of infection was calculated at 15 days interval for each genotype.

Results and Discussion

Per cent disease index (PDI)

A sum of eight okra entries in group 1, 9 entries in group 2, 8 entries in group 3 and 11 entries in group 4 with a susceptible check variety were evaluated against powdery mildew disease of okra during *kharif* 2019. The per cent disease index was calculated and results are presented in Table 2 and 3.

In okra entries (group 1) (table 2) substantial variability was found in per cent disease index (PDI) of all group 1 genotypes evaluated under the study. During the course of study PDI varied from 0.05 to 3.08, 4.61 to 19.10, 9.08 to 48.86, 21.05 to 66.58 per cent at 60, 75, 90, 105 DAS respectively. All the genotypes were free from disease up to 45 days after sowing. Highest per cent disease index was observed at 105 DAS in all the genotypes. During study lowest PDI was recorded in 2018/OKYVRES-2 (21.05%) followed by 2018/OKYVRES-4 (21.10%) and highest in local susceptible variety (66.58%) followed by 2018/OKYVRES-5 (38.40%) at 105 DAS.

In okra genotypes (group 2) (table 2) PDI varied from 1.52 to 4.63, 6.56 to 13.95, 14.68 to 48.46, 22.76 to 66.58 per cent at 60, 75, 90, 105 DAS respectively. All the genotypes were free from disease up to 45 days after sowing. During study lowest PDI was recorded in 2017/OKYVRES-1 (22.76%) followed by 2017/OKYVRES-2 (23.45%) and highest in local susceptible variety (66.58%) followed by 2017/OKYVRES-4 (34.32%) at 105 DAS.

In okra genotypes group 3 significant variability was found PDI of all genotypes (group 3) (table 2) evaluated under the study. During the course of study PDI varied from 0.82 to 3.08, 6.19 to 18.77, 6.20 to 24.07, 16.20 to 66.58 per cent at 60, 75, 90, 105 DAS respectively. All the genotypes were free from disease up to 45 days after sowing. During study lowest PDI was recorded in 2017/OKHYVRES-6 (16.20%) followed by 2017/OKHYVRES-9 (21.22%) and highest in local susceptible variety (66.58%) followed by 2017/OKHYVRES-8 (35.40%) at 105 DAS.

Significant variability was found PDI of all okra genotypes (group 4) (table 2) under the study. During the course of study PDI varied from 1.46 to 6.31, 6.01 to 15.55, 29.61 to 48.87, 46.11 to 66.90 per cent at 60, 75, 90, 105 DAS respectively. All the genotypes were free from disease up to 45 days after sowing. During study lowest PDI was recorded in 2019/OKYVRES-5 (46.11%) followed by 2019/OKYVRES-11 (46.99%) and highest in local susceptible variety (66.90%) followed by 2019/OKYVRES-8 (59.29%) at 105 DAS.

Reaction and level of resistance of okra genotypes (group 1, 2, 3 and 4) against powdery mildew

From the data it is evident that out of 37 genotypes evaluated under different

categories 14 genotypes exhibited moderately resistant reaction against powdery mildew disease, 13 genotypes exhibited moderately susceptible reaction against the disease and 10 genotypes exhibited susceptible reaction against the powdery mildew disease. None of the genotype evaluated were observed with completely immune or highly resistant reaction against the disease. As well as none of the genotype were observed with highly susceptible disease reaction (table 3).

Apparent rate of infection (r) and area under disease progress curve AUDPC (A-value) for

powdery mildew severity on different okra genotypes was also calculated. The apparent rate of disease development (r) is a measure of the speed at which an epidemic develops. It is used to assess the highest and least infection periods with respect to each crop cultivars in relation to age (Vanderplank, 1963). The AUDPC is a variable which estimates the amount of disease across the season. The rate of disease increase in fields and the cumulative amount of disease over a season (expressed as AUDPC) provide useful measures of disease progress.

