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# Growth conditions favorability of the common air born fungus *Cladosporium sphaerospermum*

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**Abstract**
This study was conducted to determine nutritional and environmental conditions required for the optimum growth of two isolates of the common airborne fungus *Cladosporium sphaerospermum*. Tested conditions were nine temperature levels (5-, 10. 15, 20, 25, 30, 35, 40, and 45C°), five pH values (4-8) and three artificial growing media (PSA, SDA, and PDA). Regarding the temperature effects on the fungal radial growth, the 25°C resulted in the highest growth values in both *Cladosporium* isolates. No fungal growth was detected at 5 C° and 45 C°. The temperature levels of 10, 15, 30 and 40° C were harmful and not suitable for the fungal growth. The 20 and 30 C° were suitable but less favorable than the 25 C° for the fungal growth. In case of the pH experiment, fungal isolates differed in their tolerance to various pH levels (Table2). Both isolates showed maximum mycelia growth at pH6. While, pH5 had more negative effects on the C1 isolate than on C2. Relative to suitability of growth medium type, SDA was the most favorable medium among the three tested media (Table3). However, the C2 isolate was much faster and had higher radial growth on all tested media than the C1 isolate.

**Keywords:** *Cladosporium sphaerospermum*, temperature, PH, media

## Introduction
Fungi are present in all ecosystems and most environmental conditions. They are influenced by the environments in which they live, and they also affect living organisms in their environments in different ways. Among the most common fungal fungi is *Cladosporium* spp. which is present in all internal and external environments (Zalar *et al*., 2007; Bensch *et al*., 2010 Miller *et al*., 2012) [6]. It is an airborne fungus with ability to produce high density spores that spread in the air especially in the summer, its spore density usually ranged from 2000 to50000 mpg (Deshmukh and Rai, 2005) [8]. *Cladosporium* is a fungus that causes several diseases for a number of economically important plants. *C. fulvum*, for instance, causes tomato leaf rot disease in South America. The disease is an important disease under high humidity in temperate regions during autumn and winter (ref).
Environmental factors such as temperature, pH and nutritional environment are crucial and playing very important rules in any organism survival and success and Normal different conditions such as humidity and temperature provide a suitable environment for the growth of a wide of fungal spores (Ababutain, 2011) [1]. Environmental factors plays an important role in dispersing fungi spores in air for short and long distances and when spores deposited a solid or liquid surface and if conditions of moisture and food are appropriate, they germinate (Bennett, 2010; Goncalves *et al*., 2010) [5]. Bensch *et al*. (2012) [7] noted that C. sphaerospermum was significantly influenced by concentrations, climate and humidity and used the P.D.A. And M.E.A., S.N.A. and O.A, and that the ideal growth was at 25m. They also noticed that the fungus did not grow at 4m and 37m. Alhussaini *et al*. (2015) [3-4] had the best growth in S.D.A. And P.D.A. The optimum temperature of the Nmoknat 20m and 25m and 5and 6, 6 gave the best dry weight of the fungal spinning *C. sphaerospermum.*
The main goal of this research was studying the main eco-physiological factors that affect mycelial growth rate including temperature, pH, media. This study thus was conducted due to the importance of this fungus and the lack of concentrated studies that highlight nutritional and environmental conditions required for the optimum growth of this fungus.

## Materials and Methods
### Fungi Isolates
*C. sphaerospermum* isolates were obtained from seed and air collected from different region in Najaf province in Iraq.

