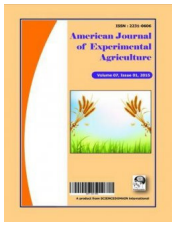

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Screening of Disease Resistant Varieties against Brown Leaf Spot of *Oryza sativa* in Allahabad, India

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Brown leaf spot disease is the most serious disease of rice. 25 varieties were screened against brown leaf spot caused by *Helminthosporium oryzae* during session (Kharif) 2014 and 2015. The results were four varieties recorded *viz.* NDR-359, CR-1, CR-2 and N-18 in highly resistant. Seven varieties were recorded *viz.* PR-103, IR-36, Prasd, Narendra-2, IR-597, OC-1339 and Cross-116 in resistant. Six varieties were recorded *viz*. IET-849, Pusa NR-381, Narendra-80, Narendra Dhan-97, Jalnidhi and Jallahari in moderately resistant. Three varieties were recorded *viz*. Rupali, MTU-7029 and Sweta in moderately susceptible. IET-2969 and Annapurna was recorded in susceptible. Three varieties were recorded *viz*. Nagina-22, CR-126 and Cauvery highly susceptible in all three screening conditions, i.e. laboratory, pot and field. In view of present investigation, it provides a useful information to the farmers by which they can use these varieties which are resistant to brown leaf spot disease of paddy. This may increase the productivity and save the economy of farmers.

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Keywords: Disease screening; resistant varieties; brown leaf spot; paddy.

1. INTRODUCTION

Rice (*Oryza sativa* L.) fulfills the need of food product in the most of the developing countries of the world. It provides energy in the form of starch and about half of the world population depended upon the rice in per day meal. More than 3.5 billion people depended on rice for more than 20% of their daily calories [1]. According to [2] rice is cultivated in 114 countries and has got third rank in the world after maize and wheat. India produce 2240 kg/ha rice annually. India rank second in terms of production in world being next to the China [2].

In India, rice grown on above one-fourth of the total crop area and provides food to about half of the country's population. Rice is playing a vital role in our national food security. It's growing in the different part of country due to their wide adaptability. Due to infection of several type of pathogens, resulting causes extensive damage to the crop. Fungi alone account for nearly 30 diseases of rice in the country [3]. Among these, a few occur in epiphytotic form in many parts of India and one of the important disease is brown leaf spot of paddy caused by *Drechslera oryzae* Subramanian and Jain (*Heliminthosporium oryzae* Breda de Hann) which caused havoc loss in Bengal during 1942-43.

Brown leaf spot disease is the most serious disease of rice [4]. It caused Bengal Famine in 1942, with yield loss of 50-90%, which resulted in death of 2 million people due to starvation. The pathogen can infects both seedlings and mature plants with the coleoptile, leaves, leaf sheath, panicle branches, glumes, and spike lets [5]. The disease is also known as poor rice farmer's disease because it occurs mostly in deficient and poor soils [6,7,8,9]. The disease has been noted to reduce yields from 6 to 90% in Asia [10,11,12].

The present research work provides a useful information the farmers by which they can use these varieties which are resistant to brown leaf spot disease of paddy. This may increase the productivity and save the economy of farmers.

2. MATERIALS AND METHODS

The present studies were carried out at Department of Botany, University of Allahabad, during Jun-Oct, 2014 and Jun-Oct 2015 for the screening of disease resistant varieties against brown leaf spot of paddy.

2.1 Collection of Infected Part Material

The pathogens *H. oryzae* were collected from the infected plant of the rice field in Allahabad district of Uttar Pradesh.

2.2 Isolation and Purification of *Helminthosporium oryzae*

Infected leaves and nodes of rice plant were cut into small pieces (0.5-1.0 cm) and surface sterilized with 2% sodium hypochlorite for two minutes. These cut pieces were then washed with sterilized water and placed on PDA plates. These PDA plates were incubated at 25℃ for 5 days for the isolation of causal agent. The identification of the pathogen was made by studying the colony characteristics of the isolates on the PDA plates by following the method described in a technical bulletin on seed borne disease and seed health testing of rice [6].

2.3 Preparation of Suspension of Pathogen

Aqueous suspension of 1×10^6 spores/ml of a virulent isolate of *Helminthosporium oryzae* was prepared.

2.4 Laboratory Screening

Twenty five varieties have been selected for the experiment. Ten seeds of each variety with three replication germinated in Petri dishes after that sprayed with already prepared suspension of *H. oryzae* inoculum in petri dishes.