Table.1 Details of okra entries

S.N.	Genotypes categories	Entry details	No. of entries	Details of entries
1	Group 1	AVT I	8+1	2018/OKYVRES-1, 2018/OKYVRES-2, 2018/OKYVRES-3, 2018/OKYVRES-4, 2018/OKYVRES-5, 2018/OKYVRES-6, 2018/OKYVRES-8, 2018/OKYVRES-7, local susceptible
2	Group 2	AVT II	9+1	2017/OKYVRES-1, 2017/OKYVRES-2, 2017/OKYVRES-3, 2017/OKYVRES-4, 2017/OKYVRES-5, 2017/OKYVRES-6, 2017/OKYVRES-7, 2017/OKYVRES-9, 2017/OKYVRES-10, local susceptible
3	Group 3	AVT II(HYBRID)	8+1	2017/OKHYVRES-1, 2017/OKHYVRES-2, 2017/OKHYVRES-3, 2017/OKHYVRES-4, 2017/OKHYVRES-8, 2017/OKHYVRES-9, 2017/OKHYVRES-10, 2017/OKHYVRES-6, local susceptible
4	Group 4	IET	11+1	2019/OKYVRES-1, 2019/OKYVRES-2, 2019/OKYVRES-3, 2019/OKYVRES-5, 2019/OKYVRES-6, 2019/OKYVRES-7, 2019/OKYVRES-8, 2019/OKYVRES-9, 2019/OKYVRES-11, 2019/OKYVRES-12, 2019/OKYVRES-13, local susceptible

Table.2 Evaluation of okra genotypes (group 1, 2, 3 and 4) against powdery mildew during *kharif* 2019-20

S.N.	Genotypes	Per cent Disease Index (PDI)							DR
		15	30	45	60	75	90	105	
	Group 1	DAS	DAS	DAS	DAS	DAS	DAS	DAS	
1	2018/OKYVRES-1	0.00	0.00	0.00	0.38	7.35	19.21	23.20	MR
2	2018/OKYVRES-2	0.00	0.00	0.00	2.12	8.48	18.02	21.05	MR
3	2018/OKYVRES-3	0.00	0.00	0.00	1.42	10.72	24.30	34.16	MS
4	2018/OKYVRES-4	0.00	0.00	0.00	0.05	4.61	11.75	21.10	MR
5	2018/OKYVRES-5	0.00	0.00	0.00	1.46	13.29	23.88	38.40	MS
6	2018/OKYVRES-6	0.00	0.00	0.00	0.55	7.91	18.15	28.2	MS
7	2018/OKYVRES-7	0.00	0.00	0.00	0.91	27.19	9.08	27.44	MS
8	2018/OKYVRES-8	0.00	0.00	0.00	1.98	19.10	12.04	24.68	MR
9	Local susceptible	0.00	0.00	0.00	3.08	13.95	48.86	66.58	S
	SEm±	-	-	-	0.20	0.88	1.81	2.07	
	CD (P=0.05)	-	-	-	0.62	2.64	5.49	6.26	
	Group 2								
1	2017/OKYVRES-1	0.00	0.00	0.00	2.97	12.98	18.76	22.76	MR
2	2017/OKYVRES-2	0.00	0.00	0.00	3.24	11.8	17.45	23.45	MR
3	2017/OKYVRES-3	0.00	0.00	0.00	2.41	12.99	24.37	30.73	MS
4	2017/OKYVRES-4	0.00	0.00	0.00	1.51	13.28	25.32	34.32	MS
5	2017/OKYVRES-5	0.00	0.00	0.00	2.42	9.96	14.68	24.68	MR
6	2017/OKYVRES-6	0.00	0.00	0.00	2.61	6.56	20.46	29.46	MS
7	2017/OKYVRES-7	0.00	0.00	0.00	4.63	10.05	17.13	25.13	MS
8	2017/OKYVRES-9	0.00	0.00	0.00	3.65	12.77	24.27	23.94	MR
9	2017/OKYVRES-10	0.00	0.00	0.00	3.57	9.36	17.43	28.43	MR
10	Local susceptible	0.00	0.00	0.00	3.08	13.95	48.86	66.58	S
	SEm±	-	-	-	0.33	0.92	1.78	2.32	
	CD (P=0.05)	-	-	-	0.99	2.75	5.35	6.93	

