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RESPONSE OF CARROT CULTIVARS AGAINST ALTERNARIA LEAF BLIGHT DISEASE CAUSED BY *ALTERNARIA ALTERNATA*

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ABSTRACT

Cultivation of resistant cultivars is the most economical and sustainable control measure of Alternaria leaf blight of carrot. Ten carrot cultivars were screened against Alternaria leaf blight disease under natural epiphytotic conditions. Three cultivars Pusa Rudhira, Kashi Krishna, Pusa Nayanjyoti were showed 10%-25% disease severity and were considered as moderately resistant. One cultivars Pusa Asita was showed 25%-50% disease severity and considered as moderately suseptible. Four cultivars Nentes, Pusa yamdagini, Saduwali local, Newra local showed 50%-70% disease severity and were considered as susceptible and two cultivars Century special and K-4 showed >75% disease incidence and were considered as highly susceptible.

Key words : Screening, Alternaria leaf blight, Varieties, *Alternaria alternata*, Carrot.

Introduction

Carrots are a domesticated form of the wild carrot, *Daucus carota*, belongs to *Apiaceae* family, native to Europe and south western Asia. The plant probably originated in Persia and was originally cultivated for its leaves and seeds. The most commonly eaten part of the plant is the taproot, although the greens are sometimes eaten as well. The carrot is a biennial plant.

It is a root vegetable that has worldwide distribution. Carrots were first used for medical purposes and gradually used as food. Written records in Europe indicated that carrots were cultivated prior to the tenth century. The colour of the carrot root flesh may be white, yellow, orange, red, purple, or very dark purple. The first cultivated carrots were yellow and purple fleshed cultivars. A rapid rise in the popularity of orange carrots was observed with the recognition of its high provitamin a content (Simon, 2010). Carotenoids and anthocyanins are the major antioxidant pigments found in carrots. The widely used orange carrot is high in α- and β carotene and is a rich source of provitamin A (Dias, 2012). The red water-soluble anthocyanin pigment and the red water insoluble lycopene pigment present in the roots of some cultivars do not contribute to the provitamin A content. Red carrot color is due to its high lycopene content (Dias, 2012). Meanwhile, anthocyanin-rich carrots are purple (Sun *et al*, 2009). They are also rich in other phenols, containing chlorogenic, caffeic and phydroxybenzoic acids along with numerous cinnamic acid derivates. Among hydroxycinnamic acid and its derivates, chlorogenic acid represents 42.2% to 61.8% of total phenolic compounds detected in different carrot tissues (Zhang and Hamauzu, 2004; Gonçalves *et al*, 2010). Carrot is affected by several pests, fungal pathogens along with some bacterial and few physiological disorders. The foliar diseases of carrot, Alternaria leaf blight is major one, which occurs worldwide. Strandberg (1992), Tulek and Dolar (2015) reported that even *A. alternata*, *A. tenuissima* and *A. radicina* also causes leaf blight disease of carrot. The

fungal disease, particularly leaf blight was observed as severe disease of carrot (Soyal *et al*., 2018). Chand and Singh (2011) recorded 60% yield losses due to leaf blight and leaf spot of carrot in India. The pathogen attacks both root and seed crop but losses are more in case of seed crop in nature. The disease appears as brownish water soaked lesions on the margins and tips of older leaflets which gradually extend to become deep brown and blighted. As the spot increase in number, the interveinal tissue dies until the entire leaflet is killed. In moist weather disease spread rapidly. On leaf petioles, elongated dark spots appeared and the entire leaf dies without spots on the foliage. It also causes damping-off of seedlings, blight of seed stalk and black decay of roots. Under heavy infection conditions leaves are entirely destroyed and harvesting becomes difficult which results in 40-60 per cent yield losses (Vintal *et al*., 1999; Farrar *et al*., 2004). Application of different types of fungicides for the control of Alternaria blight, but fungicide treatment is not economically possible, nor environmentally safe. Fungicides are first applied 1–2 days after transplantation and then require routine application at the interval of 7 to10 days for effective control, thereby increasing production cost and environment pollution (Kemmitt *et al*., 2002). Development of resistant varieties is the most economical and sustainable control measure of Alternaria leaf blight. Hence, the present study was planned to identify resistance sources against Alternaria leaf blight disease in carrot variety, which could provide a broader genetic base to facilitate the development of resistant cultivars.

Plate 1 : *Alternaria* blight symptoms on Carrot plant and leaf.

Materials and Methods

Screening of different carrot varieties against Alternaria leaf blight disease

Carrot cultivars were screened under cage house during *Rabi* 2020-21 at College of Agriculture, Jodhpur (Rajasthan). The carrot plants of 10 cultivars were show in the pot (9" × 12"), each variety planted three pots (Table 1).

Table 1 : List of cultivars used for screening against Alternaria leaf blight disease.

S. no.	Varieties
1	Pusa Asita
2	Pusa Rudhira
3	Pusa Yamdagini
4	Nentes
5	Pusa Nayanjyoti
6	Kashi Krishna (VRCAR-126)
7	Century special
8	K-4
9	Saduwali local (Sri Ganganagar)
10	Newra local

Table 2 : Reaction of a variety was categorized as follows.