2.5 Pot Screening

In pot condition also 25 varieties have been selected, each variety transplanting in 10 pots with three replication transplanted at the rate of 3 seedling in per pot. Fertilizer used 50% NPK+ BGA with FYM [13].

2.6 Field Screening

Twenty five varieties also have been selected in field condition 22 days old rice seedling were transplanted in experimental plot of 4.10×2.5 meter at the rate of 3 seedlings/hill and 20 cm row to row space and 15 cm plant to plant

distance was maintained. The experiment was carried out in Randomized Block Design (RBD) with three replications. Fertilizer used 50% NPK+ BGA with FYM [13].

The data for disease incidenc were recorded at one month interval to assess the level of resistance or susceptibility of each test variety according to following disease rating scale [14].

Percent infection (Disease incidence)	Host response (Level of resistance / susceptibility)
0-10	Highly resistant
11-20	Resistant
21-40	Moderately resistant
41-60	Moderately susceptible
61-80	Susceptible
81-100	Highly susceptible

3. RESULTS

In current study, 25 varieties screening against *Helminthosporium oryzae* during the session 2014 and 2015. Four varieties were recorded *viz.* NDR-359, CR-1, CR-2 and N-18 in highly resistant. Seven varieties were recorded *viz.* PR-103, IR-36, Prasd, Narendra-2, IR-597, OC-1339 and Cross-116 in resistant. Six varieties were recorded *viz*. IET-849, Pusa NR-381, Narendra-80, Narendra Dhan-97, Jalnidhi and Jallahari in moderately resistant. Three varieties were recorded *viz*. Rupali, MTU-7029 and Sweta in moderately susceptible. IET-2969 and Annapurna was recorded in susceptible. Three varieties were recorded *viz*. Nagina-22, CR-126 and Cauvery highly susceptible in all three screening conditions, i.e. laboratory, pot and field (Table 7).

Table 1. Screening of disease resistant varieties against *H. oryzae* in laboratory condition session 2014

S. no.	Varieties	Total no. of seeds	Infected paddy seeds in petri plate			Mean±SD	D I
			P 1	P 2	P 3		
1	IET-849	10	3	2	2	2.33±0.58	23.30
2	Rupali	10	4	5	4	4.33±0.58	43.30
3	NDR-359	10	1	0	1	0.67±058	6.70
4	CR 1	10	0	0	1	0.33±0.58	3.30
5	PR-103	10	2	1	1	1.33±0.58	13.30
6	IR-36	10	3	1	2	2.00±1.00	20.00
7	MTU-7029	10	4	5	5	4.67±0.58	46.70
8	CR-2	10	1	0	1	0.67±0.58	6.70
9	Prasd	10	1	1	2	1.33±0.58	13.30
10	Sweta	10	5	6	4	5.00±1.00	50.00
11	Annapurna	10	6	7	6	6.33±0.58	63.30
12	Narendra-2	10	2	1	2	1.67±0.58	16.70
13	IET-2969	10	7	6	7	6.67±0.58	66.70
14	IR-597	10	2	1	2	1.67±0.58	16.70
15	N-18	10	1	1	0	0.67±0.58	6.30
16	OC-1339	10	2	1	2	1.67±0.58	16.70
17	Pusa NR-381	10	3	2	2	2.33±0.58	23.30
18	Cross-116	10	1	2	1	1.33±0.58	13.30
19	Nagina-22	10	8	9	8	8.33±0.58	83.30
20	Narendra-80	10	4	3	2	3.00±1.00	30.00
21	CR-126	10	8	9	9	8.67±0.58	86.70
22	Narendra Dhan-97	10	2	2	4	2.67±1.15	26.70
23	Jalnidhi	10	3	2	3	2.67±0.58	26.70
24	Jallahari	10	2	3	2	2.33±0.58	23.30
25	Cauvery	10	9	8	9	8.67±0.58	86.70

Table 2. Screening of disease resistant varieties against *H. oryzae* in pot condition session 2014

