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Study of seasonal incidence of prevailing foliar diseases of okra *Abelmoschus esculentus* (L.) Moench

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Abstract

The intensive survey was conducted at different location of Raipur and Durg district viz. Parsada, Godhi, Bhatagaon, Ganiyari, and Baktara to record the seasonal incidence and severity of foliar diseases of okra during Kharif and Rabi season of 2016-17 in farmers field under natural condition. Per cent Disease Incidence (PDI) of *Cercospora* leaf spot of okra was highest (55.60%) in Kharif season then Rabi season (33.80%), In order to Percent Disease Severity (PDS) of *Cercospora* leaf spot of okra was also higher in Kharif season (56.18%) then Rabi season (36.92%). The average PDI of *Alternaria* leaf spot of okra was highest (56.6%) in Rabi season then Kharif season (52.80%), the average PDS of *Alternaria* leaf spot of okra was observed highest in Rabi season (54.38%) then in Kharif season (46.90%). In Kharif season average Powdery mildew disease was recorded with higher incidence (64.60%) then Rabi season (64.40%), average severity of Powdery mildew disease was also recorded highest in Kharif season (57.33%) then Rabi season. The average PDI of Okra leaf curl disease was highest in Rabi season (23%) then in Kharif season (14.4%), In case of severity of Okra leaf curl disease average PDS was recorded highest in Rabi (15.64%) then Kharif season (11.61%). The average PDI of Okra mosaic was highest in Kharif (11.2%) then in Rabi season (10%), In context of disease severity, highest severity was found in Rabi (17.2%) then Kharif season (15.28%). In case of all the diseases which was observed in survey the average PDI was highest in Kharif (39.72%) then in Rabi season (37.56), In context of disease severity average PDS was observed highest in Kharif (37.46%) then Rabi (35.90%), In case of both the season (Kharif and Rabi) highest prevailing foliar disease of okra was Powdery mildew (60.42%) followed by *Alternaria* leaf spot (52.67%), *Cercospora* leaf spot (45.63%) Okra leaf curl virus (16.17%) and lowest was okra mosaic disease (13.42%).

Keywords: Incidence, disease, seasonal incidence, okra mosaic virus, okra leaf curl virus, severity, *Cercospora*, *Alternaria*

Introduction

Okra, *Abelmoschus esculentus* (L.) Moench, is an important vegetable crop grown mainly in the tropical or sub-tropical regions during summer and rainy season. Hence, it is classified as a warm season crop (National Research Council, 2006) [27]. The major okra producing countries in the world include India (6.35 million tons), Nigeria (1.10 million tons), Iraq (0.14 million tons), Côte d'Ivoire (0.13 million tons) and Pakistan (0.10 million tons) (Anonymous 2013) [4]. Okra is known by many local names in different parts of the world. It is called lady's finger in England, gumbo in the United States of America, guino-gombo in Spanish, guibeiro in Portuguese and bhindi in India. It is quite popular in India because of easy cultivation, dependable yield and adaptability to varying moisture conditions. Even within India, different names have been given in different regional languages (Chauhan, 1972) [17]. Nutritional profile of okra showed that it contains saturated fats, carbohydrates, proteins, vitamin A, B6, B12, folate, riboflavin, niacin, pantothenic acid, Vitamin C, and E etc., it also contains magnesium, phosphorous, potassium, zinc, sodium, copper, manganese and selenium. The seeds also contains dietary fiber and sugars (Anon., 2012) [5]. The mucilage from okra is suitable for industrial and medicinal application and could be applied as plasma replacement or blood volume expander (Arapitsas, 2008) [6]. The leaf buds and flowers are also edible. The seed when roasted and ground can be used as coffee additive or substitute (Moekchantuk and Kumar, 2004) [26]. The roots and stems of okra are used for clarification of sugarcane juice from which gur or brown sugar is prepared (Chauhan, 1972) [17]. Its medicinal value has also been reported in curing ulcers and relief from haemorrhoids (Adams, 1975) [1]. Okra seeds contain a considerable amount of good quality oil and protein and can be used as a substitute for coffee (Valeriana, 2002) [39].

Therefore, there is a great need for recording fungi associated with okra seeds in an easy, quick, reliable and economic seed health testing techniques for powdery mildew, okra mosaic virus, *Cercospora* leaf spot, Fusarium wilt, Verticillium wilt, etc. (Ahmad *et al.*, 2014) [2] reported the incidence of okra blight and powdery mildew appeared during February and their severity increased till harvesting period. The overall disease complexes were found 85% per plant.

