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ORGANIC AMENDMENT-BASED MANAGEMENT OF ALTERNARIA LEAF BLIGHT OF CARROT CAUSED BY *ALTERNARIA ALTERNATA*

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ABSTRACT

The present investigation was carried out under pot conditions in the cage house of the Department of Plant Pathology, S.K.N. College of Agriculture, Jobner, Jaipur, Rajasthan to evaluate the efficacy of organic amendments against *Alternaria alternata* causing Alternaria leaf blight of carrot (*Daucus carota* L.). Six organic amendments, namely mustard cake, castor cake, neem cake, cotton cake, farmyard manure and poultry manure, along with an untreated control, were tested in a randomized block design with three replications. The amendments were mixed thoroughly in soil one month before sowing at their respective recommended doses. Disease intensity was recorded 55 days after sowing and per cent disease index was worked out. Among the treatments, neem cake at 2.5 t/ha proved to be the most effective and recorded the minimum disease intensity of 35.72 per cent with 37.61 per cent disease control over untreated control. The next best treatment was castor cake, which recorded 38.68 per cent disease intensity and 32.44 per cent disease control, followed by mustard cake with 40.05 per cent disease intensity. Cotton cake was moderately effective, whereas poultry manure and farmyard manure were comparatively less effective. The untreated control recorded the highest disease intensity of 57.25 per cent. The results indicated that neem cake was the most promising organic amendment for the management of Alternaria leaf blight of carrot under pot conditions.

Key words : *Alternaria alternata*, Alternaria leaf blight, Carrot, *Daucus carota*, Neem cake, Organic amendments.

Introduction

Carrot (*Daucus carota* subsp. *sativus*) is an important root vegetable crop known for its high medicinal, nutritional and health value. It is grown throughout the year in temperate regions, whereas in tropical and subtropical regions it is mainly cultivated during the winter season. Carrot is an excellent source of α- and β-carotene, which act as precursors of vitamin A. In addition, it contains appreciable quantities of thiamine, riboflavin, iron, vitamins A and B, ascorbic acid and sugars. Owing to its rich nutritive composition and wide adaptability, carrot holds an important position among vegetable crops.

Carrot is affected by several fungal diseases, some bacterial diseases and certain physiological disorders. Among these, Alternaria leaf blight is one of the most important foliar diseases and is caused by *Alternaria alternata*, *A. tenuissima* and *A. radicina*. This disease is widely prevalent and is considered a serious constraint to carrot production in many parts of the world. Symptoms generally appear as small, irregular, dark brown to black spots on the leaves, particularly along the margins and tips of leaflets. On petioles, greenish-brown lesions are formed, which later enlarge, girdle and ultimately kill the affected leaves. Under favourable environmental conditions, these lesions coalesce, resulting in a blighted appearance, followed by withering, drying and shedding of leaves.

In Rajasthan, carrot is cultivated over a considerable area; however, its productivity is relatively low compared with its potential. Among the various factors responsible for this low productivity, Alternaria leaf blight is an important disease-causing significant loss in marketable yield, root size and quality. Hence, there is a need to

develop management practices that are effective, eco-friendly, safe and economically viable.

Organic amendments have gained importance in disease management because of their eco-friendly nature and their ability to improve soil health and suppress plant pathogens. Several workers have reported the effectiveness of different organic amendments against species of *Alternaria*. The present investigation was undertaken to evaluate the efficacy of different organic amendments against *Alternaria alternata* causing Alternaria leaf blight of carrot under pot conditions.

Material and Methods

Experimental site and period

All experimental work was carried out in the cage house, Department of Plant Pathology, S.K.N. College of Agriculture, Jobner, Jaipur, Rajasthan. Laboratory studies were conducted for isolation, purification, pathogenicity testing, and identification of the pathogen, while the pot experiment was performed under cage house conditions.

Collection of diseased samples

Leaves of carrot showing typical symptoms of Alternaria leaf blight were collected from farmers' fields in and around the Jobner region. The diseased specimens were brought to the laboratory and examined under a microscope for preliminary observation of fungal structures. To encourage sporulation on naturally infected tissues, the samples were also kept in a humid chamber before further processing.