S. no.	Varieties	Total no. of plant	Infected plant of paddy in pot			Mean±SD	D I
			P 1	P 2	P 3		
1	IET-849	10	3	3	4	3.33±0.58	33.30
2	Rupali	10	4	5	5	4.66±0.58	46.60
3	NDR-359	10	1	0	2	1.00±1.00	10.00
4	CR 1	10	0	1	1	0.66±0.58	6.60
5	PR-103	10	2	2	2	2.00±0.00	20.00
6	IR-36	10	2	1	3	2.00±1.00	20.00
7	MTU-7029	10	5	4	6	5.00±1.00	50.00
8	CR 2	10	0	1	1	0.66±0.58	6.60
9	Prasd	10	2	0	2	1.33±1.15	13.30
10	Sweta	10	5	5	6	5.33±0.58	53.0
11	Annapurna	10	7	8	7	7.33±0.58	73.30
12	Narendra-2	10	2	2	2	2.00±0.00	20.00
13	IET-2969	10	8	7	6	7.00±1.00	66.70
14	IR-597	10	2	1	2	1.66±0.58	16.60
15	N-18	10	1	1	1	1.00±0.00	10.00
16	OC-1339	10	1	2	1	1.33±0.58	13.30
17	Pusa NR-381	10	3	3	2	2.66±0.58	26.60
18	Cross-116	10	2	1	2	1.66±0.58	16.60
19	Nagina-22	10	9	8	9	8.66±0.58	86.60
20	Narendra-80	10	3	4	3	3.33±0.58	33.30
21	CR-126	10	8	9	9	8.66±0.58	86.60
22	Narendra Dhan-97	10	5	4	4	4.33±0.58	43.30
23	Jalnidhi	10	3	3	2	2.66±0.58	26.60
24	Jallahari	10	3	2	4	3.00±1.00	30.00
25	Cauvery	10	9	8	9	8.66±0.58	86.60

4. DISCUSSION

4.1 Screening of Disease Resistant Varieties against *H. oryzae* in Laboratory Condition Season 2014 and 2015

On the basis of result examined in the laboratory condition it has found that highly resistant varieties range of disease incidence (DI) is 0-10 %, the DI level of varieties were recorded as NDR-359 (6.70%), CR-1 (3.30%), CR-2 (6.70%), N-18 (6.30%) during the session 2014 (Table 1) whereas the disease incidence level of varieties NDR-359, CR-1 above the same DI and CR-2 (3.30%), N-18 (3.30%) in the season 2015 (Table 4). Resistant varieties range of DI is 11-20 % and the DI level of varieties were recorded as PR-103 (13.30%), IR-36 (20%), Prasad (13.30%), Narendra-2, IR-597, OC-1339 (16.70%), Cross-116 (13.30%) during session 2014 (Table 1) whereas the disease incidence level of varieties were recorded as PR-103, IR-36, Narendra-2, IR-597, OC-1339 and Cross-116 were 13.30%, 20%, 13.30%, 16.70% and 13.30% respectively in the season 2015 (Table 4). Moderately resistant varieties range is DI 21-40 % and the DI level of varieties were recorded as IET-849, Pusa NR-381, Jallahari (23.30%), Narendra-80 (30%), Narendra Dhan-97, Jainidhi (26.70%) during the session 2014 (Table 1) whereas the disease incidence (DI) level of varieties were recorded as IET-849, Pusa NR-381, Jallahari (26.70%), Narendra-80, Narendra Dhan-97 (33.30%), Jalnidhi (30%) in the season 2015 (Table 4). Moderately susceptible varieties range of DI is 41-60% and the DI level of varieties were recorded as Rupali (43.30%), MTU-7029 (47.70%), Sweta (50.00%) during the session 2014 (Table 1) whereas the disease incidence level of varieties were recorded as Rupali (43.30%), MTU-7029 (50.00%), Sweta (50.00%) in the season 2015 (Table 4). Susceptible varieties range of DI is 61-80 % and the DI level of varieties were recorded as Annapurna (63.30%), IET-2969 (66.70%) during the session 2014 (Table 1) whereas the DI level of varieties were recorded as Annapurna, IET-2969 (70.00%) in the season 2015 (Table 4). Highly

susceptible varieties range of DI is 81-100% and the DI level of varieties were recorded as Nagina-22 (83.30%), CR-126 (86.70%), Cauvery (87.70%) during the session 2014 (Table 1) whereas the disease incidence (DI) level of varieties were recorded as Nagina-22, CR-126 (86.70%), Cauvery (83.30%) (Table 4).