Materials and Methods

An intensive survey was conducted during Kharif and Rabi season of 2016-17 on the incidence of prevailing diseases of okra growing area of Raipur and Durg district of Chhattisgarh. Number of 10 plants were sampled per spot per field. Total 8-10 spots were selected randomly for taking leaf samples representing the whole field. Wherever required, the complete infected plants were also collected for microscopic observation of the pathogen and other studies. Observation of diseases was taken by the using of following scale:

Disease severity scale for *Cercospora* and *Alternaria* leaf spot of okra

1 = No disease, 2 = Light spotting in the lower plant canopy, 3 = Light spotting in the lower and upper plant canopy, 4 = Some spotting with light defoliation (<10%), 5 = Noticeable spotting with some defoliation (<25%), 6 = Spotting heavy with significant defoliation (<50%), 7 = Very heavy leaf spotting with severe defoliation (<75%), 8 = Numerous spot on few remaining leaves and very heavy defoliation (<90%), 9 = Very few remaining leaves covered with spots and nearly complete defoliation (<95%) and 10 = Plant defoliated.

Disease severity scale used for the powdery mildew disease rating

The percentage of each foliar disease severity was recorded by employing disease severity scale from 0 to 4 according to Cohen *et al.* (2009) [18] was followed, whereas: 0 = No leaf lesions, 1 = 25% or less, 2 = 26 – 50%, 3 = 51 – 75% and 4 = 76 – 100% infected Area of plant leaf.

Visual scale for rating severity of okra leaf curl disease on farmers okra fields

The severity of OLCD was rated on individual plants sampled in the okra fields using a visual scale of 1-7 developed by Alegbejo (1997) [3] 0 = No symptom, 1 = No visible disease symptom, 3 = Top leaves curled and slight stunting of plant, 5 = All leaves curled and slight stunting of plant, 7 = Severe curling of leaves, stunting of plant and proliferation of auxiliary branches.

Visual scale for rating severity of okra mosaic disease in farmers okra fields

The severity of OMD was rated on the basis of a rating scale developed by Yayeh (1994) [41] for virus diseases 0 = Healthy, asymptomatic plant, 1 = Mild mosaic, mottle or chlorosis on leaves, 2 = Moderate chlorosis, mottle or mosaic without significant leaf distortion, 3 = Score 1 or 2 plus leaf malformation, 4 = Severe chlorosis, mottle or mosaic plus stunting or dwarfing of the whole plant and 5 = Score 4 plus drying and leaf drop.

Calculation

The per cent disease incidence and per cent disease severity was calculated by using the following formula.

$$\text{Per cent disease incidence} = \frac{\text{Total number of plants affected}}{\text{Total number of plants assessed}} \times 100$$

(Berger, 1980) [13]

$$\text{Per cent disease severity} = \frac{\text{Sum of all numerical ratings}}{\text{Number of leaf assessed} \times \text{Maximum scale}} \times 100$$

Statistical Analysis

All the analysis and calculation of mean infection range, percent disease incidence and percent disease severity was done by Microsoft office excel 2007.

Result and Discussion

The intensive survey was conducted at different location of Raipur and Durg district viz. Parsada, Godhi, Bhatagaon, Ganiyari, and Baktara to record the seasonal incidence and severity of foliar diseases of okra during Kharif and Rabi season of 2016-17. Observations were recorded from farmer's fields under natural condition.

Table 1: Seasonal incidence of *Cercospora* leaf spot of okra

Location	Kharif		Rabi	
	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)
Parsada	47	55.10	25	33.30
Godhi	52	54.90	34	35.80
Bhatagaon	55	56.90	37	39.00
Ganiyari	61	52.90	32	39.50
Baktara	63	61.10	41	37.00
Mean	55.60	56.18	33.80	36.92