Isolation of the pathogen

Small pieces of infected leaf tissue, along with a small portion of adjoining healthy tissue, were cut from the advancing margins of lesions. These pieces were surface sterilized in 0.1 per cent mercuric chloride ($HgCl_2$) solution for 1–2 minutes, followed by three washings in sterile distilled water to remove traces of the disinfectant. The sterilized pieces were then transferred aseptically onto Potato Dextrose Agar (PDA) medium in sterilized Petri plates and incubated at 25 ± 1°C in a B.O.D. incubator. After about 7 days of incubation, the fungal growth emerging from the infected tissues was transferred aseptically to fresh PDA slants for further growth and sporulation.

Purification of the pathogen

The pathogen was purified by single spore and hyphal tip techniques.

Single spore technique

Spores from a 7-day-old culture were suspended in sterile distilled water. The suspension was diluted so that approximately 5–10 spores could be observed in one loopful under the low-power objective of the microscope. One millilitre of this suspension was spread over plain agar medium in sterile Petri plates. After 12–24 hours, germinating spores were identified under the microscope, marked and individually transferred to PDA slants. The inoculated slants were incubated at 25 ± 1°C for further growth and sporulation. Pure cultures were maintained by periodic transfer onto fresh PDA slants.

Pathogenicity test

The pathogenicity of the isolated fungus was confirmed by artificial inoculation on healthy carrot plants. A spore-cum-mycelial suspension of the purified culture was prepared in sterile distilled water, and the inoculum concentration was adjusted to 1×10^5 spores ml^{-1}. Six-week-old carrot plants were inoculated by spraying the suspension uniformly with the help of an atomizer. Control plants were sprayed only with sterile distilled water. To maintain high humidity, the inoculated plants were covered with polythene bags and sprayed with sterile water for 48 hours. Disease development was observed regularly from the appearance of initial symptoms until full symptom expression (Plate 1). The pathogen was re-isolated from the artificially infected plants, and the reisolated culture was compared with the original culture to confirm pathogenicity.

Un-inoculated **Inoculated**

Plate 1 : Pathogenicity test of *Alternaria alternata* on carrot.

Identification of the pathogen

The purified sporulating culture was identified based on its cultural and morphological characteristics. Microscopic examination of the fungal conidia, including their size, colour, shape, septation, length and width, confirmed the pathogen as *Alternaria alternata*.

Evaluation of organic amendments against *Alternaria alternata* under pot conditions

Experimental design and treatments

A pot experiment was conducted in the cage house of the Department of Plant Pathology, S.K.N. College of

Agriculture, Jobner, Jaipur, to evaluate the efficacy of selected organic amendments against *Alternaria alternata*, the causal agent of Alternaria leaf blight of carrot. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Seven treatments were included in the study, consisting of six organic amendments and one untreated control. The organic amendments evaluated were mustard cake, castor cake, neem cake, cotton cake, farmyard manure, and poultry manure and their dosage given in Table 1.

Application of organic amendments

The required quantity of each organic amendment was mixed thoroughly with the soil in the respective earthen pots of 9 × 12 inches' size one month before sowing to allow sufficient decomposition and interaction with the soil. The amendments were applied at the rates given below.

Sowing and maintenance of plants

After the incubation period of one month following amendment incorporation, carrot seeds were sown in the treated pots. Standard agronomic practices were followed uniformly for all treatments throughout the experimental period. The untreated control pots were maintained without any organic amendment.

Recording of disease intensity

Disease observations were recorded 55 days after sowing. Carrot plants were selected at random from each treatment and disease severity was assessed on infected leaves using the prescribed disease rating scale given in Table 2. Based on the disease scores, the Per cent Disease Index (PDI) was calculated.

