

## RESISTANCE SOURCE FOR POWDERY MILDEW AND ALTERNARIA LEAF BLIGHT DISEASES IN CARROT

Carrot is an important root crop widely grown and used both in fresh and processed form. It provides an excellent source of vitamin A and fiber in the diet. Among the fungal diseases, alternaria leaf blight caused by *Alternaria dauci* Khun Groves and Skolko and powdery mildew caused by *Erysiphe heraclei* D.C.ex.St.Am. are devastating diseases, resulting in major economic loss to the carrot growers in rainy and winter season (Netzer and Katzir, 1966). The prevention of these diseases has become a major constraint in susceptible cultivars of carrot mainly due to the aggressive nature of the pathogens and air borne dispersal of conidia. The best way of controlling these diseases would be through resistance breeding by evolving cultivars with in-built resistance. Thus, there is a definite need for developing varieties resistant to diseases in carrot. Efforts have been made earlier to locate source of resistance to these diseases in carrot (Perez and Veselinov, 1980; Aguilar *et al.*, 1986; Muniz and Pante, 1988; and Vintsunas, 1986 for alternaria leaf blight and Bonnet, 1983; Lebeda and Coufal, 1987 for powdery mildew disease). This resulted in the identification of few lines with moderate resistance or tolerance to the disease. However, little effort or no effort has been made to locate source of resistance to these diseases in India. The present study was undertaken to locate sources of resistance in 75 germplasm lines screened under natural disease epiphytotic condition for three years.

The carrot germplasm lines maintained at the Indian Institute of Horticultural Research, Hessaraghatta, Bangalore were grown during kharif season for three years (1990, 91 and 92). Each line was planted in three rows of 4 m length and 30 cm apart in three replications in the field. The plant to plant distance was maintained at 10 cm. The susceptible checks Nantes for alternaria leaf blight and Beta-3 for powdery mildew was planted after every 10th and 11th row. No fungicide was used in order to ensure heavy natural incidence of these diseases. Resistance / susceptibility was determined by the percentage of damage caused to the leaves at 75th day of sowing.

Intensity of disease was severe in all the three years. The lines were placed in different categories of resistance and susceptibility on the basis of score method. The categories were resistant (1-10%), moderately resistant (11-20%), moderately susceptible (21-40%), susceptible (41-60%) and highly susceptible (61% and above).

Roots of resistant lines were uprooted after 120th day of sowing and subjected to vernalisation at 4°C for 45 days before planting for flowering in the field. Later these lines were crossed with tropical type of carrots.

Differences were observed between various lines towards disease reaction. Out of 75 lines screened, seven lines IHR 230, IHR 231, IHR 232, IHR 244, IHR 248, IHR 253 and IHR 264 showed resistance for both the diseases (Table 1). Six lines for powdery mildew, nine lines for alternaria leaf blight and seven lines for both the diseases were found moderately resistant. About 75.83 per cent of lines fell in the susceptible and highly susceptible category. Moderate susceptibility was observed in 18.62% of the lines and 29.26% of lines had moderate resistance against this disease. However, only 18.62% of the lines showed resistance for this disease.

The lines IHR 230, IHR 231, IHR 232, IHR 244, IHR 248, IHR 253 and IHR 264 were resistant to powdery mildew and alternaria leaf blight diseases besides having good quality attributes like deep orange roots with self coloured core, uniform shape and size with smooth root surface. TSS ranged from 10.2-12.6 (Table 2). The lines IHR 259, IHR 260, IHR 262, IHR 277 and IHR 295 were resistant to powdery mildew disease and IHR 282 was resistant to alternaria leaf blight. However, these lines were susceptible to one or the other disease besides poor quality traits. The lines resistant to both the diseases were temperate type of carrots, which do not flower under Bangalore condition, and hence flowering was induced through vernalisation treatment. These lines were crossed with tropical types like Pusa Keser, HC-1, HC-2, Pusa

Table 1. Grouping of germplasm lines for various resistance / susceptible categories of powdery mildew and alternaria leaf blight diseases

Disease reaction	Germplasm lines	No. of lines	Per cent disease incidence
1. Resistant (1-10%)			
a. Both the diseases	IHR 230, IHR 231, IHR 232, IHR 244, IHR 248, IHR 253, IHR 264	7	9.31
b. Powdery mildew	IHR 259, IHR 260, IHR 262, IHR 277, IHR 295	5	6.25
c. Alternaria leaf blight	IHR 282	1	1.33
2. Moderately resistant (11-20%)			
a. Both the diseases	IHR 234, IHR 249, IHR 257, IHR 258, IHR 280, IHR 281, IHR 296	7	9.31
b. Powdery mildew	IHR 235, IHR 236, IHR 239, IHR 241, IHR 265, IHR 283	6	7.98
c. Alternaria leaf blight	IHR 233, IHR 251, IHR 254, IHR 256, IHR 259, IHR 275, IHR 277, IHR 241, IHR 242	9	11.97
3. Moderately susceptible (21-40%)			
a. Both the diseases	IHR 250, IHR 261	2	2.66
b. Powdery mildew	IHR 243, IHR 245, IHR 246, IHR 266, IHR 267, IHR 270, IHR 271, IHR 294	8	10.64
c. Alternaria leaf blight	IHR228, IHR 229, IHR 236, IHR 239	4	5.32
4. Susceptible (41-60%)			
a. Both the diseases	IHR 222, IHR 223, IHR 224, IHR 225, IHR 226, IHR 227, IHR 237, IHR 238, IHR 240, IHR 252, IHR 255, IHR 285, IHR 287, IHR 293	14	18.62
b. Powdery mildew	IHR 228, IHR 233, IHR 242, IHR 251, IHR 254, IHR 256, IHR 284, IHR 286, IHR 290, IHR 291	10	13.30
c. Alternaria leaf blight	IHR235, IHR 245, IHR 246, IHR 260, IHR 262, IHR 265, IHR 266, IHR 275	8	10.64
5. Highly susceptible (>61%)			
a. Both the diseases	IHR 247, IHR 263, IHR 268, IHR 269, IHR 272, IHR 273, IHR 274, IHR 278, IHR 279, IHR 288, IHR 292	11	14.63
b. Powdery mildew	IHR229, IHR 275, IHR 276, IHR 282	4	5.32
c. Alternaria leaf blight	IHR 243, IHR 267, IHR 270, IHR 271, IHR 283, IHR 284, IHR 286, IHR 289, IHR 290, IHR 291	10	13.30

Table 2 : Important quality traits of resistant carrot lines

Resistant carrot genotypes	Root colour		Shape	T.S.S.	Root surface
	Outer	Core			
IHR 230	Deep orange	Deep orange	Cylindrical	11.0	Smooth
IHR 231	Deep orange	Deep orange	Cylindrical	12.6	Smooth
IHR 232	Deep orange	Orange	Conical	11.6	Less smooth
IHR 244	Orange	Orange	Conical	10.2	Rough
IHR 248	Orange	Orange	Cylindrical	10.8	Rough
IHR 253	Deep orange	Orange	Cylindrical	12.4	Less smooth
IHR 264	Orange	Orange	Conical	10.6	Smooth

Meghali, Deshi Red and Lucknow Local to incorporate powdery mildew and alternaria

leaf blight disease resistance, besides flowering and good root quality traits.

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