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Efficacy of different fungicides against *Alternaria alternata* causing leaf spot of date palm (*Phoenix dactylifera* L.) under in vitro conditions

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ABSTRACT

Leaf spot is an important foliar disease of date palm (*Phoenix dactylifera* L.) because infection reduces healthy leaf area and may adversely affect plant vigour and productivity. In the present investigation, *Alternaria alternata* associated with leaf spot symptoms of date palm was isolated, purified and identified on the basis of cultural and morphological characteristics, and its pathogenicity was confirmed on healthy date palm seedlings. The efficacy of six fungicides, viz., Captan 50% WP, Chlorothalonil 75% WP, Copper oxy-chloride 50% WP, Carbendazim 50% WP, Propineb 70% WP and Mancozeb 75% WP, was evaluated against the pathogen under in vitro conditions using the poisoned food technique on Potato Dextrose Agar. The experiment was conducted in Completely Randomized Design with three replications. Copper oxy-chloride 50% WP was the most effective treatment, recording the minimum mean colony diameter of 5.00 mm and maximum mycelial growth inhibition of 94.44%. Captan 50% WP ranked second with 17.00 mm colony diameter and 81.11% inhibition, followed by Propineb 70% WP (79.63%) and Mancozeb 75% WP (77.04%). Chlorothalonil 75% WP and Carbendazim 50% WP recorded 66.30 and 64.07% inhibition, respectively, whereas the untreated control recorded 90.00 mm colony growth. Under the conditions of the present experiment, copper oxy-chloride, Captan, Propineb and Mancozeb were the most promising treatments and warrant further field-level evaluation against date palm leaf spot.

Keywords: *Alternaria alternata*, Date palm, Leaf spot, Fungicides, Poisoned food technique, Mycelial growth inhibition, Copper oxy-chloride

1. Introduction

Date palm (*Phoenix dactylifera* L.) is an important fruit crop of arid and semi-arid regions and is valued primarily for its fruits as well as for the diverse uses of different plant parts. Like other perennial fruit crops, date palm is affected by a number of fungal diseases. Among these, leaf spot is important because repeated infection can reduce the functional photosynthetic leaf area and adversely influence plant vigour and productivity.

The leaf spot symptoms recorded in the supplied study material consisted of small light-brown to dark-brown necrotic specks on leaflets. The spots enlarged and became irregular to elongated, and adjacent lesions could coalesce to form larger blighted areas followed by drying of affected tissues. Such symptoms were associated with *Alternaria* infection in the investigation. (Arafat *et al.*, 2024) [1]

Alternaria alternata is a widely distributed fungal pathogen with a broad host range and is associated with leaf spot diseases on several crops. In the present investigation, the fungus associated with date palm leaf spot was isolated on Potato Dextrose Agar and purified by repeated subculturing. The isolate produced light greyish growth that subsequently became dark olivaceous to black with concentric zonation. Microscopic examination revealed septate, branched and brownish mycelium together with brown, obclavate to muriform conidia possessing transverse and longitudinal septation. Pathogenicity was demonstrated on healthy date palm seedlings followed by re-isolation of the same pathogen.

Effective management of leaf spot requires suppression of the pathogen and reduction of disease development. Chemical fungicides are important components of preliminary disease-management studies because *in vitro* screening can identify compounds with strong inhibitory activity before they are subjected to field validation. Earlier studies cited in the supplied literature have reported variable activity of fungicides against *Alternaria* spp., including mancozeb, carbendazim, copper oxychloride and other compounds. Studies specifically associated with date palm and *Alternaria* have also reported substantial activity of selected fungicides under laboratory conditions. (Mansoori, 2012).

The efficacy of fungicides can vary with the pathogen isolate, host, fungicide formulation and concentration. Therefore, screening the locally isolated pathogen is useful for identifying treatments that merit further in

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vestigation. Accordingly, the present study was undertaken to evaluate and compare the *in vitro* efficacy of six selected fungicides against the isolated *A. alternata* causing leaf spot of date palm.

2. Materials and Methods

2.1 Experimental site and pathogen

The investigation was carried out during 2025–2026 in the laboratory of the Department of Plant Pathology, Dr. Sharadchandra Pawar College of Agriculture, Baramati. Diseased date palm leaves were collected from the Malegaon, Baramati region. The associated fungus was isolated on Potato Dextrose Agar and purified by repeated sub-culturing. The isolate was identified as *Alternaria alternata* on the basis of cultural and microscopic characteristics, and pathogenicity was confirmed on healthy date palm seedlings.

2.2 Poisoned food technique

The fungicides were evaluated by the poisoned food technique using Potato Dextrose Agar (PDA) as the basal medium. Appropriate quantities of each fungicide were incorporated into sterilized and cooled PDA. Approximately 20 ml of the treated medium was poured into sterile 90-mm Petri plates. Each plate was inoculated aseptically with a 5-mm mycelial disc cut from an actively growing culture of *A. alternata*. PDA without fungicide served as the untreated control. Three replications were maintained for each treatment. Plates were incubated at 25 ± 2 °C, and observations were recorded when the untreated control attained full colony growth.

