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Research Note

Genetics of alternaria leaf blight resistance in Indian mustard [Brassica Juncea (L.) Czern & Coss.]

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Abstract
Inheritance of *Alternaria* leaf blight disease in Indian mustard (*Brassica juncea* L. Czern & Coss) was carried-out using generation mean analysis. Results based on generation mean analysis of per cent disease index (PDI) showed significant estimates of additive [d] and dominance [h] effects as well as all the three types of epistasis in all the three crosses. The opposite signs of [h] and [l] indicated that duplicate epistasis was operative in the inheritance of Alternaria leaf blight in the material studied.

Keywords
Mustard, Alternaria leaf blight, Genetics.

India is a third largest edible oil producing country in the world. Among the oilseeds, rapeseed and mustard contributes about 32% of total oilseed production in India and is the second largest indigenous oilseed crop after groundnut. *Alternaria* blight and white rust are the most important amongst the major diseases responsible for significant losses in seed yield and oil content in Indian-mustard (Kolte, 1987). Breeding of resistant varieties are the cheapest and environment friendly means for the exploitation of full potential of the improved varieties and ultimately stabilizing and increasing the production of mustard.

Alternaria blight caused by *Alternaria brassiceae* (Berk) Sacc is characterized by formation of dark brown coloured spots on leaves, stem and siliquae. Lower leaves show the symptoms first, with the appearance of black points which later on enlarge into prominent concentric rings or lesions of various sizes (Kolte, 1985). As the disease progresses, the lower leaves defoliate and spots subsequently appear on stem and siliquae. The losses in yield due to Alternaria blight at different locations in northern part of India ranged from 10 to 90 per cent (Anonymous, 1981; Kolte *et al.*, 1987). Incorporation of resistance/tolerance for Alternaria blight in improved cultivars may be the most acceptable and feasible eco-friendly means for exploitation of full genetic potential of these varieties. Hence the present study was aimed to assess the genetics of resistance to Alternaria blight.

The present investigation was carried out at the Crop Research Centre, G. B. Pant University of Agriculture & Technology, Pantnagar (Uttarakhand). Geographically, Pantnagar is situated at 29^0N latitude and 79.30^0E longitude and at an altitude of 243.84 m above the mean sea level and falls in the humid subtropical zone. It is situated in the *Tarai* region of Shivalik range of the great Himalayas. The PAB-9534 posseses high level of resistance to Alternaria leaf blight and was involved crosses of three susceptible parents Vardan, PRQ 2005 and Kanti to study the inheritance of resistance to Alternaria leaf blight the disease. F_1's were made during 2006-07. During R*abi* 2007-08 F_2, BC_1 and BC_2 generations of all the three crosses were produced. Experimental material comprising of six generations (P_1, P_2, F_1, F_2, BC_1 and BC_2) of three crosses were grown in compact family block design in three replications during 2008-09. Non-segregating generations (P_1, P_2, and F_1) were raised in single row each whereas F_2 was raised in six rows and BC_1 and BC_2 generations in four rows each. Row length was kept three meter. Varuna was grown as susceptible parent all around the plots. The incidence of Alternaria leaf blight was worked out by estimating the disease severity on the basis of rating scale and calculating the percent disease index. The number of competitive plants randomly selected from each generation per replication is given in Table.1. The selected plants were tagged and all subsequent observations were recorded on them. The plot means used for statistical analysis were obtained on the basis of the above cited randomly selected plants for each generation in each replication, separately.

For assessment of reaction of parents and different generations to Alternaria blight disease, three leaves per selected plant were randomly taken from each generation of three crosses to record the per cent leaf area infected on 0-6 point scale (Kolte, 1987).

Per cent disease intensity (PDI) was calculated as follows:

$$PDI = \frac{\text{Sum total numerical rating}}{\text{Number of observations taken}} x \frac{100}{\textit{Maximum} \text{ score}}$$

Incorporation of Alternaria leaf blight disease resistance gene in Indian mustard will require information about genetics of Alternaria leaf blight resistance. Results of six parameter model showed significant estimates of additive [d] and dominance [h] effects as well as all the three types of epistasis- additive × additive [i], additive × dominance [j] and dominance × dominance [l] in all the three crosses. The opposite signs of [h] and [l] indicated that duplicate epistasis was operative in the inheritance of *Alternaria* blight in the material studied(Table.2). It is thus, evident that fixable as well as non-fixable types of gene effects are important in the genetic control of Alternaria blight in Indian-mustard. Presence of fixable effects in the form of [d] and [i] in all the crosses suggested the scope for enhancing the level of resistant to this disease through selection. However, these findings are at variance from those of Panja and De (2005) who reported that resistance to this disease was mainly controlled by only additive genes. In another study, based on generation mean analysis, Krishnia *et al.,* (2000) found the preponderance of additive gene effects. Combining ability analysis of PDI for *Alternaria* blight by Panja and De (2005) showed the importance of both additive and non-additive gene action in controlling leaf blight resistant. The foregoing discussion clearly indicates the importance of both fixable and non-fixable effects in the inheritance of Alternaria blight in Indian-mustard. Based on results, it may be concluded that the present study has helped in the better understanding of gene effects controlling the expression of white rust disease in *B. juncea* L. It has been observed that additive, dominance as well as digenic epistasis were important in the inheritance of white rust disease in the pool of material studied. Presence of duplicate epistasis in all the cases might pose some problem in the resistance breeding programme. However, there were substantial amount of fixable effects in the form of additive and additive × additive effects which could be exploited through the conventional breeding procedures. Presence of additive × additive type of epistasis suggests for mild selection during early segregating generations so as to allow for settling of these desirable combinations (Matzinger,1961). It is gratifying that considerable amounts of dominance and epistatic effects are also available in the material which may be exploited through development of hybrids and/or use of appropriate recurrent selection procedures.

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Table 1. Number of plants selected for study in each generation

S. No.	Generation	Plants /replication	Total plants studied
1.	P_1	5	15
2.	P_2	5	15
3.	F_1	5	15
4.	F_2	50	200
5.	B_1	15	45
6.	B_2	15	45

Table.2. Gene effects and scaling test for *Alternaria* blight in different crosses in Indian mustard

(PDI)	m	[d]	[h]	[i]	[j]	[l]	Type of epitasis
Cross I (Vardan x PAB-9534)	23.23** ±0.21	-5.60** ±0.27	38.36** ±1.06	32.40** ±1.02	-3.67** ±0.32	-63.33** ±1.55	Duplicate
Cross II (PRQ-2005 x PAB-9534)	33.00** ±0.18	-2.36** ±0.33	-44.37** ±1.00	-49.60** ±1.00	-2.67** ±0.34	51.71** ±1.55	Duplicate
Cross III (Kanti x PAB-9534)	20.12** ±0.08	-5.42** ±0.23	9.87** ±0.62	8.49** ±0.58	-5.03** ±0.24	-17.69** ±1.09	Duplicate

Note- ** significant at 5% probability levels, respectively