Group 3									
1	2017/OKHYVRES-1	0.00	0.00	0.00	4.41	18.77	15.18	25.18	MS
2	2017/OKHYVRES-2	0.00	0.00	0.00	1.94	8.69	13.48	23.48	MR
3	2017/OKHYVRES-3	0.00	0.00	0.00	2.163	11.00	13.97	23.97	MR
4	2017/OKHYVRES-4	0.00	0.00	0.00	2.59	21	20.69	30.69	MS
5	2017/OKHYVRES-6	0.00	0.00	0.00	2.653	12.02	6.20	16.20	MR
6	2017/OKHYVRES-8	0.00	0.00	0.00	0.82	10.98	24.07	35.40	MS
7	2017/OKHYVRES-9	0.00	0.00	0.00	0.69	6.19	10.89	21.22	MR
8	2017/OKHYVRES-10	0.00	0.00	0.00	1.60	8.1	13.33	23.66	MR
9	Local susceptible	0.00	0.00	0.00	3.08	13.95	48.86	66.58	S
	SEm±	-	-	-	0.22	1.12	1.36	2.60	
	CD (P=0.05)	-	-	-	0.69	3.40	4.14	7.88	
Group 4									
1	2019/OKYVRES-1	0.00	0.00	0.00	4.07	15.55	37.74	58.19	S
2	2019/OKYVRES-2	0.00	0.00	0.00	2.97	6.01	29.61	51.39	S
3	2019/OKYVRES-3	0.00	0.00	0.00	3.27	11.26	38.54	51.57	S
4	2019/OKYVRES-5	0.00	0.00	0.00	3.19	10.22	46.27	46.11	MS
5	2019/OKYVRES-6	0.00	0.00	0.00	3.83	8.42	44.04	54.64	S
6	2019/OKYVRES-7	0.00	0.00	0.00	3.07	11.67	32.82	53.01	S
7	2019/OKYVRES-8	0.00	0.00	0.00	6.31	8.17	37.63	52.84	S
8	2019/OKYVRES-9	0.00	0.00	0.00	2.26	6.74	37.64	59.29	S
9	2019/OKYVRES-11	0.00	0.00	0.00	1.84	6.57	42.46	46.99	MS
10	2019/OKYVRES-12	0.00	0.00	0.00	1.46	6.57	47.01	51.14	S
11	2019/OKYVRES-13	0.00	0.00	0.00	3.21	12.60	38.32	57.95	S
12	Local susceptible	0.00	0.00	0.00	4.18	13.95	48.87	66.90	S
	SEm±	-	-	-	0.31	0.31	1.14	3.71	
	CD (P=0.05)	-	-	-	0.63	0.64	2.37	7.69	

Table.3 Classification of Okra entries (Group 1,2,3,4) on the basis of their reaction against powdery mildew disease

Grade	PDI	Reaction	No.	Name of genotypes
0	0	Immune (no disease)	-	
1	1-10%	Highly resistant (HR)	-	
2	11-25%	Moderately Resistant (MR)	4+5+5	Group 1- 2018/OKYVRES-1, 2018/OKYVRES-2, 2018/OKYVRES-4, 2018/OKYVRES-8, Group 2- 2017/OKYVRES-1, 2017/OKYVRES-2, 2017/OKYVRES-5, 2017/OKYVRES-9, 2017/OKYVRES-10 Group 3- 2017/OKHYVRES-2, 2017/OKHYVRES-3, 2017/OKHYVRES-6, 2017/OKHYVRES-9, 2017/OKHYVRES-10
3	26-50%	Moderately susceptible (MS)	4+4+3+2	Group 1- 2018/OKYVRES-3, 2018/OKYVRES-5, 2018/OKYVRES-6, 2018/OKYVRES-7, Group 2- 2017/OKYVRES-3, 2017/OKYVRES-4, 2017/OKYVRES-6, 2017/OKYVRES-7 Group 3- 2017/OKHYVRES-1, 2017/OKHYVRES-4, 2017/OKHYVRES-8 Group 4- 2019/OKYVRES-5, 2019/OKYVRES-11
4	51-75%	Susceptible (S)	10	2019/OKYVRES-1, 2019/OKYVRES-2, 2019/OKYVRES-3, 2019/OKYVRES-6, 2019/OKYVRES-7, 2019/OKYVRES-8, 2019/OKYVRES-9, 2019/OKYVRES-12, 2019/OKYVRES-13, Local susceptible
5	More than 75%	Highly susceptible (HS)	-	-

Table.4 Apparent rate of infection (r-value) of powdery mildew in different genotypes

