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Study the effect of various sources of carbon, nitrogen and pH levels on growth of *Fusarium oxysporum* f. sp. *capsici*

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Abstract
Fusarium wilt of chilli caused by *Fusarium oxysporum* f. sp. *capsici* has been emerging as one of the biotic threats in profitable cultivation of chilli crop. Therefore, present study was undertaken with the objectives *viz.*, effect of carbon, nitrogen and pH levels on growth of *Fusarium oxysporum* f. sp. *capsici*, The nutritional requirement of test pathogen was carried by using the various carbon and nitrogen sources. All the seven carbon sources were significantly utilized by the pathogen. Among that Glucose and Dextrose showed maximum growth followed by Lactose. From the seven nitrogen sources, Potassium nitrate, Calcium nitrate and Urea were best for growth of the test fungus. The different eight pH levels were studied, which revealed that pH range from 5-8 was suitable for growth of the fungus. The fungus growth was found maximum at pH levels 7 and 6.5.

Keywords: Various, carbon, nitrogen, *Capsicum annuum* L.

Introduction
Chilli (*Capsicum annuum* L.) is an important vegetable cum spice crop grown in almost all parts of tropical and subtropical regions of the world. It belongs to the family Solanaceae and originated from South and Central America where it was domesticated around 7000 BC. It was introduced in India by the Britishers in the 19th century in Shimla hills. Different varieties are cultivated for vegetable, pickles, spice and condiments.

India is the leading producer and consumer of chilli. In India chilli is grown for vegetable purpose *i.e.* green chilli and also for spice *i.e.* red chilli. Area under green chilli cultivation is about 316 thousand hectares with production of 3634 thousand metric tonnes and area under dried chilli is about 840 thousand hectares with production of 2096 thousand metric tonnes (Anonymous, 2017) [1].

Though this crop is profitable, the production and productivity of this crop on farmers field is very poor. There are several factors responsible for low productivity of chilli, but diseases caused due to biotic agents are the major one. The major diseases affecting to chilli crop are fungal *viz.*, Anthracnose and fruit rot (*Colletotrichum gloeosporioides*, *Colletotrichum capsici*), Root rot (*Phytophthora capsici*, *Rhizoctonia solani*), Damping off (*Pythium aphanidermatum*), Powdery mildew (*Leveillula taurica* / *Oidiopsis taurica*), *Fusarium* wilt (*Fusarium oxysporum* f. sp. *capsici*).

Among the various diseases, *Fusarium* wilt is very important, caused by the fungus *Fusarium oxysporum* f. sp. *capsici*. *Fusarium* is a soil borne fungus. Once a field is infected, the pathogen may survive in the soil for many years. The fungus can be disseminated by farm equipment, drainage water, wind, or animals, including humans. Generally, the dry weather condition and excessive soil moisture enhance the disease development and also when crop rotations are not practiced (Agrios, 2005) [1].

Material and Methods
Effect of various carbon sources
The growth of *Fusarium oxysporum* f. sp. *capsici* was studied by replacing standard carbon sources in place of original one in Czapek's dox agar medium.

Twenty ml of the respective sterile medium was aseptically dispensed in sterilized petri dishes under a laminar air flow were inoculated with six mm discs of *Fusarium oxysporum* f. sp. *capsici* with the help of a sterile cork borer under aseptic conditions. The petri dishes were incubated at 27 ± 20C for ten days in BOD incubation. The growth in different treatments was measured as diameter of the colony in each Petri dish.

Table 1: Treatment details

Tr. No.	Treatments
T1	Sucrose
T2	Glucose
T3	Dextrose
T4	Maltose
T5	Mannitol
T6	Lactose
T7	Starch

Effect of various nitrogen sources

The growth of *Fusarium oxysporum* f. sp. *capsici* was studied by replacing standard nitrogen sources in place of original one in Czapek's dox agar medium. Twenty ml of the respective sterile medium was aseptically dispensed in sterilized petri dishes under a laminar air flow and inoculated with 5 mm discs of *Fusarium oxysporum* f. sp. *capsici* with the help of a sterile cork borer under aseptic conditions. The petri dishes were incubated at 27 ± 20C for seven days in BOD incubation, their after the growth in different treatments was measured as diameter of the colony in each petri dish.

