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Evaluations on Resistance Genotypes against Wilt of Linseed Caused by *Fusarium oxysporum* Schlecht. Ex. fr. f. sp lini. (Bolley) Synder and Hansen

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A B S T R A C T

Linseed is commonly known as "*Ulsee*" or "*Tisee*" (*Linum usitatissimum* L.). Wilt of linseed caused by *Fusarium oxysporum* f. sp lini. pathogens, and screened out against this fungus. Out of 200 genotypes screened, three lines namely, LCK-6028,PKDL-71,T-397 showed no wilting (0.00%) during both the years of testing and were rated as highly resistant, While, 2 genotypes namely SLS-58 and NDL-2004-5 showed less than 5% wilting and rated as resistant(R). 12 genotypes namely Kiran, LMS-23-06, BAU-610-A, Polf-19, H-15, BAU-2K-20, NL-165, BAU-04-07, PKDL-58, NDL-05, LMS-95-4 and RKD-1 showed less than 15% wilting rated as moderately resistant. Besides these, 41 lines were rated moderately susceptible, 38 susceptible and 104 highly susceptible.

Introduction

Linseed commonly known as "*Ulsee*" or "*Tisee*". (*Linum usitatissimum* L.) (2n = 30) belongs to the family Linaceae is second commercially most important *rabi* oil seed crops after rape seed mustard in area as well as in production one. The two products of seed are linseed oil and linseed meal. The oil and protein percent in seed of linseed varies from 37.8 to 43.2% and 20.00 to 24.8% respectively. Globally linseed productivity is 1006 kg/ha While our national productivity is 449 kg/ha. (Anonymous- 2012). In our country, Madhya Pradesh leads in both (Yield 0.328 lakh tonnes and acreage 1.044 lakh ha) followed by Uttar Pradesh (yield 0.271 lakh tonnes and acreage 1.080 lakh ha). In Uttar Pradesh the productivity is 251 kg/ha (Anonymous, 2012).Thus linseed is a multipurpose crop and every effort should be taken to boost up the production of this valuable crop. The production of this important oil and fibre yielding crop is very low in India. Amongst the various factors responsible for lowering down its yield, the diseases especially those caused by fungi are considered to be the major one. The important diseases affecting crops are Alternaria blight, powdery mildew, rust and wilt. Consequent upon continuous cropping of linseed in same marginalized field, year after year, soil becomes sick with root rot (*Rhizoctonia* spp., *Pythium* spp., *Fusarium* spp.) and wilt [*Fusarium oxysporum* Schlecht. Ex. fr. f. sp lini. (Bolley) Synder and Hansen] pathogens, resulting in partial or total yield loss due to these diseases (Kolte and Fitt, 1997; Sharma *et al.*, 2002).

Seed treatment (Singh *et al.*, 2005) manages only early root rot and wilt and varieties (Sharma *et al.*, 1972) tend to lose their resistance due to variation in pathogen population. Therefore, keeping in view the importance of the crop and seriousness of the disease the present investigation is Identification of resistant sources.

Materials and Methods

Collection of diseased material

Naturally affected plants of linseed showing symptoms of wilt disease were collected during *rabi* 2010-11 from Genetics and Plant Breeding, Farm N. D. University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.). Such affected plants were brought to the laboratory and critically examined for the presence of causal organism. The freshly collected diseased materials were used for isolation of the pathogen.

Preparation of culture media

Modified Czapek-Dox-Agar medium was used for isolation of Fusarium wilt pathogen using method of Singh and Chaube (1970). Potato-Dextrose-Agar medium was used for maintaining of pure culture of the wilt pathogen.

Isolation and purification of pathogen

The diseased plants of linseed were collected from the experimental plots of Genetics and Plant Breeding Farm of N. D. Uni. of Agri. and Tech., Narendra Nagar (Kumarganj), Faizabad (U.P.). The causal organisms were isolated from affected roots of linseed plants. The affected roots were first washed in tap water to remove dust particles and then thoroughly washed with sterilized water in order to remove the surface contaminants. Instruments to be used were sterilized by using 95 per cent methylated alcohol. Small pieces of diseased portion along with healthy parts were cut into pieces with a sterilized blade.