2.3 Observation and calculation

Radial mycelial growth was measured in millimetres. The percentage inhibition of mycelial growth over the untreated control was calculated using the formula:

$$\text{Percentage inhibition} = \frac{C - T}{C} \times 100$$

where C represents colony growth in the untreated control and T represents colony growth in the fungicide-treated plate. The methodology in the supplied study material attributes the calculation to Arora and Upadhyay (1978) and Vincent (1927) [2].

2.4 Statistical Analysis

The experiment was analysed under Completely Randomized Design (CRD) following the statistical procedure cited in the supplied study material (Panse *et al.*, 1963) [3]. Percentage observations were transformed by the arcsine method for statistical analysis. Standard error and critical difference at $P = 0.05$ were used for comparison among treatments.

3. Results and Discussion

The six fungicides differed markedly in their ability to suppress the mycelial growth of *A. alternata*. All fungicide treatments reduced colony growth compared with the untreated control, which recorded 90.00 mm colony diameter. The observed reduction in colony diameter corresponded with increased inhibition of mycelial growth.

Table 1. Effect of different fungicides on mycelial growth of *Alternaria alternata* under *in vitro* conditions

Treatment	Fungicide	Concentration (ppm)	Mean colony diameter (mm)	Growth inhibition (%)
T ₁	Captan 50% WP	1250	17.00	81.11
T ₂	Chlorothalonil 75% WP	1000	30.33	66.30
T ₃	Copper oxy-chloride 50% WP	1250	5.00	94.44
T ₄	Carbendazim 50% WP	1000	32.33	64.07
T ₅	Propineb 70% WP	1000	18.33	79.63
T ₆	Mancozeb 75% WP	1000	20.67	77.04
T ₇	Untreated control	—	90.00	0.00

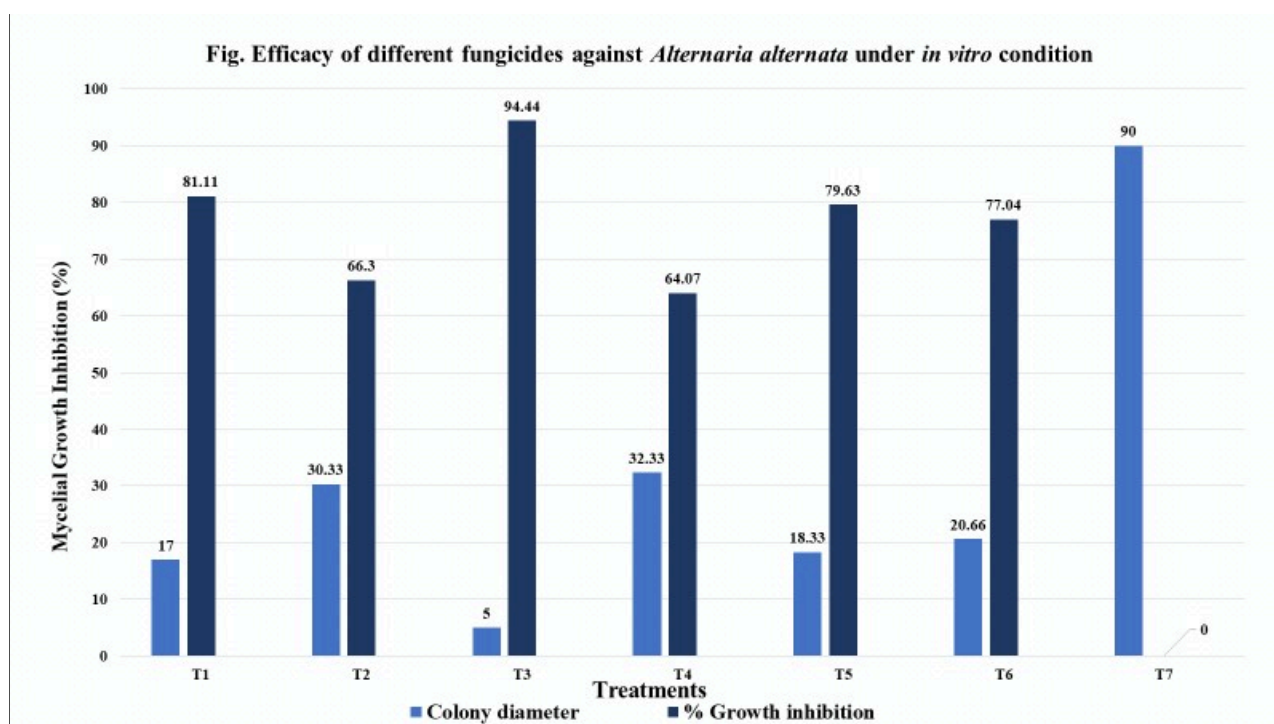


Figure 1. Effect of selected fungicides on mycelial growth inhibition of *Alternaria alternata* under *in vitro* conditions

