Abstract

The genetics of resistance against rust disease caused by *Melampsora lini* in linseed or flax was studied in F1, F2, BC1 and BC2 generations of a susceptible variety T-397, crossed with a resistant variety Surbhi. On the basis of the segregating ratio obtained in F2 and backcross generations of the cross, T-397 × Surbhi i.e., (3:1) in F2 and (1:1) in BC1 revealed that single dominant gene is responsible for resistance against rust in these linseed genotypes under study.

Keywords

Linseed, Rust, Inheritance, Resistance

Introduction

Linseed (*Linum usitatissimum* L.) belongs to the genus Linum is one of the earliest crop cultivated for its seeds and fibre. Almost every part of the linseed plant is utilized commercially either directly or after processing. Being an important oilseed crop, its average productivity in India is very low, because of various factors viz., narrow genetic base, non-availability of high yielding varieties and resistance to biotic and abiotic stresses, etc.

Rust, wilt, alternaria blight and powdery mildew are major diseases associated with it. Out of these diseases, rust is the most serious disease of linseed. *Melampsora lini* the fungal pathogen responsible for rust disease on flax is of interest for both economic and scientific reasons. It can cause severe losses in seed yield as well as reducing fibre quality in flax plants grown for linen production; From the scientific view point, *M. lini* came to prominence in 1942 when Harold Flor reported the results of an inheritance study which demonstrated that single allelic gene pairs determine the avirulence/virulence phenotype on host lines with particular resistance genes, which led him to propose his now famous ‘gene-for-gene’ hypothesis.
Since effective chemical control of this disease is not available, use of resistant cultivars have been suggested. The information on inheritance of the rust resistance is important to decide the breeding strategies in linseed crop therefore to breed stable resistant cultivars against rust it is imperative to know the genetics and gene responsible for resistance against this disease. Hence the present study was conducted to gather the information on underlying genetic mechanism of resistance of linseed plants to the pathogen, *Melampsora lini*.

Materials and Methods

During summer 2015 (off season) the cross (T-397 × Surbhi) was attempted at HAREC, Kukumseri (Lahaul & Spiti) to produce sufficient F₁ seed. In normal crop season at Palampur, i.e *rabi* 2015-16 the F₁s were advanced to F₂ and simultaneously F₁s were back crossed with the parents to generate BC₁ and BC₂. During off season in summer 2016 at HAREC, Kukumseri more F₁, BC₁ and BC₂ generations were generated, selfed to produce B₁s and B₂s. A field trial was conducted comprising of parents, F₁s, back crosses (BC1 and BC2) and F₂s in Compact Family Block Design with three replications during *rabi* 2016-17 in the Experimental Farm of Shivalik Agricultural Research and Extension Centre (SAREC), Kangra (H.P.). *As Kangra is the hot spot for linseed rust in Himachal Pradesh. The plot size consisted of row length of 2.5 m having row to row and plant to plant distance of 30 cm and 5 cm respectively. The non segregating generations (Parents and F₁s) were grown in single row of 2m length. The segregating F₂ generations were grown in six rows and BC₁ and BC₂, were grown in four rows. Scale by (Kumar and Gupta 1999) was used to evaluate linseed genotypes for disease reaction to rust.

Results and Discussion

In the present study single cross combination viz., T-397 x Surbhi was screened to study the inheritance against rust resistance at (SAREC) Kangra in artificial disease epiphytotic conditions which were created in experiments for the rust disease using “infector row technique” with T-397 (check variety) planted after every row of test material as well as on border around the field to maintain the effective inoculum load. In order to encourage disease pressure, artificial inoculation with spraying of spore suspension was also done, during *rabi* 2016-17.

| Grade | Disease (% area of leaves) | Symptoms | Disease reaction |
|-------|---------------------------|----------|-----------------|
| 0     | Free from disease         | No pustule formation | Highly resistant (HR) |
| 1     | 1 to 10                   | Few scattered and scanty pustules seen after careful searching | Resistant (R) |
| 2     | 11 to 25                  | Pustules common and seen early on plants | Moderately resistant (MR) |
| 3     | 26 to 50                  | Pustules very common | Moderately susceptible (MS) |
| 4     | 51 to 75                  | Pustules extensive on whole plant, defoliation and drying of leaves | Susceptible (S) |
Table 1 Disease reactions of parents their F₁’s and segregating generations of the linseed to rust (Melampsora lini)

| S.No. | Generations | Total no. of plants | No. of Observed plants | Ratio tested | No. of expected plants | Observed $\chi^2$ Value | P value |
|-------|-------------|---------------------|------------------------|--------------|------------------------|-------------------------|---------|
|       |             |                     | Resistance            | Susceptible  | Resistance             | Susceptible             |         |
| 1     | P₁          | 52                  | 0                      | 52           | -                      | -                       |         |
| 2     | P₂          | 45                  | 45                     | 0            | -                      | -                       |         |
| 3     | F₁          | 44                  | 44                     | 0            | -                      | -                       |         |
| 4     | BC₁         | 49                  | 26                     | 23           | 1:1                    | 24.5                    | 0.18    | 0.67   |
| 5     | BC₂         | 47                  | 47                     | 0            | -                      | -                       |         |
| 6     | F₂          | 164                 | 120                    | 44           | 3:1                    | 121.5                   | 0.40    | 0.53   |

The segregation of resistant and susceptible plants in F₂ generation of cross T-397 x Surghi, revealed the good fit to 3:1 ratio (Table.2). These results were confirmed by the back cross generations which fitted well to 1:1 ratio. This confirmed that a single dominant gene is responsible for resistance against rust. Earlier reported by Srinivasachar and Seetharam (1971), Kutuzova (1978), Kamthan et al., (1991) and Lawrence et al., (2007) resistance to rust governed by single dominant gene. The results on rust resistance inheritance are in conformity with earlier workers.

References

Kamthan KP, Shukla AK and Misra DP. 1991. Independent genetic resistance to wilt rust and powdery mildew in linseed. Agricultural and Biological Research 7: 56-60
Kumar A and Gupta TR. 1999. Resistant sources for linseed rust. Plant Disease Research 14: 90-91
Kutuzova SN. 1978. Genetic analysis of resistance to Melampsora lini (Ehrenb.) Lev. in fibre flax. Genetika 14: 1620-1624
Lawrence GJ, Dodds PN and Ellis JG. 2007. Rust of flax and linseed caused by Melampsora lini. Molecular Plant Pathology 8: 349–364
Srinivasachar and Seetharam. 1971. Induction of resistance to rust, Melampsora lini in flax, by gamma radiation. Radiation Botany 11: 143–144

How to cite this article:

Ritika Singh, Satish Paul, Sandeep Kumar and Ashok Kumar. 2019. Inheritance of Gene Conferring Resistance to Rust (Melampsora lini) Disease of Linseed (Linum usitatissimum L.) in North West Himalayas. Int.J.Curr.Microbiol.App.Sci. 8(09): 690-692.
doi: https://doi.org/10.20546/ijcmas.2019.809.082