The cut pieces were surface sterilized with 0.1 per cent mercuric chloride solution under aseptic conditions inside the laminar flow and washed thoroughly 3-4 times with sterilized water to remove the traces of mercuric chloride. Excess moisture was removed by placing them in the fold of sterilized blotting papers. These pieces were transferred to 2 per cent Potato Dextrose Agar (PDA) medium in 90 mm Petridishes, previously autoclaved at 15 p.s.i. for 20 minutes with the help of sterilized needles.

The petridishes were then transferred at 28±2 ^{0}C temperature for 7 days in B.O.D. incubator. These incubated plates were observed for mycelial growth of the causal fungus after 24 hours of inoculation daily once till the growth of the fungus was noted. As soon as the mycelial growth was visible around these pieces the hyphal tips from the advancing mycelium were cut and transferred into the culture tubes containing Potato-Dextrose Agar medium for further purification, identification and maintenance of culture. The pure culture of fungus was obtained by adopting single spore techniques (Choi, Y.W 1999).

Pure culture of the pathogen and Pathogenicity test

The purification of fungal isolates was taken following single spore isolation technique (Choi, 1999). Reported these cultures were sub cultured at monthly intervals and maintained on Potato-Dextrose-Agar slants under refrigeration at 6 to 8 ^{0}C for further studies.

Pathogenicity test of the isolate obtained from affected linseed roots was done on the same host to establish the pathogenic nature of the fungus. The experiment was carried out in pots (30 cm diameter) filled with approximately 5 kg sterilized soil (autoclaved at 1.10 kg/cm^2 pressure for 2 hrs.) which were previously washed with 5.0 per cent solution of formalin. The inoculum was prepared by growing the pure culture of *Fusarium oxysporum* f. sp. *lini* on sand corn meal (9:1) medium in 250 ml conical flasks and autoclaved at 15 p.s.i. for 30 minutes.

Each flask was then inoculated with pure culture of *Fusarium oxysporum* f. sp. *lini* and incubated at room temperature (approximately 28-30 ^{0}C) for 15 days. Inoculation of soil was done 7 days before sowing by thoroughly mixing soil with fungus culture grown on sand corn meal medium in separate pots.

The culture was added at the rate of 5 per cent of the weight of soil in the pots. Controlled pots were filled with soil, without adding inoculum. Healthy and surface sterilized seeds of the linseed variety 'Chambal' were first disinfected with 0.1 per cent mercuric chloride solution for 3 minute and then rinsed with sterilized water, dried and were sown in the pots. The pots were then inoculated under aseptic conditions in glass house at 28 ±1 ^{0}C and irrigated regularly once every day to maintain sufficient moisture.

In control pots, sterilized sand, corn meal medium without fungal inoculum was mixed and surface sterilized seeds of 'Chambal' were sown in pots. The pots kept in glass house were observed critically for seedling emergence and wilt incidence upto 60 days of sowing. After germination plants were observed daily for development of symptoms and confirming Koch's postulates.

Evaluation of linseed genotypes against *Fusarium* wilt in sick field

The study was conducted in the wilt sick plot at Genetics and Plant Breeding Farm of Narendra Deva University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during *rabi.* 2010-11 and 2011-12 to identify resistant sources against the pathogen causing wilt in linseed.