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

The percent disease control (PDC) was calculated by using the following formula:

$$PDC = \frac{\text{Disease in control} - \text{Disease in treatment}}{\text{Disease in control}} \times 100$$

Results and Discussion

The antifungal effect of six organic amendments was evaluated under pot condition against *Alternaria alternata* causing Alternaria leaf blight of carrot. The data presented in Table 3 and Fig. 1 revealed that all the organic amendments differed significantly in their effect on disease intensity. Among the six organic amendments, neem cake was found most effective and recorded the minimum disease intensity of 35.72 per cent with 37.61 per cent disease control over untreated control. Castor cake was the next best treatment and recorded 38.68 per cent disease intensity with 32.44 per cent disease control. Mustard cake also proved effective and recorded 40.05 per cent disease intensity with 30.04 per cent disease control.

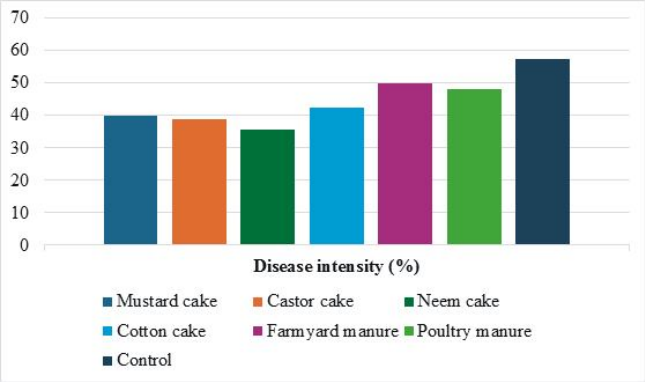

Fig. 1 : Efficacy of organic amendments against *Alternaria alternata* under pot condition (*in vivo*).

Table 1 : Organic amendments and their doses.

Organic amendment	Quantity/pot
Mustard cake	20 g
Castor cake	20 g
Neem cake	20 g
Cotton cake	20 g
Farmyard manure	25 g
Poultry cake	25 g

Table 2 : Details of the disease rating scale.

S. no.	Description	Grade
1	No incidence/ healthy	0
2	Symptoms on leaf tip and leaves only	1
3	Symptoms on leaves and petiole	2
4	Symptoms on leaves,petiole and stem	3
5	Symptoms on leaves,petiole,stem and inflorescence	4
6	Seed	5

Cotton cake was moderately effective and recorded 42.50 per cent disease intensity with 25.71 per cent disease control. Poultry manure and farmyard manure were comparatively less effective and recorded 48.00 and 50.05 per cent disease intensity, respectively. The untreated control recorded the highest disease intensity of 57.25 per cent.

Among the organic amendments evaluated under pot condition, neem cake was the most promising in reducing disease intensity, followed by castor cake and mustard cake. The superiority of neem cake observed in the present study is in conformity with the findings of Prajapati

et al. (2019), who reported lower disease intensity of purple blotch of garlic with neem cake. The present findings are also supported by Srinivasan and Jebaraj (2017), who reported that neem cake recorded superior plant growth with lower disease incidence in tomato fruit rot.

Thus, under *in vivo* conditions, neem cake proved to be the most effective organic amendment against *A. alternata*, recording the least disease intensity of 35.72 per cent, followed by castor cake (38.68%). In contrast, farmyard manure and poultry manure were less effective under the present conditions. The results clearly indicate that neem cake can be used as a promising organic amendment for the management of Alternaria leaf blight of carrot.

Pramod Kumar and Palakshappa (2009) evaluated the compatibility of organic amendments such as biocompost, castor cake, distillery yeast sludge, farmyard manure, groundnut cake, karanj cake, neem cake, pressmud and safflower cake and their effects on *Alternaria porri* and *Alternaria alternata* causing purple blotch of onion. They reported that maximum inhibition of mycelial growth of *A. alternata* was recorded in groundnut cake, followed by castor cake at both 5 and 10 per cent concentrations.