4.2 Screening of Disease Resistant Varieties against *H. oryzae* in Pot Condition Season 2014 and 2015

On the basis of result examined in the pot condition it has found that highly resistant varieties range of DI 0-10 %, the DI level of varieties were recorded as NDR-359, N-18 (10%), CR-1 and CR-2 (6.60%) during the session 2014 (Table 2) whereas the DI level of varieties were recorded as NDR-359, CR-2 above the same DI and CR-1 (3.30%), N-18 (6.70%) in the season 2015 (Table 5). Resistant varieties range of DI 11-20 %, the DI level of varieties were recorded as PR-103, IR-36, Narendra-2 (20%), Prasad, OC-1339 (13.30%), IR-597, Cross-116 (16.70%) during the session 2014 (Table 2) whereas the DI level of varieties were recorded as PR-103, Prasad, OC-1339, Cross-116 (16.70%), IR-36, Narendra-2, IR-597 (13.30%) in the season 2015 (Table 5). Moderately resistant varieties range of disease incidence (DI) 21-40%, the disease incidence (DI) level of varieties were recorded as IET-849, Narendra-80 (33.30%), Pusa NR-381, Jalnidhi (26.60%), Narendra Dhan-97, Jallahari (30%) during the session 2014 (Table 2) whereas the disease incidence (DI) level of varieties were recorded as IET-849, Narendra-80 (30%), Pusa NR-381, Jalnidhi (23.30%), Narendra Dhan-97, Jallahari (26.70%) in the season 2015 (Table 5). Moderately susceptible varieties range of DI is 41-60%, the DI level of varieties were recorded as Rupali (46.60%), MTU-7029 (50.00%), Sweta (53.30%) during the session 2014 (Table 2) whereas the DI level of varieties were recorded

Table 3. Screening of disease resistant varieties against *H. oryzae* in field condition session 2014

S. no.	Varieties	Total no. of plant	Infected plant of paddy in field			Mean±SD	D I
			F 1	F 2	F 3		
1	IET-849	320	96	98	94	96±2.00	30.00
2	Rupali	320	138	137	139	138±1.00	43.12
3	NDR-359	320	19	20	18	19±1.00	5.94
4	CR 1	320	15	17	16	16±1.00	5.00
5	PR-103	320	46	48	47	47±1.00	14.69
6	IR-36	320	41	39	40	40±1.00	12.50
7	MTU-7029	320	145	148	145	146±1.73	45.62
8	CR 2	320	16	15	17	16±1.00	5.00
9	Prasd	320	40	43	43	42±1.73	13.12
10	Sweta	320	148	147	149	148±1.00	46.25
11	Annapurna	320	212	214	216	214±2.00	66.87
12	Narendra-2	320	46	48	47	47±1.00	14.69
13	IET-2969	320	210	214	212	212±2.00	66.25
14	IR-597	320	42	44	43	43±1.00	13.44
15	N-18	320	22	24	23	23±1.00	7.19
16	OC-1339	320	39	41	40	40±1.00	12.50
17	Pusa NR-381	320	75	77	76	76±1.00	23.75
18	Cross-116	320	43	45	44	44±1.00	13.75
19	Nagina-22	320	270	273	273	272±1.73	85.00
20	Narendra-80	320	95	97	96	96±1.00	30.00
21	CR-126	320	265	268	265	266±1.73	83.12
22	Narendra Dhan-97	320	89	90	88	89±1.00	27.81
23	Jalnidhi	320	83	84	82	83±1.00	25.94
24	Jallahari	320	90	91	89	90±1.00	28.12
25	Cauvery	320	266	266	269	267±1.73	83.44

Table 4. Screening of disease resistant varieties against *H. oryzae* in laboratory condition session 2015