Two hundred genotypes (BAU-06-08, NDL-2005-17, LCK-8012, SLS-75, NL260, RLC-120, NDL-2005-26, RLC-122, PCL-01-06, SLS-77, LMS-23-06, RLC-16, LCK-8029, SLS- 74, RL-6016, PKDL-62, PKDL-65, PCL-12-03-06, Kiran, ORRAS-07, LCK-6028, OCL-99- 57, PKDL-71, LCK-7034, LCP-1, RLC-115, OHKS-01-07, RLC-112, RLC-121, LCP-146, LMS-2007-01, OHVM-07, LBR-06, LDCP-09, NDL-2005-24, RLC-117, Gaurav, RRN-5, RL-2600, JLT-315, RL-27106, LCK-8007, NDL-2005-34, LC-2279-4, BAU-06-05, OAS-01-07, OAS-02-07, OHKS-02-07, OVVM-07, RRN-07, LCP-147, JLT-204, BAU-06-17, KL-219, LCK-7035, SLS-76, LCK-7002, RJK-25, Polf-17, JRF-3, LCK-9436, RJK-26, A-202, Parvati, RJK-27, RJK-21, LMS-23-06, RJK-30, RJK-31, BAU-610A, Polf-29, Polf-34, RJK-32, Polf-19, JRF-1, RJK-33, RJK-34, RLC-107, RJK-35, RLC-125, RJK-36, RJK-37, RL-99-19, NL-126, RKD-3, RKD-4, Surabhi, RKD-5, AB-LCP-147, H-15, RLC-95, NDL-2005-16, Gonali, BAU-2K-20, LCK-4036, NL-157, NDL-202, BAU-07-07, PKDL-62, RKD-6, Meera, NL-165, NL-119, RLC-186, PKDL-73, SLS-58, JLT-206, RKJ-11, RLC-102, RRN-2, LCK-5005, EC-41590, LCK-7002, Polf-15, RRN-04, PKDL-20, LMS-03, SLS-67, SLS-71, RKD-02, BAU-04-07, RJK-41, RKD-7, LCK-4028, RKD-8, RL-2600, Sikha, RLC-106, BAU-9910, LMS-49-2K, LMS-23-2K, SLS-68, RKJ-18, EC-22799, Polf-23, PKDL-43, EC-520246, RJK-43, LMSP-05, EC-44, RLC-85, PKJ-23, PKJ-9, RJK-10, Polf-5, LMS-125-4, RJK-40, LMS-149-4, OL-98-13-9, SLS-131, RRN-03, BAU-08-07, PCL-35-06, PKDL-52, RJK-38, OLC-11, PKDL-21, PKDL-42, PKDL-75, EC-520247, PKDL-41, PKDL-55, PKDL-64, RJK-45, RJK-39, LCK5021, PKDL-58, LMS-2007, RL-27035, PKDL-44, OLC-10, NDL-05, NDL-2004-05, PKDL-74, PKDL-72, BAU-2K-17, JLT-118, RRN-06, RLC-100, LCK-5002, SLS-61, LSM-95-04, RL-26028, RJK-44, NL-142, LMS-6-12-A, KL-215, SLS-72, RKD-01, PKDL-18, RL-27039, PKDL-23, SLS-73, RJK-28, RJK-29, RL-9933, T-397, RLC113, RJK-42, AND RL-99-26), were screened in well-developed wilt sick field. Each genotypes were sown in 3 meter long paired row, including susceptible check 'Chambal' after five test entries. Ayogi resistant check and Garima local check were also planted after every 10 entries. After complete germinations, the total numbers of plants in each row were counted for initial plant stand. Wilt incidence was observed frequently, at 15 days interval in each variety. The final wilt incidence was calculated by deducting the number of plants survived from the initial plant stand and converted into percentage using the formula given as below-

$$\left[\text{Percent wilt incidence} = \frac{\text{No. of wilted plants}}{\text{Total no. of plants}} \times 100\right]$$

The promising genotypes were placed in various categories of resistance and susceptibility on the basis of standard rating scale for *Fusarium* wilt as described by Sharma *et al.*, (1972) given as under (Table 2).

Studies on symptom

Wilt of linseed caused by *Fusarium oxysporum* f. sp. *lini* is one of the important disease of linseed growing areas. The pathogen can attack at any stage of crops (Figs. 1 and 2). Consequent upon continuous cropping of linseed in same marginalized fields, year after year, soil become sick with root-rot and wilt pathogens resulting in partial to total yield loss due to this disease. Most of the verities have become susceptible to this disease and suffer a lot with view to search the resistant sources, of a evaluation of botanicals against disease causing pathogen and eco-friendly management of disease under sick field condition, the following experiments was conducted and result are being presented. The plants were attack during all stages of their growth. Seedling wilt phase occurs after the third week of sowing when temperature is high. Affected seedling show drooping of the leaves and paler colour than healthy ones. Whole seedling collapsed and lies flat on the ground. Affected seedling did not show any rottings on stem or root surface, but such roots when splits open vertically from the collar region to down word, showed brown discoloration of the internal tissues. In case of adult plants, initial symptoms appeared as ill-defined dark green or brownish spots on leaves which later turned yellow from the edge and then become brown and withered. Drooping and death of plants followed. Root of the wilted plants showed no internal rotting, drying or discoloration. Root and stem of wilted plants when split vertically showed internal discoloration of the pith and xylem. The older plants, unlike seedlings, do not usually fell down and decayed, but remained standing even after death and dried up leaves often fell down leaving. In some cases primary stem died and apparently healthy lateral branches developed from the first node. Partial wilting was also noted in some entries.