S.no.	Genotypes	Rate of infection 'r'			Average 'r'
		60-75 DAS	75-90 DAS	90-105 DAS	
1	2018/OKYVRES-1	0.084	0.010	0.001	0.032
2	2018/OKYVRES-2	0.026	0.008	0.001	0.012
3	2018/OKYVRES-3	0.040	0.007	0.002	0.016
4	2018/OKYVRES-4	0.184	0.013	0.005	0.067
5	2018/OKYVRES-5	0.041	0.005	0.003	0.016
6	2018/OKYVRES-6	0.069	0.009	0.003	0.027
7	2018/OKYVRES-7	0.062	-0.010	0.010	0.021
8	2018/OKYVRES-8	0.036	-0.004	0.006	0.013
9	2017/OKYVRES-1	0.023	0.003	0.001	0.009
10	2017/OKYVRES-2	0.020	0.004	0.002	0.009
11	2017/OKYVRES-3	0.027	0.005	0.001	0.011
12	2017/OKYVRES-4	0.040	0.005	0.002	0.016
13	2017/OKYVRES-5	0.024	0.004	0.004	0.011
14	2017/OKYVRES-6	0.017	0.012	0.002	0.011
15	2017/OKYVRES-7	0.011	0.005	0.003	0.006
16	2017/OKYVRES-9	0.018	0.005	0.000	0.008
17	2017/OKYVRES-10	0.015	0.006	0.003	0.008
18	2017/OKHYVRES-1	0.018	-0.002	0.004	0.007
19	2017/OKHYVRES-2	0.028	0.005	0.005	0.013
20	2017/OKHYVRES-3	0.028	0.002	0.004	0.012
21	2017/OKHYVRES-4	0.030	0.000	0.003	0.011
22	2017/OKHYVRES-6	0.024	-0.008	0.011	0.009
23	2017/OKHYVRES-8	0.057	0.007	0.002	0.022
24	2017/OKHYVRES-9	0.056	0.007	0.006	0.023
25	2017/OKHYVRES-10	0.033	0.006	0.005	0.014
26	2019/OKYVRES-1	0.018	0.006	0.002	0.009
27	2019/OKYVRES-2	0.013	0.016	0.003	0.011
28	2019/OKYVRES-3	0.019	0.009	0.001	0.010
29	2019/OKYVRES-5	0.018	0.011	0.000	0.010
30	2019/OKYVRES-6	0.012	0.013	0.001	0.009
31	2019/OKYVRES-7	0.021	0.008	0.002	0.010
32	2019/OKYVRES-8	0.004	0.013	0.001	0.006
33	2019/OKYVRES-9	0.021	0.016	0.002	0.013
34	2019/OKYVRES-11	0.026	0.016	0.000	0.014
35	2019/OKYVRES-12	0.032	0.017	0.000	0.017
36	2019/OKYVRES-13	0.021	0.008	0.002	0.010
37	Local susceptible	0.016	0.008	0.001	0.009

Table.5 Area under disease progress curve AUDPC (A-value) and yield (q/ha) for genotype group 1, 2 and 4

S.N.	Genotypes	AUDPC	Yield (q/ha)
1	2018/OKYVRES-1	578.13	47.78
2	2018/OKYVRES-2	587.23	25.84
3	2018/OKYVRES-3	803.00	41.44
4	2018/OKYVRES-4	404.65	19.73
5	2018/OKYVRES-5	867.7	41.87
6	2018/OKYVRES-6	610.75	40.62
7	2018/OKYVRES-7	763.5	14.71
8	2018/OKYVRES-8	682.15	22.74
9	2017/OKYVRES-1	691.50	21.19
10	2017/OKYVRES-2	663.35	17.24
11	2017/OKYVRES-3	827.23	23.35
12	2017/OKYVRES-4	859.15	26.46
13	2017/OKYVRES-5	591.10	12.33
14	2017/OKYVRES-6	665.65	23.54
15	2017/OKYVRES-7	665.78	27.57
16	2017/OKYVRES-9	790.08	40.10
17	2017/OKYVRES-10	668.85	38.02
18	2019/OKYVRES-1	1,296.85	23.14
19	2019/OKYVRES-2	964.25	20.92
20	2019/OKYVRES-3	1,182.78	18.99
21	2019/OKYVRES-5	1,241.10	12.88
22	2019/OKYVRES-6	1,254.08	26.91
23	2019/OKYVRES-7	1,110.90	12.65
24	2019/OKYVRES-8	1,178.00	20.62
25	2019/OKYVRES-9	1,144.18	9.58
26	2019/OKYVRES-11	1,487.90	18.58
27	2019/OKYVRES-12	1,209.18	20.20
28	2019/OKYVRES-13	1,246.58	15.7
29	Local susceptible	1,506.75	27.12

