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Screening of linseed germplasms for resistance against Powdery Mildew caused by *Oidium lini* Skoric

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In the present study linseed germplasms were screened for powdery mildew (*Oidium lini* Skoric) resistance under filed condition. Powdery mildew disease significantly reduces the yield and quality of the seeds. Screening of broad ranged germplasms revealed that 17 germplasms (EC-41656, FR-3, Kanpur – 41/2, GS-232, LS-35, LCK-11, POLF-16, POLF-17, OR-1-4, S-801, JRF-1(8), S-91-26, RL- 903, Meera, EC-322646, UDN-55, IDSN-6) were highly resistant even after artificial inoculation, whereas 16 germplasms showed symptoms after the inoculation but the infection was not severe and recovery was rapid.

Key words: Germplasms, linseed, Powdery Mildew, resistant, screening

INTRODUCTION

Linseed (*Linum usitatissimum* L.) is an important oilseed crop grown for both seed and fiber. Almost every part of its plant is commercially utilized either direct or after processing. Its fiber is used in the manufacturing of canvas, cloth, water resistant pipes, paper and straw board. Linseed oil is used in the manufacturing of paints and varnish, oil cloth and linoleum (Hatim and Abbasi, 1994). It is next in importance to rapeseed-mustard grown during *rabi* season. In India it is grown on 3.59 lakh hectares contributing 1.47 lakh tons in production in the oilseed scenario of the country with a productivity level of 408 kg/ha. (2010-11) (Anon., 2012). On small scale, the seed and its oil are directly used for human consumption as flax seeds and other baked and fried foods stuffs by a small segment of population. Linseed is highly nutritious and a good source of complete protein (all 8 essential amino acids), high order linolenic acid (an essential polyunsaturated Omega-3 fatty acid), complex carbohydrates, vitamins and minerals. Recent advances in medical research have found linseed as best herbal source of Omega-3 and Omega-6 fatty acids which have immense nutritional / medicinal effect on human body system.

Linseed occupies an important position in India for its technical grade oil producing ability. Karnataka is eighth largest grower of linseed only after Madhya Pradesh, Chhattisgarh, Maharashtra, Uttar Pradesh, Jharkhand, Bihar and Odisha with an area of 11,000 ha. mainly as sole crop as well as intercrop with other *rabi* crops like sorghum, bengalgram, safflower and wheat producing about 4000 tones of seed with a productivity of 364 kg/ha (2010-11) (Anon., 2012). However, production

wise also Karnataka stands eighth position. As majority of farmers are growing their own local types only. A mere replacement of their material with elite varieties and management of biotic factor losses can boost the productivity to a considerable extent. Among the biotic factors powdery mildew is the most serious and devastating foliar disease in the Northern Karnataka. A white powdery, dust like coating on the leaves, stem as well as on the pods of mycelium and spores of the fungus *Oidium lini* Skoric characterize the disease. This disease is more prevalent in late sown crop, where it can limit the yields up to 60 per cent (Srivastava *et al.*, 1997).

The disease can be managed by fungicides but it is more expensive for the farmers. Therefore, there is a need to identify the resistant sources to develop varieties resistant to pests and diseases to stabilize the yield potentials of linseed variety. The manipulation of inherent potentials of plants in the form of resistant variety is a cheaper, viable and most environmental friendly alternate to reduce losses from biotic stresses.

MATERIALS AND METHODS

A field experiment was conducted to screen the 371 germplasms of linseed crop constitutes the different parts of the country under AICRP linseed trials (Table 1) to identify the sources for powdery mildew breeding programmes. All the 371 germplasms were sown during the first fortnight of November in order to coincide the crop flowering period with disease incidence. The germplasms were sown with 45 cm spacing between line and 10 cm spacing between plants and to facilitate the good inoculums to build up one resistant check (Sheela) and one susceptible check (Chambal) were sown for every 10 germplasms at AICRP linseed experimental block, Main Agricultural Research Station, Raichur during *rabi* 2011-12, the centre is also identified as hot spot for powdery mildew disease. The recommended packages of practice were followed to raise a good crop. The intensity of disease in the field was estimated from five randomly selected plants in each genotype which were tagged with labels at the flowering stage of the crop. On an average 10 leaves were selected at random from the selected plant and disease severity was recorded by visually examining each leaf and the disease severity was scored by using 0-5 scales and described as follows, (Anon., 2011).

Further, the per cent disease Index was calculated by using the formula given by Wheeler (1969), The germplasms which constitute the resistant group after screened during *rabi* 2011-12 were again screened in order to confirm the resistant sources during *rabi* 2012-13 at AICRP linseed experimental block, Main Agricultural Research Station, Raichur. The experiment was laid out in randomized complete block design with two replications with one resistant check (Sheela) and one susceptible check (Chambal) for every 10 rows. The powdery mildew mass of *Oidium lini* pathogen was collected from the susceptible variety and added to the 1 per cent sugar solution to prepare the inoculums, when the crop enters to flowering stage the artificial inoculation was carried out. After two days, artificial inoculation was also carried out with smearing off the infected plants to the germplasms. One week after the inoculation the germplasms were observed for disease severity as carried out during *rabi* 2011-12.

$$\text{Per cent disease severity} = \frac{\text{Sum of all observation grades}}{\text{Total number of plants observed}} \times \frac{100}{\text{Maximum grade}}$$