Results and Discussion

Evaluation of linseed genotypes against *Fusarium* wilt in sick field

Per cent wilting in different test entries ranged from zero to 100.00 per cent during 2010-11 and zero to 92.50 per cent during 2011-12 respectively. Out of 200 genotypes screened, 3 lines namely, LCK-6028, PKDL-71 and T-397 showed no wilting (0.00%) and 2 entries viz: SLS-58 and NDL-2004-05 during both the years of testing showed more than 1 to less than 5% wilting.While 12 entries such as, Kiran, RLC-107, BAU-610-A, Polf-19, H-15, BAU-2K-20, NL-165, BAU-04-07, PKDL-58, NDL-05, LMS-95-4, RKD-1, showed more than 5% and less than 15% wilting. Rest of the entries showed variable percentage of wilting ranging from more than 16 to 100 per cent during both the years. Resistant check Ayogi showed zero to 4.50% wilting while commercially grown cultivar Garima showed 50.75 to 60% wilting. The susceptible check Chambal showed 85.50 to 100% wilting in experimental plot during both the years (Table 1).

The tested genotypes were found variable in per cent wilting under sick field condition during both the years of the testing. Based on maximum wilting percentage of both the year, the genotypes were categories in different susceptibility and resistant groups.

Fig.1 Wilt of linseed sick plot

Fig.2 Pathogenicity test

Table.1 Evaluation of linseed genotypes against *Fusarium* wilt in sick field

S.No.	Genotypes	Per cent plant wilted		Mean
		2010-2011	2011-12	
1	BAU-06-08	56.66	50.00	53.33
2	NDL-2005-17	88.88	60.00	74.44
3	LCK-8012	58.33	46.66	52.49
4	SLS-75	59.52	40.00	49.76
5	NL-260	61.53	50.00	55.76
6	RLC-120	33.84	30.00	31.92
7	NDL-2005-26	95.45	85.00	90.22
8	RLC-122	46.00	35.55	40.77
9	PCL-01-06	97.50	70.00	83.75
10	SLS-77	50.00	43.33	46.66
11	LMS-23-06	23.52	18.66	21.09
12	RLC-116	59.18	47.50	53.34
13	LCK-8029	48.88	35.45	42.16
14	SLS-74	93.33	80.00	86.66
15	RL-6016	69.69	66.66	68.17
16	PKDL-62	64.44	50.00	57.22
17	PKDL-65	46.66	34.11	40.38
18	PCL-12-03-06	25.00	20.50	22.75
19	Kiran	15.25	10.50	12.87
20	ORRAS-07	100.00	80.55	90.27
C_1	Chambal	100.00	99.00	99.50