Table.6 Area under disease progress curve AUDPC (A-value) and yield (q/ha) for Okra entries from group 3

S.N.	Genotypes	AUDPC	Yield (q/ha)
1	2017/OKHYVRES-1	764.50	35.45
2	2017/OKHYVRES-2	537.98	58.54
3	2017/OKHYVRES-3	586.82	21.52
4	2017/OKHYVRES-4	894.52	54.88
5	2017/OKHYVRES-6	434.68	10.04
6	2017/OKHYVRES-8	803.63	32.76
7	2017/OKHYVRES-9	425.85	43.35
8	2017/OKHYVRES-10	513.68	16.83
9	Local susceptible	1,506.75	27.12

Table.7 Summary table, AUDPC and yield of okra entries from group 1, 2, 3 and 4

S.N.	AUDPC ('A' value)	No. of genotypes	Genotypes	Yield (q/ha)
1.	Okra genotypes group 1, 2 and 4 A-value <1000	18	2018/OKYVRES-1, 2018/OKYVRES-2, 2018/OKYVRES-3, 2018/OKYVRES-4, 2018/OKYVRES-5, 2018/OKYVRES-6, 2018/OKYVRES-7, 2018/OKYVRES-8, 2017/OKYVRES-1, 2017/OKYVRES-2, 2017/OKYVRES-3, 2017/OKYVRES-4, 2017/OKYVRES-5, 2017/OKYVRES-6, 2017/OKYVRES-7, 2017/OKYVRES-9, 2017/OKYVRES-10, 2019/OKYVRES-2	12.33 to 47.78 q/ha
2.	Okra genotypes group 1, 2 and 4 A-value >1000	11 (including local susceptible check)	2019/OKYVRES-1, 2019/OKYVRES-3, 2019/OKYVRES-5, 2019/OKYVRES-6, 2019/OKYVRES-7, 2019/OKYVRES-8, 2019/OKYVRES-9, 2019/OKYVRES-11, 2019/OKYVRES-12, 2019/OKYVRES-13, Local susceptible	9.58 to 27.12q/ha
3.	Okra genotypes group 3 (Hybrid) A-value <1000	08	2017/OKHYVRES-1, 2017/OKHYVRES-2, 2017/OKHYVRES-3, 2017/OKHYVRES-4, 2017/OKHYVRES-6, 2017/OKHYVRES-8, 2017/OKHYVRES-9, 2017/OKHYVRES-10	10.04 to 58.54q/ha
4.	Okra genotypes group 3 (Hybrid) A-value >1000	-	-	-

Plate.1 Symptoms of powdery mildew in the experimental field



Initial symptoms of powdery mildew on okra leaves



Heavily infected leaves of okra with powdery mildew



Powdery mildew infected field of okra

Plate.2 Experimental site to identify source of resistance against powdery mildew in okra