Per cent Disease Incidence (PDI) of *Cercospora* leaf spot of okra was highest (55.60%) in Kharif season then Rabi season (33.80%), on context of location specific highest PDI was recorded in Kharif session was from Baktara (63%) followed by Ganiyari (61%), Bhatagaon (55%), Godhi (52%) and lowest was from Parsada (47%), and in Rabi season highest PDI was also recorded from Baktara (41%), followed by Bhatagaon (37%), Godhi (34%), Ganiyari (32%) and lowest was recorded from Parsada (25%). In order to Perc ent Disease Severity (PDS) of *Cercospora* leaf spot of okra was also higher in Kharif season (56.18%) then Rabi season (36.92%) (Table 1). On perticular location highest PDS in Kharif season was recorded from Baktara (61.10%) followed by Bhatagaon (56.90%), Parsada (55.10%), Godhi (54.90%), and lowest was from Ganiyari (52.90%), and in Rabi season highest PDS was from Ganiyari (39.50%) followed by Bhatagaon (39.00%), Baktara (37.00%), Godhi (35.80%), and lowest was recorded in Parsada (33.30%). (Table 1)

Cercospora leaf spot of okra caused by *Cercospora abelmoschi* effect the yield loss of okra by 76.49% of disease intencity in okra (Singh *et al.*, 2001) [32]. In other crop it caused yield loss up to 47% (Singh *et al.*, (2014) [33]. Many workers have also reported similar findings (Bakhshi *et al.*, (2015) [10], (Catarino *et al.*, 2016) [14]. The average PDI of *Alternaria* leaf spot of okra was highest (56.6%) in Rabi season then Kharif season (52.80%), highest PDI of *Alteranria* leaf spot in Kharif season was observed from Godhi (62%) followed by Baktara (61%), Bhatagaon (57%), Parsada (49%) and lowest was from Ganiyari (35%), and in Rabi season highest disease incidence was from Parsada (70%) followed by Baktara (65%), Ganiyari (52%), Godhi (46%) and lowest disease incidence was observed from Bhatagaon (46%) (Table 2).

The average PDS of *Alternaria* leaf spot of okra was observed highest in Rabi season (54.38%) then in Kharif season (46.90%). In case of disease severity of *Alternaria* leaf spot in Kharif season was observed highest in Baktara (54.50%) followed by Parsada (46.30%), Ganiyari (45.30%), Godhi (45.30%) and lowest was observed in Bhatagaon (43.10%), and Rabi season highest PDS was observed in Ganiyari (62.30%) followed by Baktara (61.50%), Bhatagaon (55.00%), Godhi (48.70%) and lowest PDS was in Parsada (44.40%). (Table 2)

Phapale *et al.*, (2010)^[28] studied *Alternaria* leaf spot is always found associated at all the places and throught the cropping season causing serious losses. Similar results were reported by some earlier workers (Thippeswami *et al.*, 2007; Atia *et al.*, 2004; Sindhumole *et al.*, 2015)^[36, 7, 30].

Table 2: Seasonal incidence of *Alternaria* leaf spot of okra

Location	Kharif		Rabi	
	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)
Parsada	49	46.30	70	44.40
Godhi	62	45.30	50	48.70
Bhatagaon	57	43.10	46	55.00
Ganiyari	35	45.30	52	62.30
Baktara	61	54.50	65	61.50
Mean	52.80	46.90	56.60	54.38

In Kharif season average Powdery mildew disease was recorded with higher incidence (64.60%) then Rabi season (64.40%), in Kharif season highest PDI of Powdery mildew was recorded from Bhatagaon (71%), followed by Parsada (69%), Ganiyari (67%), Baktara (59%), and lowest PDI was recorded from Godhi (57%) and in Rabi season highest PDI was recorded from Parsada (75%) followed by Baktara (67%), Ganiyari (63%), Godhi (60%) and lowest was in Bhatagaon (57%). Average severity of Powdery mildew disease was also recorded highest in Kharif season (57.33%) then Rabi season. The PDS in Kharif season was recorded highest in Ganiyari (61.50%) followed by Bhatagaon (60.05%), Godhi (58.25%), Baktara (57.10%) and lowest was in Parsada (49.75%) and in Rabi season highest PDS was recorded from Parsada (71.75%) followed by Godhi (55.50%), Baktara (51.50%), Bhatagaon (50.75%) and was lowest in Ganiyari (47.25%). (Table 3)

Similar results were reported by some earlier workers (Mitov *et al.*, 1977; Diaz 1999; Band *et al.*, 2007; Bachihal *et al.*, 2013; Jagtap *et al.*, 2013; Vidhate *et al.*, 2014; Atiq *et al.*, 2014;)^[25, 19, 11, 9, 21, 40, 8]