C_2	Ayogi	0.00	1.50	o.75
C_3	Garima	58.00	60.00	59.00
21	LCK-6028	0.00	0.00	0.00
22	OLC-99-57	45.00	30.00	37.50
23	PKDL-71	0.00	0.00	0.00
24	LCK-7034	48.07	46.66	47.36
25	LCP-1	33.33	27.50	30.41
26	RLC-115	78.42	60.00	69.21
27	OHKS-01-07	85.00	55.00	70.00
28	RLC-112	58.33	46.66	53.49
29	RLC-121	88.00	76.66	82.33
30	LCP-146	46.77	35.00	48.88
31	LMS-2007-01	56.66	40.00	48.33
32	OHVM-07	62.85	50.00	56.42
33	LBR-06	27.77	26.66	27.01
34	LDCP-09	82.85	76.08	79.46
35	NDL-2005-24	92.45	65.55	79.00
36	RLC-117	85.00	70.00	77.50
37	Gaurav	96.15	66.66	81.40
38	RRN-5	78.26	80.00	79.13
39	RL-2600	87.17	81.25	84.21
40	JLT-215	30.00	24.73	27.36
C_1	Ayogi	0.00	0.00	0.00
C_2	Chambal	100.00	100.00	100.00
C_3	Garima	56.50	55.00	55.75
41	RL-27106	90.00	92.50	91.25
42	LCK-8007	88.09	80.00	84.04
43	NDL-2005-34	70.00	74.54	72.27
44	LC-2279-4	76.00	80.00	78.00
45	BAU-06-05	68.96	75.00	71.98
46	OAS-01-07	30.77	33.33	32.05
47	OAS-02-07	72.00	91.11	81.55
48	OHKS-02-07	88.00	83.33	85.66
49	OVVM-07	82.85	78.33	80.59
50	RRN-07	87.30	80.00	83.66
51	LCP-147	77.82	60.00	68.91
52	JLT-204	62.85	53.00	57.92
53	BAU-06-17	28.57	15.00	21.78
54	KL-219	27.82	25.71	26.76
55	LCK-7035	76.19	60.00	68.09
56	SLS-76	61.29	56.66	58.97
57	LCK-7002	86.66	66.66	76.66
58	RJK-25	46.66	30.00	38.33
59	Polf-17	37.50	23.33	30.41
60	JRF-3	38.00	20.00	29.00

C_1	Garima	58.50	60.00	59.25
C_2	Ayogi	1.50	2.00	1.75
C_3	Chambal	99.78	98.50	99.14
61	LCK-9436	52.22	38.88	45.55
62	RJK-26	53.75	35.71	44.73
63	A-202	85.00	76.66	80.83
64	Parvati	40.83	37.50	39.16
65	RJK-27	56.66	46.66	51.66
66	RJK-21	80.00	54.28	67.14
67	NDL-2005-29	27.46	20.00	23.73
68	RJK-30	43.18	35.71	39.44
69	RJK-31	23.33	16.66	19.99
70	BAU-610A	10.75	8.50	9.62
71	Polf-29	12.27	15.11	13.69
72	Polf-34	29.18	23.20	26.19
73	RJK-32	20.00	15.88	17.94
74	Polf-19	6.6	10.94	8.77
75	JRF-1	12.50	18.33	15.41
76	RJK-33	23.00	22.22	22.61
77	RJK-34	28.46	21.53	24.99
78	RLC-107	5.00	7.50	6.25
79	RJK-35	20.00	15.29	17.64
80	RLC-125	52.63	31.48	42.05
C_1	Chambal	95.00	98.00	96.50
C_2	Garima	55.00	58.00	56.50
C_3	Ayogi	2.50	2.00	2.25
81	RJK-36	17.77	15.55	16.66
82	RJK-37	22.00	28.33	25.16
83	RL-99-19	96.15	56.00	76.07
84	NL-126	16.00	13.00	14.50
85	RKD-3	70.00	50.00	60.00
86	RKD-4	65.00	44.44	79.72
87	Surbhi	70.00	62.02	66.01
88	RKD-5	92.50	87.14	89.82
89	AB-LCP-147	35.71	52.44	34.07
90	H-15	15.00	10.50	12.75
91	RLC-95	42.30	34.07	38.18
92	NDL-2005-16	51.21	40.00	45.60
93	Gonali	100.00	83.33	91.66
94	BAU-2K-20	10.34	8.57	9.45
95	LCK-4036	37.00	17.00	27.00
96	NL-157	63.95	54.54	59.24
97	NDL-202	26.00	13.75	19.87
98	BAU-07-07	48.08	43.33	45.96
99	PKDL-62	56.87	53.96	55.41