Field view of Okra Group-I entries



**Field view of Okra Group-II entries
genotypes**



Field view of Okra Group-III entries



Field view of Okra Group IV entries

Fig.1 Disease progress curve for different okra entries in group I

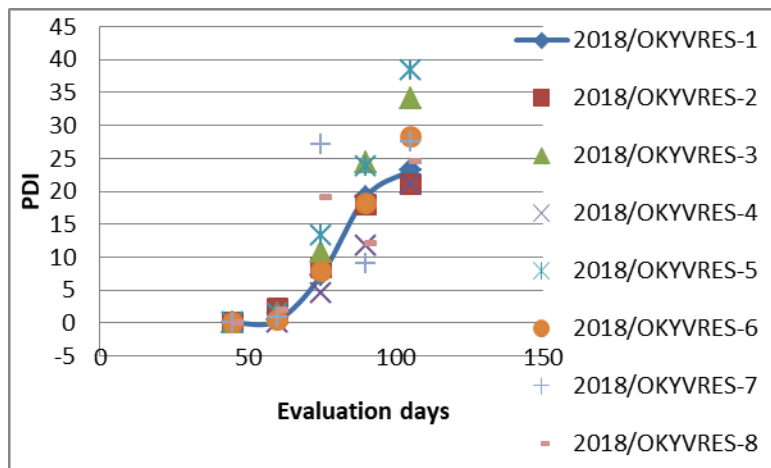


Fig.2 Disease progress curve for different okra entries in group II

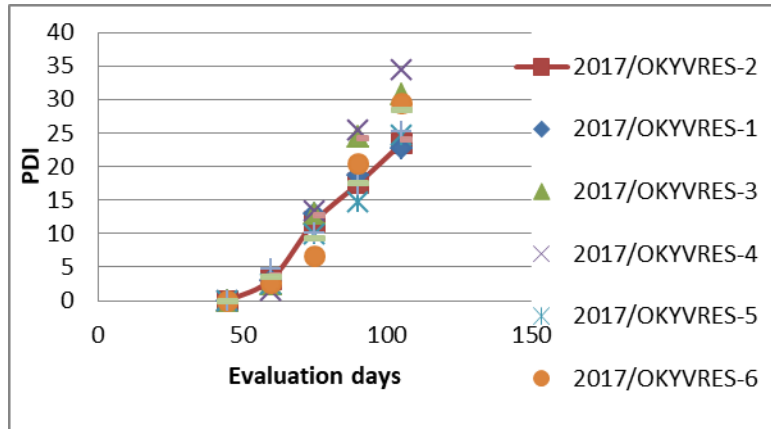


Fig.3 Disease progress curve for different okra entries in group III

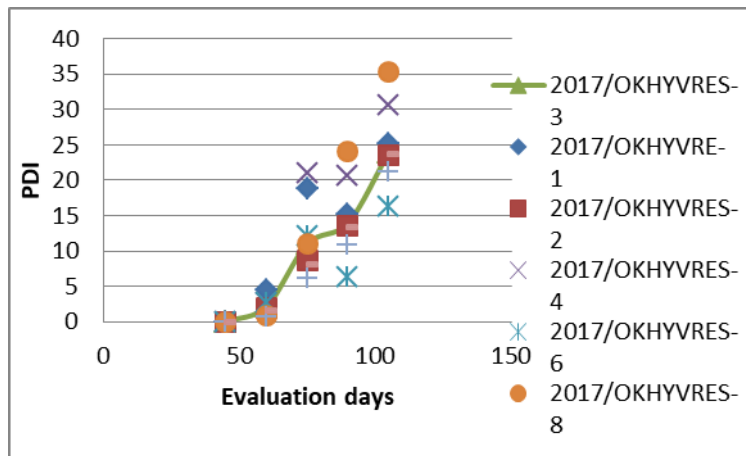
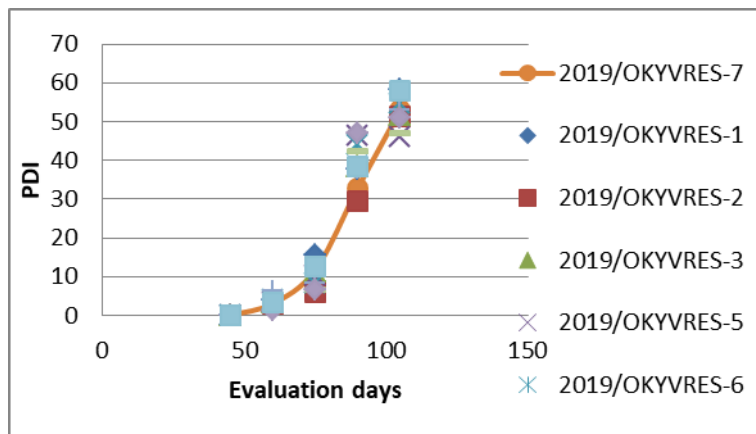


Fig.4 Disease progress curve for different okra entries in group IV



Apparent rate of infection (r) in all the genotypes showed similar trend in the speed of progress of disease, it was higher during (60-75) days after sowing followed by (75-90) days after sowing and lowest speed of progress was observed during (90-105) days after sowing. Average value of ' r ' ranged from 0.006 to 0.067 (table 4), indicating thereby the susceptibility of plants was more during 60-75 days after sowing. Our results matched with the earlier findings as the higher disease progress during 66-87 days of crop age *i.e.* at fruiting stage (Sharma, 2016). The growth stage of the plant appears to be an important factor for powdery mildew development as observed by (Sivaprakasam *et al.*, 1981), (Sharma, 1992) and (Mishra and Shirsole, 2017). This information is important in deciding the time of application of fungicides for the efficient management of the pathogen.