S. no.	Varieties	Total no. of seeds	Infected paddy seeds in petri plate			Mean±SD	D I
			P 1	P 2	P 3		
1	IET-849	10	3	3	2	2.67±0.58	26.70
2	Rupali	10	4	5	4	4.33±0.58	43.30
3	NDR-359	10	0	1	1	0.67±0.58	6.70
4	CR 1	10	1	0	0	0.33±0.58	3.30
5	PR-103	10	2	1	2	1.67±0.58	16.70
6	IR-36	10	2	1	1	1.33±0.58	13.30
7	MTU-7029	10	5	4	6	5.00±1.00	50.00
8	CR-2	10	0	0	1	0.33±0.58	3.30
9	Prasd	10	2	1	2	1.67±0.58	16.70
10	Sweta	10	6	5	4	5.00±1.00	50.00
11	Annapurna	10	7	6	8	7.00±1.00	70.00
12	Narendra-2	10	1	1	2	1.33±0.58	13.30
13	IET-2969	10	7	6	8	7.00±1.00	70.00
14	IR-597	10	1	2	1	1.33±0.58	13.30
15	N-18	10	0	1	0	0.33±0.58	3.30
16	OC-1339	10	1	2	2	1.67±0.58	16.70
17	Pusa NR-381	10	2	3	3	2.67±0.58	26.70
18	Cross-116	10	1	3	1	1.67±1.15	16.70
19	Nagina-22	10	9	8	9	8.67±0.58	86.70
20	Narendra-80	10	3	4	3	3.33±0.58	33.30
21	CR-126	10	9	8	9	8.67±0.58	86.70
22	Narendra Dhan-97	10	4	3	3	3.33±0.58	33.30
23	Jalnidhi	10	2	3	4	3.00±1.00	30.00
24	Jallahari	10	2	2	4	2.67±1.15	26.70
25	Cauvery	10	8	9	8	8.33±0.58	83.30

as Rupali (43.30%), MTU-7029 (46.70%), Sweta (43.30%) in the season 2015 (Table 5). Susceptible varieties range of DI 61-80%, the DI level of varieties were recorded as Annapurna (73.30%), IET-2969 (66.70%) during the session 2014 (Table 2) whereas the DI level of varieties were recorded as Annapurna (70.00%), IET-2969 (66.70%) in the season 2015 (Table 5). Highly susceptible varieties range of DI 81-100 %, the DI level of varieties were recorded as Nagina-22, CR-126, Cauvery (86.60%) during the session 2014 (Table 2) whereas the DI level of varieties were recorded as varieties Nagina-22, CR-126, Cauvery (83.30%) in the season 2015 (Table 5).

4.3 Screening of Disease Resistant Varieties against *H. oryzae* in Field Condition Season 2014 and 2015

On the basis of result examined in the field condition it has found that highly resistant varieties range of DI 0-10 %, the DI level of varieties were recorded as NDR-359 (5.94%), CR-1, CR-2 (5%), N-18 (7.19%) during the session 2014 (Table 3) whereas the DI level of varieties were recorded as NDR-359 (5.62%), CR-1 (4.69%), CR-2 (5%), N-18 (6.87%) in the season 2015 (Table 7). Resistant varieties range of DI 11-20%, the DI level of varieties were recorded as PR-103 (14.69%), IR-36, OC-1339 (12.50%), Prasad (13.12%), Narendra-2 (14.69%), IR-597 (13.44%), Cross-116 (13.75%) during the session 2014 (Table 3) whereas the DI level of varieties were recorded as PR-103, Narendra-2 (14.37%), IR-36 (12.81%), Prasad (12.50%), IR-597, OC-1339 (13.12%) in the season 2015 (Table 6). Moderately resistant varieties range of disease incidence (DI) 21-40 %, the DI level of varieties were recorded as IET-849, Narendra-80 (30%), Pusa NR-381 (23.75%), Narendra Dhan-97 (27.81%), Jalnidhi (25.94%), Jallahari (28.12%) during the session 2014 (Table 3) whereas the DI level of varieties were recorded as IET-849, Narendra-80 (29.69%), Pusa NR-391 (23.47%), Narendra Dhan-97 (27.19%), Jalnidhi (25.31%), Jallahari (27.50%) in the season 2015 (Table 6).

Moderately susceptible varieties range of disease incidence (DI) 41-60%, the DI level of varieties were recorded as Rupali (43.12%), MTU-7029 (45.62%), Sweta (46.25%) during the session 2014 (Table 3) whereas the DI level of varieties were recorded as Rupali (42.50%), MTU-7029 (45.31%), Sweta (45.62%) in the season 2015 (Table 6). Susceptible varieties range of DI 61-80%, the DI level of varieties were recorded as Annapurna (66.87%), IET-2969 (66.25%) during the session 2014 (Table 3) whereas the disease incidence (DI) level of varieties were recorded as Annapurna (66.25%), IET-2969 (65.62%) in the season 2015 (Table 6). Highly susceptible varieties range of disease incidence (DI) 81-100%, the DI level of varieties were recorded as Nagina-22 (85.00%), CR-126 (83.12%), Cauvery (83.44%) during the session 2014 (Table 3) whereas the DI level of varieties were recorded as Nagina-22 (84.06%), CR-126 (82.81%), Cauvery (82.50%) in the season 2015 (Table 6).