100	RKD-6	96.66	89.28	92.97
C_1	Garima	58.00	60.00	59.00
C_2	Chambal	90.00	85.50	87.75
C_3	Ayogi	3.00	4.50	3.75
101	Meera	44.11	25.00	34.55
102	NL-165	11.11	10.25	10.68
103	NL-119	60.00	53.24	56.22
104	RLC-186	67.00	52.33	59.66
105	PKDL-73	29.30	29.80	29.55
106	SLS-58	5.00	1.00	3.00
107	JLT-206	20.00	15..30	7.65
108	RKJ-11	52.33	45.88	49.10
109	RLC-102	46.00	36.00	41.00
110	RRN-2	38.52	37.50	38.01
111	LCK-5005	72.85	58.49	65.67
112	EC-41590	59.09	46.21	52, 65
113	LCK-7002	68.00	49.47	58.73
114	Polf-15	19.16	10.00	14.58
115	RRN-04	20.83	15.00	17.91
116	PKDL-20	95.65	63.92	79.78
117	LMS-03	51.78	37.54	44.66
118	SLS-67	86.25	89.18	87.71
119	SLS-71	85.55	76.25	80.90
120	RKD-02	60.00	23.25	41.62
C_1	Chambal	98.88	99.47	99.18
C_2	Ayogi	2.00	1.50	1.75
C_3	Garima	52.00	55.00	53.50
121	BAU-04-07	12.72	7.50	10.11
122	RJK-41	15.75	5.55	10.65
123	RKD-7	85.71	46.15	65.93
124	LCK-4028	29.41	23.68	26.54
125	RKD-8	93.33	50.00	71.66
126	RL-2600	27.17	11.00	19.08
127	Sikha	53.75	25.00	39.37
128	RLC-106	22.00	18.00	20.00
129	BAU-9910	10.00	15.96	12.98
130	LMS-49-2K	72.00	16.27	44.13
131	LMS-23-2K	86.36	75.00	80.68
132	SLS-68	40.00	20.00	30.00
133	RKJ-18	50.00	44.00	47.00
134	EC-22799	85.00	76.92	80.96
135	Polf-22	23.33	20.00	21.66
136	PKDL-43	27.77	25.15	26.46
137	EC-520246	31.66	25.00	28.33
138	RJK-43	88.75	87.17	87.96

139	LMSP-05	60.00	70.00	65.00
140	EC-44	35.00	30.67	32.83
C_1	Ayogi	1.00	1.50	1.25
C_2	Chambal	99.98	99.87	99.93
C_3	Garima	55.00	58.00	56.50
141	RLC-85	35.71	25.55	30.63
142	PKJ-23	48.75	42.00	45.37
143	RKJ-9	56.00	40.00	48.00
144	RKJ-10	59.09	40.00	49.54
145	Polf-5	31.25	23.33	27.29
146	LMS-125-4	80.00	71.42	75.71
147	RJK-40	85.45	62.50	73.97
148	LMS-149-4	95.00	80.00	87.50
149	OL-98-13-9	76.66	67.50	72.08
150	SLS-131	63.75	66.66	65.20
151	RRN-03	43.33	45.00	44.16
152	BAU-08-07	48.57	41.00	44.78
153	PCL-35-06	47.77	29.09	38.43
154	PKDL-52	30.00	20.00	25.00
155	RJK-38	20.65	16.00	18.32
156	OLC-11	70.00	54.00	62.00
157	PKDL-21	68.00	60.00	49.00
158	PKDL-42	46.00	40.00	43.00
159	PKDL-75	97.82	75.00	86.41
160	EC-520247	65.00	57.14	61.07
C_1	Chambal	98.99	97.89	98.44
C_2	Garima	52.50	50.75	51.63
C_3	Ayogi	1.50	2.50	2.00
161	PKDL-41	54.09	40.00	47.04
162	PKDL-55	52.00	46.66	49.33
163	PKDL-64	26.02	20.00	48.02
164	RJK-45	51.25	33.07	42.16
165	RJK-39	19.56	15.00	17.28
166	LCK-5021	30.00	24.28	27.14
167	PKDL-58	14.28	10.00	12.14
168	LMS-2007	45.00	38.00	41.50
169	RL-27035	80.00	62.85	71.42
170	PKDL-44	36.66	42.10	36.38
171	OLC-10	31.66	20.00	25.83
172	NDL-05	14.28	9.09	11.68
173	NDL-2004-05	5.00	4.50	4.75
174	PKDL-74	16.66	20.00	18.33
175	PKDL-72	51.08	11.76	31.42
176	BAU-2K-17	15.75	10.45	13.10
177	JLT-118	23.07	23.33	23.20