The value of 'A' ranged from 404.65 to 1506.75 for the evaluated genotypes of Okra entries from group 1, 2 and 3. Eighteen genotypes *viz.* 2018/OKYVRES-1, 2018/OKYVRES-2, 2018/OKYVRES-3, 2018/OKYVRES-4, 2018/OKYVRES-5, 2018/OKYVRES-6, 2018/OKYVRES-7, 2018/OKYVRES-8, 2017/OKYVRES-1, 2017/OKYVRES-2, 2017/OKYVRES-3, 2017/OKYVRES-4, 2017/OKYVRES-5, 2017/OKYVRES-6, 2017/OKYVRES-7, 2017/OKYVRES-9, 2017/OKYVRES-10 and 2019/OKYVRES-2 exhibited 'A' value less than 1000, whereas ten genotypes including local susceptible check exhibited 'A' value more than 1000 *viz.* 2019/OKYVRES-1, 2019/OKYVRES-3, 2019/OKYVRES-5, 2019/OKYVRES-6, 2019/OKYVRES-7, 2019/OKYVRES-8, 2019/OKYVRES-9, 2019/OKYVRES-11, 2019/OKYVRES-12, 2019/OKYVRES-13, Local susceptible (table 7). Maximum value for 'A' was observed for local susceptible variety (1,506.75) followed by

2019/OKYVRES-11 (1,487.90), whereas minimum A-value of (404.65) was observed in genotype 2018/OKYVRES-4 followed by 2018/OKYVRES-1 (578.13) (Table 5).

Yield ranged from 9.58q/ha to 47.78q/ha for all the evaluated okra genotypes of group 1, 2 and 3 entries. Yield ranged from 12.33q/ha to 47.78q/ha in the okra genotypes showing 'A' value less than 1000, whereas it ranged from 9.58 to 27.12q/ha in okra genotypes showing 'A' value more than 1000 (table 7). Highest yield of 47.78q/ha was observed in genotype 2018/OKYVRES-1 followed by 2018/OKYVRES-5 (41.87q/ha), whereas minimum yield was observed in genotype 2019/OKYVRES-9 (9.58q/ha) followed by 2019/OKYVRES-7 (12.65q/ha) (Table 5).

The value of 'A' ranged from 425.85 to 1506.75 for the evaluated okra entries from group 3. All the genotypes 2017/OKHYVRES-1, 2017/OKHYVRES-2, 2017/OKHYVRES-3, 2017/OKHYVRES-4, 2017/OKHYVRES-6, 2017/OKHYVRES-8, 2017/OKHYVRES-9, 2017/OKHYVRES-10 showed 'A' value less than 1000 except for local susceptible which exhibited 'A' value more than 1000 (table 7).

Maximum value for AUDPC was observed for local susceptible variety (1,506.75) followed by 2017/OKHYVRES-4 (894.52), whereas minimum A-value of (425.85) was observed in genotype 2017/OKHYVRES-9 followed by 2017/OKHYVRES-6 (434.68) (Table 6).

Yield ranged from 10.04q/ha to 58.54q/ha for all the evaluated okra entries from group 3. Highest yield of 58.54q/ha was observed in genotype 2017/OKHYVRES-2 followed by 2017/OKHYVRES-4 (54.88q/ha), whereas minimum yield was observed in 2017/OKHYVRES-6 (10.04q/ha) (table 6).

In conclusion, development of resistant varieties is the most appropriate, economical approach to the disease management strategies. An effort was made to screen different okra genotypes against powdery mildew disease, the most common threat to okra cultivation. Among the 37 Okra entries evaluated none were found with completely immune or highly resistant, as well as none of the genotype were found with highly susceptible disease reaction. 14 genotypes namely 2018/OKYVRES-1, 2018/OKYVRES-2, 2018/OKYVRES-4, 2018/OKYVRES-8, 2017/OKYVRES-1, 2017/OKYVRES-2, 2017/OKYVRES-5, 2017/OKYVRES-9, 2017/OKYVRES-10, 2017/OKHYVRES-2, 2017/OKHYVRES-3, 2017/OKHYVRES-6, 2017/OKHYVRES-9, 2017/OKHYVRES-10 were recorded with moderately resistant reaction and rest 23 genotypes along with local susceptible check showed moderately susceptible or susceptible reaction against the disease. Higher apparent rate of infection was (observed during 60-75 days after sowing) tells the stage of the plant at which it is most susceptible, for the efficient and judicious management of the disease. Maximum A-value of (1506.75) was observed in the local susceptible variety.

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