Disease rating	Description	Host reaction
0	No symptoms	Highly resistant (HR)
1	Symptoms on leaf tip and leaves only (up to 10 %)	Resistant (R)
2	Symptoms on leaves and petiole (>10-25%)	Moderately Resistant (MR)
3	Symptoms on leaves, petiole and stem (> 25-50%)	Moderately Susceptible (MS)
4	Symptoms on leaves, stem and Inflorescence (> 50-75%)	Susceptible (S)
5	Symptoms on leaves, stem and Inflorescence including seeds (>75%)	Highly Susceptible (HS)

Four observations on Alternaria Leaf blight incidence were recorded at 15 days interval, starting from first initial symptoms on leaves. Observations on disease intensity were recorded on 5 plant selected in each pot by using disease rating scale given by Jaiman *et al*. (2013) with slight modifications and per cent disease intensity was calculated. The percent disease intensity (PDI) was calculated by using the formula of Wheeler, 1969.

$$PDI = \frac{\text{Sum of all individual ratings}}{\text{Number of plants observed} \times \text{Maximum disease rating scale}} \times 100$$

Results and Discussion

Screening of available cultivars against Alternaria leaf blight of carrot

Based on the per cent number of plants (foliage) affected by the Alternaria leaf blight pathogen, the carrot cultivars were categorized into six groups. The cultivars

Table 3 : Response of different carrot cultivars to *Alternaria alternata* under artificial inoculate condition.

S. no.	Varieties	Per cent disease intensity	Disease reaction
1	Pusa Asita	41.81 (40.27)	MS
2	Pusa Rudhira	22.37 (28.20)	MR
3	Pusa Yamdagini	62.71 (52.34)	S
4	Nentes	67.10 (54.98)	S
5	Pusa Nayanjyoti	18.00 (25.08)	MR
6	Kashi Krishna	21.08 (27.31)	MR
7	Century special	79.60 (63.12)	HS
8	K-4	84.19 (66.56)	HS
9	Saduwali local	55.37 (48.07)	S
10	Newra local	69.04 (56.17)	S
SEm(±)		**0.70**	-
C.D at 5%		**2.081**	-

present in group I (Highly resistant) having no incidence, group II (resistant) having >10%, group III (Moderately resistant) having 10% to 25%, group IV (Moderately Suseptible) having 25 to 50% incidence, group V (susceptible) having 50% to 75 % and group VI (Highly susceptible) having >75% (Jaiman *et al*., 2013).

Ten carrot cultivars were screened against *Alternaria alternata* under cage house conditions. Three cultivars Pusa Rudhira, Kashi Krishna, Pusa Nayanjyoti were showed 10%-25% disease severity and were considered as moderately resistant. One cultivars Pusa Asita was showed 25%-50% disease severity and considered as moderately suseptible. Four cultivars Nentes, Pusa yamdagini, Saduwali local, Newra local showed 50%-70% disease severity and were considered as susceptible and two cultivars Century special and K-4 showed >75% disease incidence and were considered as highly susceptible. However, the differences among these cultivars based on the per cent Alternaria leaf blight severity were not significant (Table 3).

Since, no precise information was available on screening of these varieties against Alternaria leaf blight of carrot in Rajasthan and other states. Similar results were also found by Roy (1969) evaluated 11 varieties of carrot against Alternaria leaf blight disease. These varieties were evaluated early nantes, nantes, amsterdam forcing, champion scarlet horn, long orange, early gem, danvers, fyazabad, golden heart, imperator and tender sweet. The results concluded that all varieties showed susceptible response against Alternaria leaf blight disease. Scott and Wenham (1972) screened 86 imported carrot seed lines during 1968-69, were found to transmit *Alternaria radicina*, the cause of black rot disease, and 7 transmitted *Alternaria dauci*, the cause of Alternaria leaf blight. Pawelec *et al*. (2006) screened three carrot cultivars and F2 genotypes segregating under Glasshouse and laboratory for ALB resistance evaluated against self-pollinated F3 field grown plants. Zafar *et al*. (2017) screened five carrot varieties (Gold Mines, Mah Rani, Long Red, Deep Red and Red Core) against leaf blight in carrot caused by *Alternaria dauci*. Long Red variety showed resistant response however Red core showed moderately resistant response, while Deep Red showed moderately susceptible response, but Mah Rani and Gold Mine were found susceptible against *A. dauci* (Choudhary *et al*., 2021; Dhaka and Choudhary, 2022; Dhaka *et al*., 2022).

Conclusion

Ten carrot cultivars were screened against Alternaria leaf blight under cage house conditions. Among these three cultivars *viz*., Pusa Rudhira, Kashi Krishna, Pusa Nayanjyoti were showed moderately resistant. One cultivars Pusa Asita was showed moderately susceptible. Four cultivars *viz*., Nentes, Pusa yamdagini, Saduwali local, Newra local showed 50-70% disease severity and were considered as susceptible and two cultivars *viz*., Century special and K-4 showed highly susceptible reactions.

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