178	RRN-06	63.33		55.55	59.44
179	RLC-100	86.66		50.00	68.33
180	LCK-5002	80.00		76.92	78.46
C_1	Garima	55.00		58.00	56.50
C_2	Chambal	99.80		99.89	99.85
C_3	Ayogi	0.75		1.50	1.13
181	SLS-61	68.59		58.88	63.73
182	LSM-95-04	14.66		10.52	12.52
183	RL-26028	50.90		44.61	47.75
184	RJK-44	52.27		45.00	48.63
185	NL-142	90.00		82.35	86.17
186	LMS-6-12-A	73.33		62.22	67.77
187	KL-215	30.00		27.27	28.63
188	SLS-72	76.38		65.38	70.88
189	RKD-01	11.42		15.00	13.21
190	PKDL-18	82.00		92.18	87.09
191	RL-27039	69.04		80.00	88.02
192	PKDL-23	27.14		25.55	26.34
193	SLS-73	37.14		30.00	33.57
194	RJK-28	63.63		58.46	61.04
195	RJK-29	52.50		45.55	44.02
196	RL-9933	90.00		66.36	78.18
197	T-397	0.00		0.00	0.00
198	RLC-113	25.00		14.73	19.86
199	RJK-42	91.42		79.41	85.41
200	RL-99-26	100.00		80.00	90.00
C_1	Ayogi	1.50		2.00	1.75
C_2	Chambal	99.78		98.50	99.14
C_3	Garima	52.00		55.00	53.50
		2010-11		**2011-12**	
		SEm±	**CD at 5%**	**SEm±**	**CD at 5%**
Un replicated of same block		4.09	9.22	5.36	12.12
Un replicated treatment of diff. block		4.99	11.29	6.57	14.85
Un replicated treatment vs Check		5.24	11.85	6.89	15.58

Table.2 Reaction of genotypes against *Fusarium* wilt

Score	Reaction	Percent Mortality	No. of genotypes	Name of genotypes
0	HR	0	03	LCK-6028, PKDL-71, T-397
1	R	Upto-5	02	SLS-58, NDL-2004-5
2	MR	5-15	12	Kiran, RLC-107, BAU-610-A, Polf-19, H-15, BAU-2K-20, NL-165, BAU-04-07, PKDL-58, NDL-05, LMS-95-4, RKD-1

3	MS	15-30	41	LMS-23-06, PCL-12-03-06, LBR-06, JLT-215, BAU-06-17, KL-219, NDL 2005-29, RJK-31, Polf-29, Polf-34, RJK-32, JRF-1, RJK-33, RJK-34, RJK-35, RLC-125, RJK-36, RJK-37, NL-126, NDL-202, PKDL-73, JLT-206, Polf-15, RRN-4, RJK-41, LCK-4028, RL-2600, RLC-106, BAU-9910, Polf-22, PKDL-43, PKDL-52, RJK-38, PKDL-64, RJK-39, LCK-5021, PKDL-74, BAU-2K-17, JLT-118, PKDL-23, RLC-113
4	S	30-50	38	RLC-120, RLC-122, SLS-77, LCK-8029, PKDL-65, OLC-99-57, LCK-7034, LCP-1, LCP-146, OAS-01-07, RJK-25, Polf-17, JRF-3, Parvati, RJK-30, AB-LCP-147, RLC-95, LCK-4036, BAU-07-07, Meera, RLC-102, RRN-2, SLS-68, RJK-18, EC-520246, EC-44, RLC-85, PKJ-23, Polf-5, RRN-3, BAU-08-07, PCL-35-06, PKDL-42, LMS-2007, PKDL-44, OLC-10, KL-215, SLC-73,
5	HS	Above 50	104	BAU-06-08, NDL-2005, LCK-8012, SLS-75, NL-26, NDL-2005-26, PCL-01-06, RLC-116, SLS-74, RL-6016, PKDL-62, ORRAS-07, RLC-115, OHKS-01-07, RLC-112, RLC-121, LMS-2007-01, OHVM-07, LDCP-09, NDL-2005-24, RLC-117, Gaurav, RRN-5, RL-2600, RL-27106, LCK-8007, NDL-2005-34, LC-2279-4, BAU-06-05, OAS-02-07, OHKS-OL-07, OVVM-07, RRN-07, LCP-147, JLT-204, LCK-7035, SLS-76, LCL-7002, LCK-9436, RJK-26, A-202, RJK-27, RJK-21, RL-99-19, RKD-03, RKD-04, Surbhi, RKD-05, NDL-2005-16, Gonali, NL-157, PKDL-62, RKD-6, NL-119, RLC-186, RKJ-11, LCK-5005, EC-41590, LCK-7002, PKDL-20, LMS-03, SLS-67, SLS-71, RKD-2, RKD-7, RKD-8, Sikha, LMS-49-2K, LMS-23-2K, EC-22799, RJK-43, LMSP-5, RJK-9, RKJ-10, LMS-125-4, RJK-40, LMS-14-09-04, OL-98-13-9, SLS-31, OLC-11, PKDL-21, PKDL-75, EC-520-247, PKDL-41, PKDL-55, RJK-45, RL-27035, PKDL-72, RRN-6, RLC-100, LCK-5002, SLS-61, RL-26018, RJK-44, NL-142, LMS-6-12-A, SLS-72, PKDL-18, RL-27039, RJK-28, RJK-29, RL-9933RJK-42, RL-9926