Table 2: Treatment details

Tr. No.	Treatments
T1	Sodium nitrate
T2	Ammonium oxalate
T3	Urea
T4	Potassium nitrate
T5	Calcium nitrate
T6	Magnesium nitrate
T7	Ammonium nitrate

Effect of different pH levels

The stock culture of *Fusarium oxysporum* f. sp. *capsici* were grown on PDA for seven days and cut into 5 mm discs and placed on the center of the pre poured medium (20 ml for each plate). The pH of the media were adjusted by N/10 HCI or N/10 NaOH solutions with the help of pH meter. The inoculated plates were placed in inverted position and incubate at 27 ± 2°C up to seven days. The colony diameter was recorded by measuring the redial growth of the colony in mm. Further, the difference in the rate of growth were recorded and analyzed statistically.

Table 3: Treatment details

Tr. No	Treatments
T1	5.0
T2	5.5
T3	6.0
T4	6.5
T5	7.0
T6	7.5
T7	8.0
T8	8.5

Results and Discussion

Effect of carbon sources

The results (Table 4, PLATE1 & Fig.1) revealed that all of the test carbon sources showed significant effect on growth of the test pathogen. However in Glucose (75.33 mm) gave maximum growth, followed by Dextrose (73.66 mm), Lactose (71.00 mm), Maltose (67.00 mm), Mannitol (64.00 mm) and Sucrose (60.66 mm).

Table 4: Effect of different carbon sources on growth of *F. oxysporum* f. sp. *capsica*

Tr. No.	Treatments	Mean Colony Diameter (mm)*
T1	Sucrose	60.66
T2	Glucose	75.33
T3	Dextrose	73.66
T4	Maltose	67.00
T5	Mannitol	64.00
T6	Lactose	71.00
T7	Starch	66.66
S. E. (m) ±		0.35
C.D (P = 0.01)		1.03

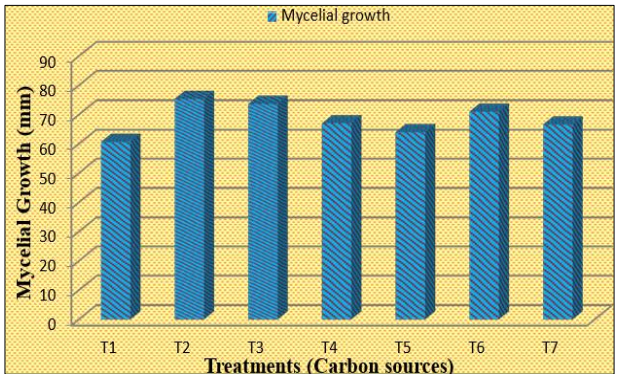

Fig 1: Effect of different carbon sources on growth of *Fusarium oxysporum* f. sp. *capsica*

Plate 1: Effect of different carbon sources on growth of *Fusarium oxysporum* f. sp. *capsica*

Effect of nitrogen sources

The results (Table 5, PLATE 2 & Fig. 2) revealed that among the test nitrogen sources, Potassium nitrate showed maximum mycelial growth (64.50 mm), followed by Calcium nitrate (63.16 mm), Urea (62.66 mm), Magnesium nitrate (54.33 mm) and Sodium nitrate (48.33 mm). Ammonium nitrate and Ammonium oxalate showed minimum growth (22.66 mm) and (21.00 mm).

Table 5: Effect of different nitrogen sources on growth of *F. oxysporum* f. sp. *capsica*

Tr. No.	Treatments	Mean Colony Diameter (mm)*
T1	Sodium nitrate	48.33
T2	Ammonium oxalate	21.00
T3	Urea	62.66
T4	Potassium nitrate	64.50
T5	Calcium nitrate	63.16
T6	Magnesium nitrate	54.33
T7	Ammonium nitrate	22.66
	S. E. (m) ±	0.40
	C.D (P = 0.01)	1.18

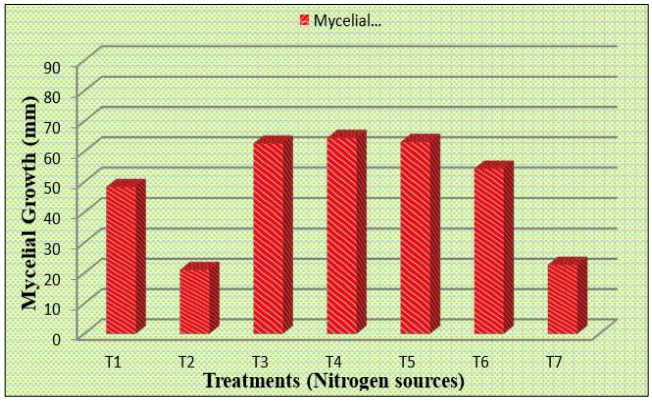

Fig 2: Effect of different nitrogen sources on growth of *Fusarium oxysporum* f. sp. *capsici*