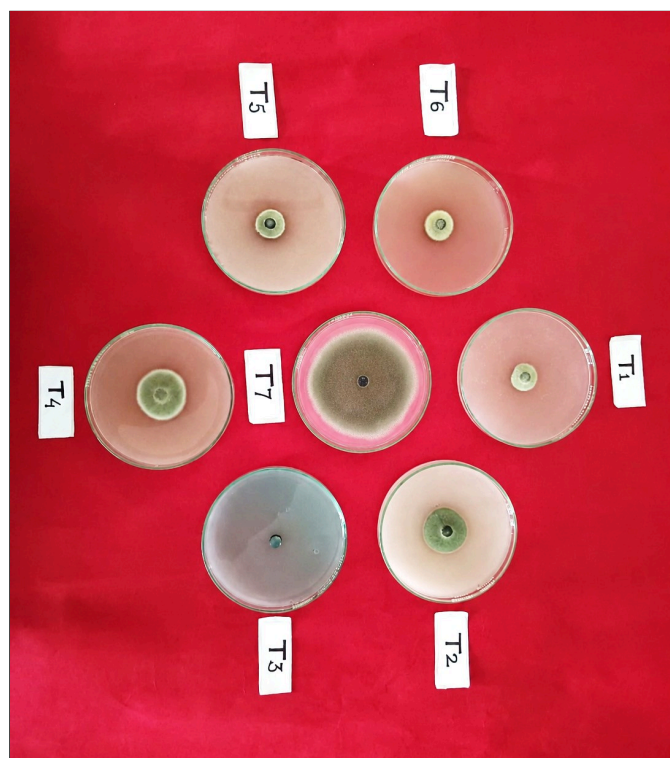


Plate 1. Effect of different fungicides against *Alternaria alternata* under *in vitro* conditions

Copper oxy-chloride 50% WP was the most effective treatment against *A. alternata*, recording the minimum mean colony diameter of 5.00 mm and the maximum mycelial growth inhibition of 94.44%. The high level of inhibition indicates strong suppression of the pathogen under the conditions of the poisoned food assay. Captan 50% WP ranked second, with 17.00 mm colony diameter and 81.11% inhibition.

Propineb 70% WP and Mancozeb 75% WP were the next most effective treatments, recording mean colony diameters of 18.33 and 20.67 mm and corresponding inhibition values of 79.63 and 77.04%, respectively. These treatments therefore produced substantially greater suppression than Chlorothalonil 75% WP and Carbendazim 50% WP.

Chlorothalonil 75% WP recorded 30.33 mm mean colony diameter and 66.30% inhibition, whereas Carbendazim 50% WP recorded the highest colony diameter among the fungicide treatments (32.33 mm) and 64.07% inhibition. The untreated control recorded 90.00 mm colony growth and showed no inhibition. Thus, the overall order of efficacy based on inhibition of mycelial growth was Copper oxy-chloride > Captan > Propineb > Mancozeb > Chlorothalonil > Carbendazim.

The superior performance of copper oxy-chloride in the present investigation is in agreement with the broader evidence cited in the supplied literature indicating that copper-based fungicides can suppress *Alternaria* growth. Garmendia *et al.* (2025) [4], as cited in the supplied literature, emphasized that the performance of copper-based products may vary with formulation, dose and disease pressure. The present results also correspond generally with reports cited in the supplied study material in which mancozeb, carbendazim, chlorothalonil and other fungicides reduced *Alternaria* growth under *in vitro* conditions. (plate no.1, table no.1, fig.1).

The findings are also comparable with the date-palm and *Alternaria* studies cited in the supplied literature. Ahmed (2020) [5], Kadhim *et al.* (2022) [6], and Matrood *et al.* (2021) [7] reported activity of selected fungicides or management treatments against *Alternaria* associated with date palm. The present isolate, however, showed its highest inhibition with copper oxy-chloride, while the relative efficacy of individual fungicides has varied among studies. Such variation may

be associated with differences in pathogen isolate, fungicide formulation, concentration and experimental conditions.

The present experiment was conducted under controlled *in vitro* conditions; therefore, the observed inhibition represents preliminary fungicidal efficacy and should not by itself be interpreted as a field-use recommendation. Further field validation is necessary to determine disease-control performance, crop safety, practical application schedules and other considerations before any field recommendation is made.

4. Conclusion

Under the *in vitro* conditions of the present investigation, all six evaluated fungicides suppressed the mycelial growth of *Alternaria alternata* compared with the untreated control. Copper oxy-chloride 50% WP was the most effective treatment, recording 94.44% growth inhibition, followed by Captan 50% WP (81.11%), Propineb 70% WP (79.63%) and Mancozeb 75% WP (77.04%). Chlorothalonil 75% WP and Carbendazim 50% WP recorded comparatively lower inhibition. Copper oxy-chloride, Captan, Propineb and Mancozeb may therefore be considered promising candidates for further field-level evaluation against date palm leaf spot caused by *A. alternata*.

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