HR= Highly resistant, R= Resistant, MR= Moderately resistant, MS=Moderately susceptible, S=Susceptible, HS= Highly susceptible

Out of 200 genotypes screened, three lines namely, LCK-6028, PKDL-71, T-397 showed no wilting (0.00%) during both the years of testing and were rated as highly resistant(HR), While, 2 genotypes namely SLS-58 and NDL-2004-5 showed less than 5% wilting and rated as resistant(R). 12 genotypes namely Kiran, LMS-23-06, BAU-610-A, Polf-19, H-15, BAU-2K-20, NL-165, BAU-04-07, PKDL-58, NDL-05, LMS-95-4 and RKD-1 showed less than 15% wilting rated as moderately resistant(MR). Besides these, 41 lines were rated moderately susceptible (MS), 38 susceptible(S) and 104 highly susceptible (HS) (Table 2). Singh and Singh (2011) also evaluated commercially grown cultivars namely Jawahar-23, Jeevan, Kiran, Padmini, R-552, Surbhi, Type-397 and Chambal against root-rot wilt disease under sick field condition for evaluation of their resistance and performance of yield at N.D.U.A. & T. Kumarganj Faizabad (U.P.).They reported Jeevan and Padmini as resistant, Jawahar-23, Kiran, Type-397, R-552 and Surbhi as moderately resistant. However, Jeevan gave highest yield (1118.05kg/ha) followed by Surbhi and Padmini. They again evaluated 280 genotype against the root rot–wilt complex and reported 10 genotype such as NP-19, NPRR-271, No-294, LC-2221, LMS-154-03, LMS-166-03, RLC-94, SLS-56, Ayogi and LMS-129-1 as resistant. Kishor *et al.*, (2011) collected a set of 78 germplasm from P.C. Unit (linseed) and screened in a highly wilt sick field of Nawabganj Research Farm of C.S.A. University of Agriculture & Technology, Kanpur during 2003-04 and 2004-05 cropping seasons against *Fusarium oxysporum* f.sp. *lini* and reported 26 genotypes *viz*., Ayogi, BAU-9906, BAU-2K-14, BAU-2K-15, DPL-19, EC-41656, 12BJP, Local, Jeevan, KI-1, KI-31, L-103, L-107, LC-2057, M-3, NL-14, No-7, NP (RR)-65, RLC-46, JLS-9, Padmini, Rashmi, R-552, Surabhi, Sweta, and T-397 as resistant. In present study LCK-6028, PKDL-71, T-397 was recorded highly resistant which supports the findings of Singh and Singh (2011) and Kishor *et al.*, (2011) and rest of the resistant lines are new record which may be used in breeding programme.

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