Table 3: Seasonal incidence of Powdery mildew disease of okra

Location	Kharif		Rabi	
	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)
Parsada	69	49.75	75	71.75
Godhi	57	58.25	60	55.50
Bhatagaon	71	60.05	57	50.75
Ganiyari	67	61.50	63	47.25
Baktara	59	57.10	67	51.50
Mean	64.6	57.33	64.4	55.35

The average PDI of Okra leaf curl disease was highest in Rabi season (23%) then in Kharif season (14.4%), in Kharif season PDI of this disease was recorded highest in Parsada (19%) followed by Bhatagaon (16%), Ganiyari (14%), Baktara (12%) and lowest was in Godhi (11%), and in Rabi PDI was highest from Parsada (29%) followed by Godhi (27%), Bhatagaon (25%), Baktara (21%) and lowest was in Ganiyari

(13%). In case of severity of Okra leaf curl disease average PDS was recorded highest in Rabi (15.64%) then Kharif season (11.61%), in Kharif season highest PDS of Okra leaf curl disease was recorded from Parsada (13.57%) followed by Baktara (12.10%), Ganiyari (11.00%), Godhi (11.00%) and lowest was in Bhatagaon (10.42%), and in Rabi season PDS was recorded highest in Baktara (17.10%) followed by Ganiyari (16.00%), Bhatagaon (15.42%), Godhi (15.28%) and lowest was in Parsada (14.42%).(Table 4)

Tiendrebeogo *et al.* (2010)^[37] observed the impact of okra leaf curl disease on four accessions of a local okra cultivar and four commercial okra cultivars was assessed in field conditions. Disease incidence varied from 68.5% to 72.5% among accessions of the local cultivar while commercial cultivars were much less infected (8.7-16.2%). Therefore, the results of the present finding are in conformity with results of previous workers like (Bediako *et al.*, 2014; Mansoor *et al.*, 2001; Chakraborty *et al.*, 1997; Kumar *et al.*, 2012;)^[12, 24, 15, 22]

Table 4: Seasonal incidence of Okra leaf curl disease

Location	Kharif		Rabi	
	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)
Parsada	19	13.57	29	14.42
Godhi	11	11.00	27	15.28
Bhatagaon	16	10.42	25	15.42
Ganiyari	14	11.00	13	16.00
Baktara	12	12.10	21	17.10
Mean	14.4	11.618	23	15.644

The average PDI of Okra mosaic was highest in Kharif (11.2%) then in Rabi season (10%), in Kharif season PDI was observed highest from Parsada (16%), followed by Godhi (13%), Bhatagaon (11%), Baktara (9%) and lowest was in Ganiyari (7%), and in Rabi season PDI was highest in Bhatagaon (12%), followed by Baktara (11%), Parsada (10%), Godhi (9%) and lowest was in Ganiyari (8%). In context of disease severity, highest severity was found in Rabi (17.2%) then Kharif season (15.28%), in Kharif PDS was observed highest from Bhatagaon (18.00%) followed by Parsada (17.60%), Godhi (16.40%), Baktara (13%) and lowest in Ganiyari (11.42%) and in Rabi season PDS was observed highest in Godhi (21.60%) followed by Bhatagaon (19.40%), Ganiyari (18.40%), Baktara (17.00%) and lowest was in Parsada (9.60%).(5)

Seth *et al.* (2016)^[29] studied Yellow Vein Mosaic Virus (YVMV) disease of okra causes yield loss of 50-90% in India. It corroborated with the results of (Singh *et al.*, 2007; Dubey *et al.*, 2012; Sohrab *et al.*, 2013; Solankey *et al.*, 2014; Kumar *et al.*, 2015; Choudhary *et al.*, 2016)^[31, 20, 34, 35, 23, 16]

Table 5: Seasonal incidence of Okra mosaic disease

Location	Kharif		Rabi	
	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)
Parsada	16	17.6	10	9.60
Godhi	13	16.40	9	21.60
Bhatagaon	11	18.00	12	19.40
Ganiyari	7	11.42	8	18.40
Baktara	9	13	11	17.00
Mean	11.2	15.284	10	17.2