Grade	Disease severity	Reaction
0	Free from infection	High ly Resistance (HR)
1	0.1 to 10 per cent plants/ plant parts infected	Resistance (R)
2	10.1 to 25 per cent plants/plant parts infected	Moderately Resistance (MR)
3	25.1 to 50 per cent plants/plant parts infected	Moderately Susceptible (MS)
4	5 0.1 to 75 per cent plants /plant parts infected	Susceptible (S)
5	>75 per cent plants /plant parts infected	Highly Susceptible (HS)

RESULTS AND DISCUSSION

Powdery mildew symptoms started to appear in the first week of January and reached its peak by the end of January when all the plant parts of the susceptible check were severely infected up to 92 per cent. Of the total germplasms screened 23 per cent could not enter the reproductive phase, 85 germplasms failed to initiate flowering due to the severity. Of the 286 germplasms that initiated flowering, 243 completed flowering and 189 germplasms were succeeded in producing viable seeds, 33 of which were resistant, 115 were moderately resistant and 41germplasms were grouped as susceptible (Table 2). After the 120 days of sowing 33 germplasms (EC-41656, FR-3, Kanpur – 41/2, GS-232, LS-35, LCK-11, H-22, ILS-169, KL-31, KL-176, MS-4, EC-322646, SJKO-2, SJKO-6, SJKO-22, POLF-16, POLF-17, OR-1-4, S-801, JRF-1(8), S-91-26, RL- 903, Meera, RKY-2, RKY-9, POLF-30, UDN-19, UDN-55, UDN-66, IDSN-6, IDSN-7, IDSN-8 and IDSN-20) were resistant at maturity and produced fully filled pods with no empty locules.

To confirm the disease resistance, the resistance germplasms were sown during the *rabi* 2012-13 and were inoculated artificially in another set of experiment and observation were recorded on daily. Thirty three resistant germplasms were inoculated till development of symptoms or otherwise. After a week of inoculation nine germplasms *viz.*, H-22, ILS-169, KL-31, KL-176, MS-4, SJKO-2, UDN-66, IDSN-7 and IDSN-20 developed the symptoms, seven germplasms namely SJKO-6, RKY-2, SJKO-22, RKY-9, POLF-30, UDN-19 and IDSN-8 developed the disease after the second inoculation and remaining 17 germplasms (EC-41656, FR-3, Kanpur – 41/2, GS-232, LS-35, LCK-11, POLF-16, POLF-17, OR-1-4, S-801, JRF-1(8), S-91-26, RL- 903, Meera, EC-322646, UDN-55, IDSN-6) were remained resistant (Table 3). The highly resistant germplasms were suggested for use in breeding programme to develop resistant cultivars.

Powdery mildew causes qualitative as well as quantitative losses to crops (Reddy *et al.*, 2013). Conventional breeding can be an option for develop-

Table 1 : Details of linseed germplasm screening trials against powdery mildew

Trials	No. of germplasms						
	Total	HR	R	MR	MS	S	HS
Germplasms screening	200	0	26	63	85	21	5
Uniform Disease Nursery	66	0	3	21	24	12	6
Uniform Disease Nursery (Artificial)	31	0	0	4	14	8	5
Promising Entries	45	0	0	15	20	9	1
Initial Disease Screening Nursery	29	0	4	12	7	5	1
Total	371	0	33	115	150	55	18

Table 2 : Varied level reaction of linseed germplasms to the powdery mildew infection under field conditio

Vegetative Traits	Germplasms screened	Germplasms surviving	Survival %	Resistant	Moderately resistant	Susceptible
First flower initiation	371	286	77	41	138	107
Reached 100 % flowering	286	243	85	39	129	75
Reached to vegetative maturity	243	189	78	33	115	41

Table 3 : Response of 33 resistant germplasms to artificial inoculation by *Oidium lini* under field condition

Germplasms	Days after inoculation	Symptom appearance	Incidence of Powdery mildew (%)
EC-41656	At maturity	No	0
FR-3	At maturity	No	0
Kanpur – 41/2	At maturity	No	0
GS-232	At maturity	No	0
LS-35	At maturity	No	0
LCK-11	At maturity	No	0
POLF-16	At maturity	No	0
POLF-17	At maturity	No	0
OR-1-4	At maturity	No	0
S-801	At maturity	No	0
JRF-1(8)	At maturity	No	0
S-91-26	At maturity	No	0
RL-903	At maturity	No	0
H-22	7 days	Yes	6
ILS-169	7 days	Yes	8
KL-31	7 days	Yes	6
KL-176	7 days	Yes	5
MS-4	7 days	Yes	5
EC-322646	At maturity	Normal	0
SJKO-2	7 days	Yes	6
SJKO-6	12 days	Yes	9
SJKO-22	12 days	Yes	10
RKY-9	12 days	Yes	10
RKY-2	12 days	Yes	8
POLF-30	12 days	Yes	10
UDN-19	12 days	Yes	10
UDN-55	At maturity	No	0
UDN-66	7 days	Yes	6
IDSN-6	At maturity	No	0
IDSN-7	7 days	Yes	5
IDSN-8	12 days	Yes	10
IDSN-20	7 days	Yes	6
Meera	At maturity	No	0

ment of resistant cultivars if resistant sources are available. Among the resistant germplasms, 17 germplasms were highly resistant, and these could be used in breeding programs for development of disease-resistant and high-yielding varieties.

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