Similar results were reported by [15,16,17,18,19, 20] and [21]. [21] found resistant character in accession lines JR75, RWR92-3 and RWR54 against brown spot of rice. Variability in rice germplasm in response to various diseases was also reported by [22] and [23]. They also categorized rice germplasm into different groups ranging from highly susceptible to highly resistant against various rice diseases. [24] and [25] have also showed significant variability in rice genotypes against diseases. [20] screened the accession line Lohana 1, Kalamkata and Rangi as highly resistant against brown spot. [19] found six highly resistant and three resistant among fifty rice accession lines in India. In Pakistan, [4] found only one entry among seventy entries was resistant against brown leaf spot. For managing the brown leaf spot disease, the most desirable means is host resistance, especially in developing countries [26].

Table 5. Screening of disease resistant varieties against *H. oryzae* in pot condition session 2015

S. no.	Varieties	Total no. of plant	Infected plant of paddy in pot			Mean±SD	D I
			P 1	P 2	P 3		
1	IET-849	10	3	2	4	3.00±1.00	30.00
2	Rupali	10	4	4	5	4.33±0.58	43.30
3	NDR-359	10	1	1	1	1.00±0.00	10.00
4	CR 1	10	1	0	0	0.33±0.58	3.30
5	PR-103	10	1	2	2	1.67±0.58	16.70
6	IR-36	10	1	2	1	1.33±0.58	13.30
7	MTU-7029	10	4	5	5	4.67±0.58	46.70
8	CR 2	10	1	0	1	0.67±0.58	6.70
9	Prasd	10	2	1	2	1.67±0.58	16.70
10	Sweta	10	4	4	5	4.33±0.58	43.30
11	Annapurna	10	6	8	7	7.00±1.00	70.00
12	Narendra-2	10	1	2	1	1.33±0.58	13.30
13	IET-2969	10	7	6	7	6.67±0.58	66.70
14	IR-597	10	1	1	2	1.33±0.58	13.30
15	N-18	10	1	0	1	0.67±0.58	6.70
16	OC-1339	10	1	2	2	1.67±0.58	16.70
17	Pusa NR-381	10	3	2	2	2.33±0.58	23.30
18	Cross-116	10	2	1	2	1.67±0.58	16.70
19	Nagina-22	10	9	8	8	8.33±0.58	83.30
20	Narendra-80	10	3	3	3	3.00±0.00	30.00
21	CR-126	10	9	8	8	8.33±0.58	83.30
22	Narendra Dhan-97	10	3	2	3	2.67±0.58	26.70
23	Jalnidhi	10	2	2	3	2.33±0.58	23.30
24	Jallahari	10	2	2	4	2.67±1.15	26.70
25	Cauvery	10	8	8	9	8.33±0.58	83.30

Table 6. Screening of disease resistant varieties against *H. oryzae* in field condition session 2015

S. no.	Varieties	Total no. of seeds	Infected plant of paddy in field			Mean±SD	D I
			F 1	F 2	F 3		
1	IET-849	320	94	97	94	95±1.73	29.69
2	Rupali	320	135	136	137	136±1.00	42.50
3	NDR-359	320	18	19	17	18±1.00	5.62
4	CR 1	320	14	16	15	15±1.00	4.69
5	PR-103	320	45	47	46	46±1.00	14.37
6	IR-36	320	43	38	42	41±2.64	12.81
7	MTU-7029	320	144	148	143	145±2.64	45.31
8	CR 2	320	15	17	16	16±1.00	5.00
9	Prasd	320	38	42	40	40±2.00	12.50
10	Sweta	320	146	147	145	146±1.00	45.62
11	Annapurna	320	210	211	215	212±2.64	66.25
12	Narendra-2	320	45	47	46	46±1.00	14.37
13	IET-2969	320	209	211	210	210±1.00	65.62
14	IR-597	320	41	43	42	42±1.00	13.12
15	N-18	320	22	23	21	22±1.00	6.87
16	OC-1339	320	41	43	42	42±1.00	13.12
17	Pusa NR-381	320	76	75	74	75±1.00	23.47
18	Cross-116	320	44	43	42	43±1.00	13.44
19	Nagina-22	320	270	269	268	269±1.00	84.06
20	Narendra-80	320	94	96	95	95±1.00	29.69
21	CR-126	320	263	268	264	265±2.64	82.81
22	Narendra Dhan-97	320	87	88	86	87±1.00	27.19
23	Jalnidhi	320	80	84	79	81±2.64	25.31
24	Jallahari	320	88	90	86	88±2.00	27.50
25	Cauvery	320	264	263	265	264±1.00	82.50