### Environmental Studies
The effect of some cultural conditions such as nutrient media, temperature and PH on growth of fungi *Cladosporium sphaerospermum*, was carried out. The inoculums were in the form of disks, prepared using a sterile cork poorer (5 mm). The disks were obtained from homogenous growth of 5 days old cultures grown in Potato Dextrose Agar (PDA) medium at 28°C. All the three conducted experiments in this study were complete randomized design (C.R.D.) with three replicates. The experiments were carried out in the graduate laboratory of plant pathology in the Dept.of Plant Protection/Faculty of Agriculture-Univ. of Kufa

### Temperature effects on growth of two *C. sphaerospermum* isolates
Two isolates (C1 and C2) of *C. sphaerospermum* were grown under nine temperature rates (5, 10, 15, 20, 25, 30,

35, 40 and 45 C°) for detection the optimum temperature required for the maximum growth of fungal mycilia. A 0.5 cm diameter disc was taken from 7 days old pure culture of the fungus. The disc then was cultured in the center of Petri dish containing standard PDA medium. The dishes were incubated according to the temperatures mentioned. The radial growth of *C. sphaerospermum* isolates was calculated after 10 days of incubation by measuring colony diameter (AIhara *et al.*, 2002) [2].

**Effect of different pH values on growth of two *C. sphaerospermum* isolates**

Standard PDA medium was used with five pH levels (4, 5, 6, 7 and 8) to determine the best pH value for growth of two *C. sphaerospermum* isolates. The pH value was modified using HCl and NaOH. Three Petri dishes containing standard PDA were cultured with *C. sphaerospermum* as formerly mentioned for each isolate and each pH value. The dishes were incubated at 25C°. Ten days after, the fungal radial growth was measured for each dish for growth rate calculation (Alhussaini *et al.*, 2015) [3-4].

**Effect of culture medium type on growth of *C. sphaerospermum* isolates**

Three different culture media (P.D.A., P.S.A. and S.D.A.) were examined for their effects on the growth of the two fungal isolates. A three 9 cm petri dishes were cultured with each fungal isolate for each tested media. Each growth medium was prepared isolate according to the manufacture company instructions. After preparation, media were sterilized, cooled, poured in Petri dishes and incubated for use. Dishes were inoculated with the 7 days old *C. sphaerospermum* isolates as was described. All the prepare dishes were incubated at 25 C°. Fungal growth (colony diameter) was measured and recorded 10 days post inoculation (Dean *et al.*, 2005).

**Statistical analysis**

Data from the three experiments were analyzed and analysis of variance ANOVA was performed using GenStat 12th edition (https://www.vsni.co.uk/). Means were compared according to least significant difference (L.S.D.) at 95% confidence ($P \leq 0.05$).

**Results and Discussion**

**Temperature effects on growth of two isolates of *C. sphaerospermum* (C1 and C2)**

The results of Table (1) showed that growth of the two *C. sphaerospermum* isolates C1 and C2 significantly differed at different temperature levels. Generally, the C2 isolate gave radial growth of 0.57 cm which significantly differed from that of the C1 isolate (0.38 cm). It was also noticed that different temperature levels had significant effects on the growth of the two fungal isolates. The 25C° resulted in the highest fungal radial growth (1.45 cm) compared to all the tested temperature rates.

**Table 1:** Temperature effects on growth of two isolates of *C. sphaerospermum* (C1 and C2).

| Treatments (fungal isolates) | Fungal radial growth (cm) | | | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | Temperatures | | | | | | | | | |
| | 5 C° | 10 C° | 15 C° | 20 C° | 25 C° | 30 C° | 35 C° | 40 C° | 45 C° | |
| *C. sphaerospermum* (C. 1) | 0 | 0 | 0.5 | 1.1 | 1.4 | 0.3 | 0.1 | 0 | 0 | 0.38 |
| *C. sphaerospermum* (C. 2) | 0 | 0.1 | 0.7 | 1 | 1.5 | 1 | 0.6 | 0.2 | 0 | 0.57 |
| Mean | 0 | 0.05 | 0.6 | 1.05 | 1.45 | 0.65 | 0.35 | 0.1 | 0 | |
| LSD $_{P\leq0.05}$ | Fungi=0.0846 | | | Temperature=0.179 | | | Interaction=0.253 | | | |

Values are means of three replicates. Differences among treatments were calculated based on least significant difference LSD ($P \leq 0.05$).