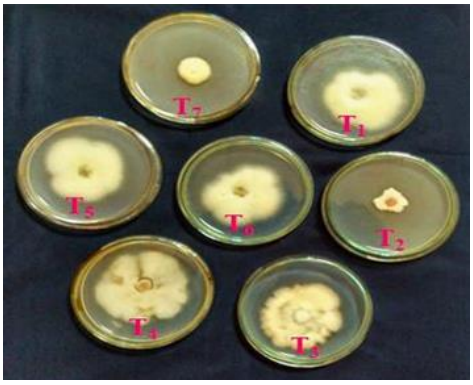

Plate 2: Effect of different nitrogen sources on growth of *Fusarium oxysporum* f. sp. *capsici*

Effect of pH

The results (Table 6, PLATE 3 & Fig. 3) revealed that the pH in the range of 5.0-8.0 was suitable for growth of the test fungus. Significantly highest mycelial growth was found at pH 7.0 (78.33 mm), followed by pH 6.5 (74.00 mm), pH 7.5 (73.83 mm), pH 6.0 (72.50 mm), pH 5.5 (71.33 mm), pH 8.0 (70.83 mm), pH 5.0 (69.00 mm) and pH 8.5 (68.50 mm).

Table 6: Effect of different pH levels on growth of *F. oxysporum* f. sp. *capsici*

Tr. No.	Treatments	Mean Colony Diameter (mm)*
T1	5.0	69.00
T2	5.5	71.33
T3	6.0	72.50
T4	6.5	74.00
T5	7.0	78.33
T6	7.5	73.83
T7	8.0	70.83
T8	8.5	68.50
S. E. (m) ±		0.50
C.D (P = 0.01)		1.46

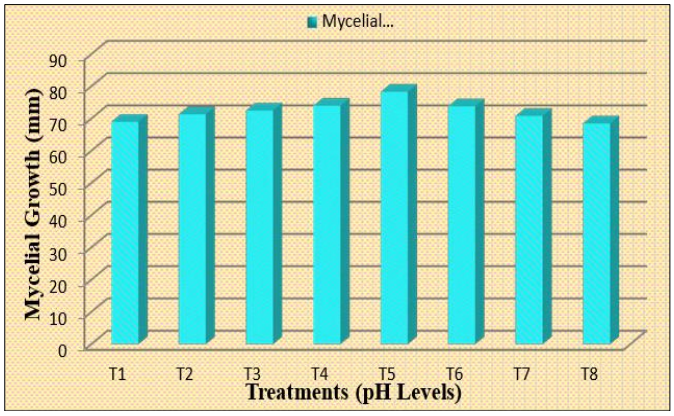

Fig 3: Effect of different pH levels on growth of *Fusarium oxysporum* f. sp. *capsica*

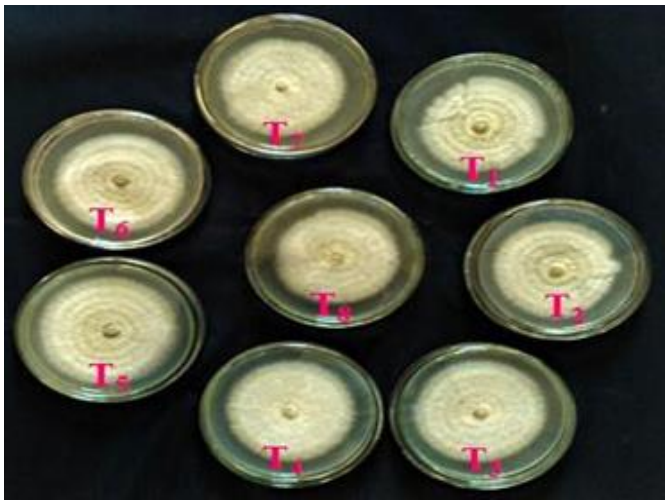

Plate 3: Effect of different pH levels on growth of *Fusarium oxysporum* f. sp. *capsici*

Conclusion

Among seven carbon sources Glucose and Dextrose shows the maximum growth. From various nitrogen sources, the potassium nitrate show maximum growth. The pH level ranging from 5.0-8.0 was suitable for growth of the fungus. Among that the pH level 7.0 and 6.5 shows the maximum growth of the test fungus.

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