Table 7. Screened varieties against *H. oryzae* in laboratory, pot and field condition session 2014 and 2015

S. no.	Host response level of resistance	Range of D I (%)	Session 2014 and 2015		
			Laboratory condition	Pot condition	Field condition
1	Highly resistant	0-10	NDR-359, CR 1, CR 2, N-18	NDR-359, CR 1, CR 2, N-18	NDR-359, CR 1, CR 2, N-18
2	Resistant	11-20	PR-103, IR-36, Prasd, Narendra-2, IR-597, OC-1339, Cross-116	PR-103, IR-36, Prasd, Narendra-2, IR-597, OC-1339, Cross-116	PR-103, IR-36, Prasd, Narendra-2, IR-597, OC-1339, Cross-116
3	Moderately resistant	21-40	IET-849, Pusa NR-381, Narendra-80, Narendra Dhan-97, Jalnidhi, Jallahari	IET-849, Pusa NR-381, Narendra-80, Narendra Dhan-97, Jalnidhi, Jallahari	IET-849, Pusa NR-381, Narendra-80, Narendra Dhan-97, Jalnidhi, Jallahari
4	Moderately susceptible	41-60	Rupali, MTU-7029, Sweta,	Rupali, MTU-7029, Sweta	Rupali, MTU-7029, Sweta
5	Susceptible	61-80	IET-2969, Annapurna	IET-2969, Annapurna	IET-2969, Annapurna
6	Highly susceptible	81-100	Nagina-22, CR-126, Cauvery	Nagina-22, CR-126, Cauvery	Nagina-22, CR-126, Cauvery