**The effect of pH values on the growth of C1 and C2 isolates of *C. sphaerospermum*.**

Results showed that fungal growth of the isolates was affected by different pH values (Table 2). The C2 isolate in general gave radial growth (0.96cm) higher than the radial growth of C1 isolate (0.52cm). The highest fungal radial growth (1.53cm) was recorded at pH 6 which significantly differed from that recorded at pH5 and pH7 gave ( 0.73cm) and (0.783cm) respectively, while no fungal growth was detected at pH4 and pH8,. The C1 isolate was more affected by the pH6 resulting in radial growth of (1.5cm) which is significantly lower than that of C2 (0.9cm).

It was observed that the growth rate of the isolates of C2 and C1 with pH 6 was (1.5 cm) each, while the growth of isolating C2 in function 5 was (0.9 cm) and the isolation of C1 was (0.6 cm) while the C2 isolation in function 7 gave growth rate (1.0 cm) and the isolation of fungi C1 was (0.4 cm).

**Table 2:** pH values effects on growth of two isolates of *C. sphaerospermum* (C1 and C2)

| Treatments (fungal isolates) | Fungal radial growth (cm) | | | | | Mean |
|---|---|---|---|---|---|---|
| | PH | | | | | |
| | 4 | 5 | 6 | 7 | 8 | |
| *C. sphaerospermum* (C. 1) | 0 | 0.633 | 1.533 | 0.433 | 0 | 0.5198 |
| *C. sphaerospermum* (C. 2) | 0 | 0.933 | 1.533 | 1.033 | 0 | 0.6998 |
| Mean | 0 | 0.783 | 1.533 | 0.733 | 0 | |
| LSD $_{P\leq0.05}$ | Fungi=0.0352 | | pH=0.0557 | | Interaction=0.0788 | |

Values are means of three replicates. Differences among treatments were calculated based on least significant difference LSD ($P \leq 0.05$)

**Effect of culture medium type on growth of *C. sphaerospermum* isolates**

Fungal radial growth of the two *C. sphaerospermum* isolates differed as the growing medium differs (Table3). Both isolates showed similar total growth on all the media tested even though the C2 had slightly higher radial growth

(1.4cm) than C1 (1.3cm). The SDA medium resulted in the highest fungal radial growth that of 1.44cm compared radial growth of 1.34cm and 1.31 resulted from PDA and PSA media, respectively. Interaction effect showed that C2 on the SDA medium resulted in the highest radial growth value (1.45cm) with slight difference from the C1 (1.43cm) on the same medium. Similar results were detected on the two other media where the fungal radial growth of the C2 isolate was always higher than that of C1.

**Table 3:** Fungal growth of two isolates of *C. sphaerospermum* (C1 and C2) affected by different type of growing media

| Treatments (fungal isolates) | Fungal radial growth (cm) | | | Mean |
|---|---|---|---|---|
| | Media | | | |
| | PSA | SDA | PDA | |
| *C. sphaerospermum* (C. 1) | 1.23 | 1.43 | 1.33 | 1.33 |
| *C. sphaerospermum* (C. 2) | 1.39 | 1.45 | 1.35 | 1.4 |
| Mean | 1.31 | 1.44 | 1.34 | |
| LSD $_{P\leq0.05}$ | Fungi=0.0352 | Media=0.0557 | Interaction=0.0788 | |

Values are means of three replicates. Differences among treatments were calculated based on least significant difference LSD ($P\leq0.05$)

The overlap rate observed that the growth rate of isolating the C2 isolates on the SDA medium was (1.45 cm), C1 growth rate was (1.43 cm), while the growth rate of isolation of the C2 on the center of the PDA was (1.35 cm) and isolating the fungus C1 gave (1.33 cm) and gave the growth rate of isolation of the fun C2 on the center of PSA was (1.39cm) and isolating the fungus C1 gave (1.23cm).

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