In case of all the diseases which was observed in survey the average PDI was highest in Kharif (39.72%) then in Rabi season (37.56), in Kharif highest PDI was observed in Powdery mildew disease (64.60%) followed by *Cercospora*

leaf spot disease (55.60%), *Alternaria sp.* leaf spot (52.80%), Okra leaf curl disease (14.40%) and lowest PDI was in Okra mosaic disease (11.20%), and in Rabi season highest PDI was also observed in Powdery mildew disease (64.40%) followed by *Alternaria* leaf spot (56.60%), *Cercospora* leaf spot (33.80%), Okra leaf curl disease (23.00%) and lowest was also in Okra mosaic disease (10%). In context of disease severity average PDS was observed highest in Kharif (37.46%) then Rabi (35.90%), in Kharif PDS was highest in Powdery mildew (57.33%) followed by *Cercospora* leaf spot (56.18%), *Alternaria* leaf spot (46.90%), Okra mosaic disease (15.28%) and lowest was Okra leaf curl disease, and in Rabi season PDS was also highest in Powdery mildew (55.35%) followed by *Alternaria* leaf spot (54.38%), *Cercospora* leaf spot (36.92%), Okra mosaic disease (17.20%) and lowest was in Okra leaf curl disease (15.64%). In case of both the season

(Kharif and Rabi) highest prevailing foliar disease of okra was Powdery mildew (60.42%) followed by *Alternaria* leaf spot (52.67%), *Cercospora* leaf spot (45.63%) Okra leaf curl virus (16.17%) and lowest was okra mosaic disease (13.42%) (Table 6).

Table 6: Seasonal incidence of all foliar diseases of okra

Disease	Kharif		Rabi		Mean
	Incidence (%)	Severity (%)	Incidence (%)	Severity (%)	
CLS	55.60	56.18	33.80	36.92	45.63
ALS	52.80	46.90	56.60	54.38	52.67
PM	64.60	57.33	64.40	55.35	60.42
OLCV	14.40	11.618	23.00	15.644	16.17
OMD	11.20	15.284	10.00	17.20	13.42
Mean	39.72	37.46	37.56	35.90	

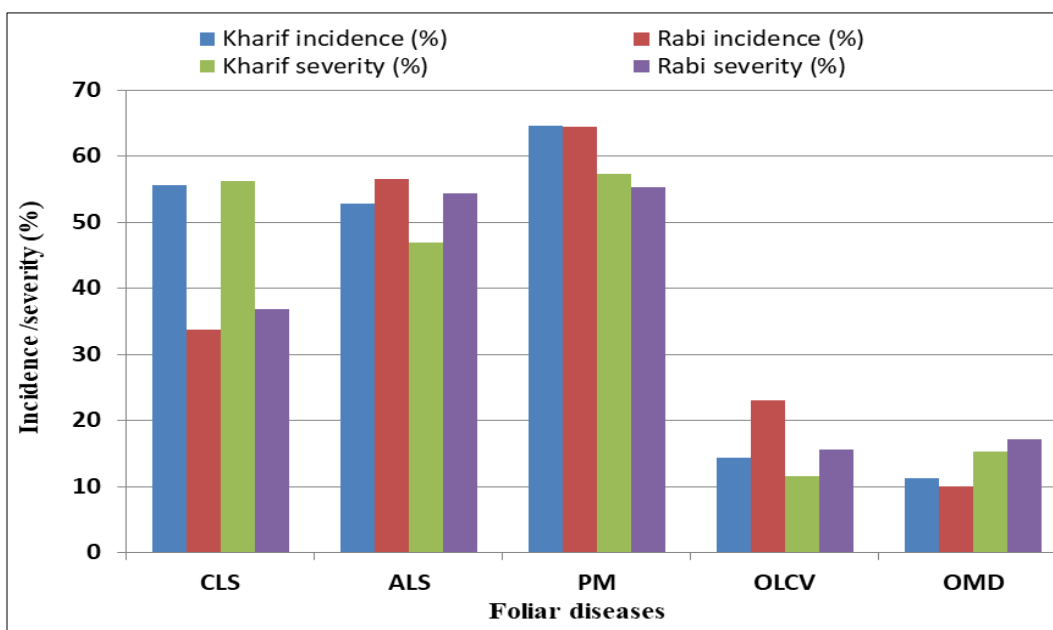


Fig 1: Seasonal incidence and severity of all foliar diseases of okra



Fig 2: Foliar diseases of okra

Conclusion

Average incidence and severity of foliar diseases was highest in Kharif season then Rabi season. Powdery mildew disease

was recorded with highest incidence and severity in both the season.

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