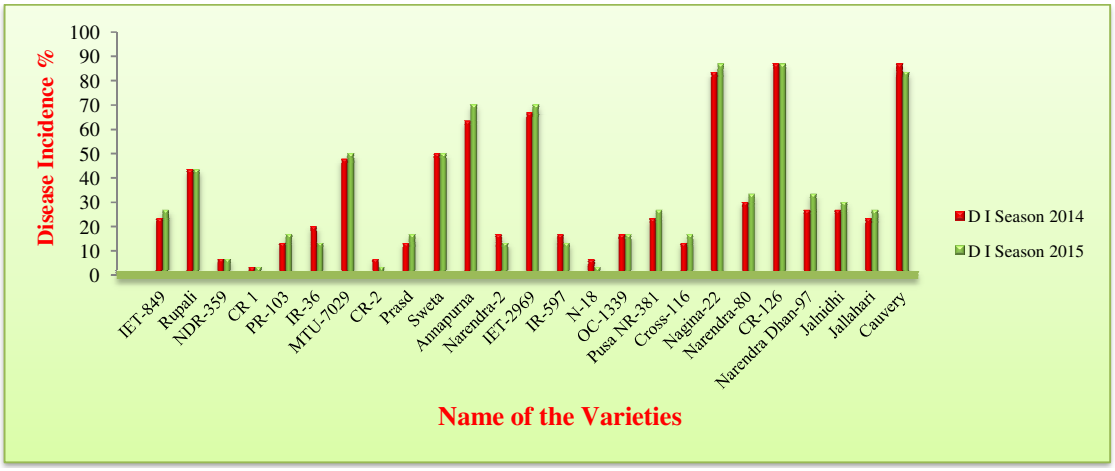

Fig. 1. Disease incidence level in laboratory condition season 2014 and 2015

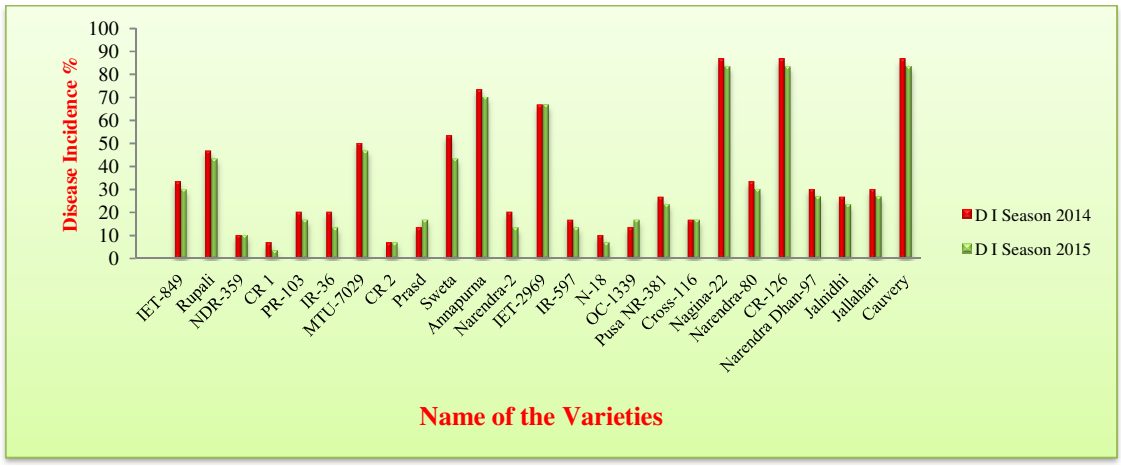

Fig. 2. Disease incidence level in pot condition season 2014 and 2015

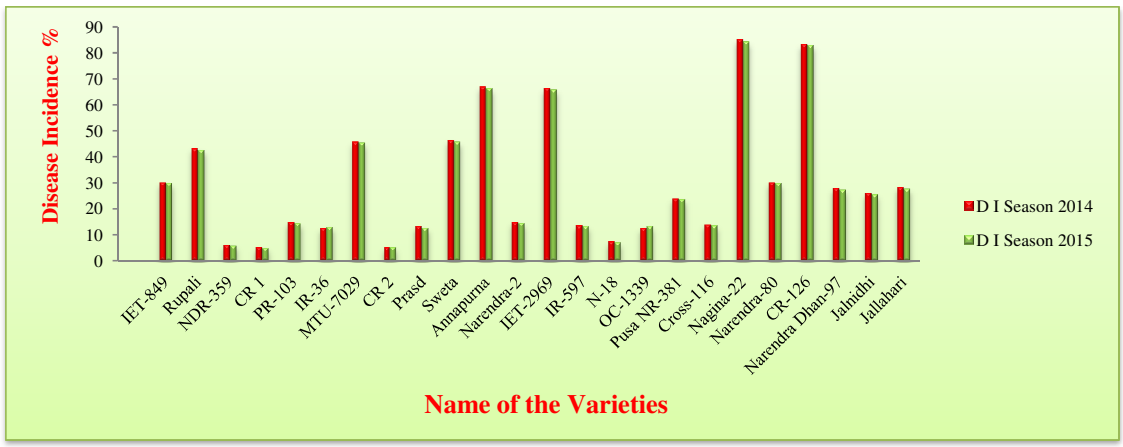

Fig. 3. Disease incidence level in field condition season 2014 and 2015

Similar results were also reported by [18] screened 23 genotypes during 1990 and 1991 that 19 genotypes were highly resistance and 3 resistant to leaf and neck blast caused by *Pyricularia oryzae*. [7] screened 39 (course) and 40 (fine) entries/varieties for three years from Rice Research Institute Kala Shah Kaku and NIAB, Faisalabad. The screening revealed that amongst the course entries/varieties like IR-6 and KS-282 were found highly resistant in 1998 and resistant in 1999 and 2000 while on over all basis IR-8, DR-82 and DM- 15-1-95 were found resistant in the entire test. Similar results were also reported by [27] in screening of twenty five rice germplasm lines and found that two lines KSK-282 and IRRI-6 were highly resistant. The screening of rice germplam against the blast disease was also carried out in other rice growing countries. [28] in screening trials at Bangladesh reported that among twenty eight restored line and four standard checks, three were highly resistant, 12 resistant, 16 moderately susceptible. [23] developed methods for screening of 437 upland genotype from Indonesia (IAT), Colombia and IRRI (Philippines) for resistance to *Pyricularia oryzae* six times within two years and found that 176 genotype were highly resistant while other had low to high susceptibility to rice blast disease.

5. CONCLUSION

In view of present investigation, it provides a useful information to the farmers by which they can use these varieties which are resistant to brown leaf spot disease of paddy in Allahabad region. This may increase the productivity and save the economy of farmers.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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