Srinivasan and Jebaraj (2017) observed the efficacy of different organic amendments, viz., farmyard manure, decomposed coir pith, vermicompost, neem cake, pungam cake, castor cake and sesame cake, against tomato fruit rot pathogen under pot culture conditions. Among the tested amendments, neem cake recorded maximum plant growth and yield with lower disease incidence over control. Similarly, Prajapati *et al.* (2019) studied the response of different organic manures against purple blotch of garlic and found that poultry manure recorded the minimum disease index followed by neem cake, goat manure, farmyard manure and vermicompost, as compared to control.

Jackson *et al.* (2019) evaluated seven organic composts, *viz.*, vermicompost, farm yard manure, neem compost, bonemeal compost, coirpith compost, vesicular arbuscular mycorrhiza and seaweed extract, for antifungal properties against *Alternaria brassicae* causing Alternaria leaf spot of mustard under *in vitro* and polyhouse conditions. Under *in vitro* conditions, the highest inhibition of fungal mycelium was recorded in vermicompost, while under polyhouse conditions neem compost reduced disease severity to the maximum extent.

The fungicidal properties of these amendments are largely attributed to the presence of secondary metabolites such as azadirachtin and various limonoids, which disrupt the fungal metabolic processes and inhibit mycelial proliferation (Choudhary and Ashraf, 2019; Mandal *et al.*, 2025). Furthermore, the decomposition of these organic substrates stimulates the proliferation of beneficial soil microbiota, such as *Trichoderma* and *Pseudomonas* species, which exert antagonistic pressure against *A. alternata* through competitive exclusion (Madhumitha *et al.*, 2022). Additionally, the gradual release of volatile organic compounds during the breakdown of these oil cakes contributes to a suppressive soil environment, thereby limiting the primary inoculum survival of *A. alternata* (Vyas and Sharma, 2021). This synergistic combination of direct chemical inhibition and induced microbial suppression highlights the multifaceted potential of organic soil amendments in integrated disease management programs (Devi *et al.*, 2024).

Table 3 : Efficacy of organic amendments against *Alternaria alternata* causing Alternaria leaf blight of carrot under pot condition (*in vivo*).

Treatments	Dose (t/ha)	Disease intensity* (%)	Disease control (%)
Mustard cake	2.5	40.05 (39.26)	30.04
Castor cake	2.5	38.68 (38.46)	32.44
Neem cake	2.5	35.72 (36.70)	37.61
Cotton cake	2.5	42.50 (40.69)	25.71
Farmyard manure	15.0	50.05 (45.03)	12.58
Poultry manure	5.0	48.00 (43.85)	16.16
Control	-	57.25 (49.17)	0.00
SEm ±	1.51		
CD (P=0.05)	4.64		

*Average of three replications
Figures given in parentheses are angular transformed values.

Future investigations should prioritize elucidating the specific dose-response relationships of these amendments across varying soil types to optimize field-level application protocols. Moreover, integrating these amendments with biological control agents could potentially enhance the durability of disease suppression by fostering a more resilient soil-plant microbiome. Such a multifaceted approach aligns with sustainable agricultural practices that emphasize reducing chemical dependency while simultaneously promoting long-term soil fertility (Corato, 2020; Shree *et al.*, 2024).

Recent research into molecular mechanisms further demonstrates that such amendments actively modulate plant systemic resistance, priming the host against future

pathogen challenges (Rosskopf *et al*., 2020). Given these multifaceted benefits, incorporating neem cake into carrot cultivation strategies offers a sustainable alternative to conventional synthetic fungicides, effectively reducing environmental chemical residues while ensuring robust crop health. Furthermore, soil amendment with brassicaceous materials like mustard cake has been shown to provide significant biofumigant effects that further suppress soil-borne inoculum pressure of *Alternaria* species, expanding the range of viable organic management options (Naghman *et al*., 2023)

Conclusion

Among the six organic amendments tested under pot conditions, neem cake was found to be the most effective in reducing disease intensity caused by *Alternaria alternata* inciting Alternaria leaf blight of carrot, followed by castor cake and mustard cake. Cotton cake was moderately effective, whereas poultry manure and farm yard manure were less effective. Therefore, neem cake may be considered a suitable organic amendment for the management of Alternaria leaf blight of carrot under pot conditions.

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