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Effect of *Fusarium oxysporum* on germination and seedling growth of sesamum

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Abstract
Sesame (*Sesamum indicum* L.) is an annual plant of the *Pedaliaceae* family and one of the most ancient oilseed crops known to man. Sesame has been grown, for cooking and medicinal needs. Generally, 65% of world sesame production is used as edible oil, and 35% for confectionary purpose. In the present investigation five seed samples *viz.,* AKT-101, GT-10, JLT-408, N-8, PKV NT-11 were tested to detect the association of seed borne mycoflora by standard blotter paper method, pretreatment blotter method and agar plate method. From the present study it was revealed that six fungal species associated with sesamum varieties *viz., Fusarium oxysporum, Aspergillus niger, Aspergillus flavus, Alternaria alternata, Curvularia lunata and Cladosporium* spp. Standard blotter paper method was found superior in detection of seed borne mycoflora of sesamum. The inhibitory effect of major seed borne fungus *Fusarium oxysporum* was observed on seed germination, seedling length and seedling vigour index of sesamum varieties by towel paper method. The result indicated that uninoculated seed samples exhibited germination in the range of 83.25% to 96.50% while the inoculated seed samples showed germination ranging from 52.50% to 65.25%. Shoot length were ranged from 2.8 to 3.4 cm in inoculated seed samples and 6.3 to 7.2 cm in uninoculated samples. Root length was ranged from 4.6 to 5.5 cm in inoculated seeds and 6.9 to 8.1 cm in uninoculated seeds. It was observed that shoot and root length of sesamum varieties reduced due to *Fusarium oxysporum* over an uninoculated seeds. A seedling vigour index ranged from 388.50 to 580.70 in inoculated seeds and it was ranged from 1182.10 to 1389.60 in uninoculated seeds.

Keywords: Seed mycoflora, seed treatment, *Fusarium oxysporum*

Introduction
Sesame (*Sesamum indicum* L.) is an annual plant of the *Pedaliaceae* family and one of the most ancient oilseed crops known to man. Sesame has been grown, for cooking and medicinal needs. Generally, 65% of world sesame production is used as edible oil, and 35% for confectionary purpose. The fatty acid composition contains high levels of unsaturated fatty acids, and low levels of saturated (less than 15%) and antioxidant fatty acids. The presence of antioxidants has been reported to have health promoting effects, such as lowering cholesterol levels and hypertension in humans and to have neuroprotective effects against brain damage, as well as reducing the incidence of certain cancers. Sesame seed is a source of protein and high in sulfur, containing amino acids, minerals, and vitamins. Sesame oil compounds also have multiple physiological functions, such as estrogenic activity, providing anti-inflammatory functions, and decreasing blood lipids and arachidonic acid levels.
Sesamum seeds infected by different seed borne mycoflora. Infected seeds disperse mycoflora from seed to seed. They cause seed to deteriorate in the soil prior to germination, resulting in seedling mortality. Workers in sesame seeds, however, discovered an association of fungi such as *Alternaria dianthicola, Aspergillus flavus, Aspergillus ustus, Macrophomina* spp, *Alternaria sesame, A. Sesamicola, and Alternaria tenuis.* Seed borne mycoflora such as *Alternaria* spp. *Aspergillus* spp. *Fusarium* spp. *Curvularia* spp. *Cephalosporium* spp. *Dreschslera* spp., and *Penicillium* spp. minimize sesamum seed germination and seedling vigour.

Methodology
Detection of seed borne mycoflora from sesamum
Different seed health testing method *viz.,* standard blotter paper method, pre-treatment blotter method and agar plate method were employed to investigation or detection of seed borne fungi associated with sesame seed samples and isolate it separately.

Effect of seed mycoflora on seed germination per cent, shoot growth, root growth and seedling vigour index

In order to study of mycoflora on seed germination, seedling growth and seedling vigour index, cultural filtrate was prepared as follows.

Preparation of cultural filtrare

The ten day old fungal growth of fungal species on the agar plate was scraped, and the scraping were made into a concentrated suspension by adding them to 1 ml sterile water which was further diluted so as to have a spore suspension.

Seed inoculation

Apparently healthy seeds of sesame cultivars were surface sterilized soaked in conidial suspension of mycoflora for 30 min dried at room temperature for overnight. The seed of control treatment were similarly treated except that they were soaked in sterile distilled water.

Rolled paper towel method

This method was used to determine the effect of seed borne inoculum on sesamum seed quality parameters, i.e., germination and vigour tests. According to ISTA rules**.** 100 seeds were randomly chosen and placed on two layers of moist germination paper, which were then stacked 10 seeds per row on a polythene sheet**.** These seeds were coated with another moist germination and carefully rolled to avoid putting too much pressure on the seed. The rolled towel paper was placed in a slanting position against the wall of the laboratory tables and incubated for 7 days at 26±2°C. On the seventh day, the first count of germination was made. The seedlings that were morphologically normal were counted, and germination was expressed as a percentage.

Germination (%)

On the day of final count, all normal seedling were counted. Based on the number of normal seedlings, the germination per cent from each sample in each replication was computed as per the formula mentioned here.

$$\text{Germination (\%)} = \frac{\text{Number of normal seedling}}{\text{Total number of seed sown}} \times 100$$

Seedling length (cm)

Ten normal seedling were taken from each sample in each replication at random on the seventh day and the seedling length was measured from the tip of the primary leaf to the tip of primary root with the help of scale and mean seedling length was expressed in centimeters.

Seedling vigour index

Seedling vigour index was calculated using the following formula given by Abdul Baki and Anderson (1973) [1].

Seedling vigour index = Germination (%) x Mean seedling (cm)

Result

Detection of seed borne mycoflora with different method

Different standard methods were used to detect the presence of seed borne mycoflora includes standard blotter paper method, pretreatment blotter paper method and agar plate method.

The observation recorded in all the methods were presented in Table 1 revealed that the association of *Fusarium oxysporum* had the highest mean incidence (31.58%), followed by *Aspergillus Niger* (26.00%) and *Aspergillus flavus* (10.58%). The other remaining fungi *viz., Alternaria alternata*, *Curvularia lunata* and *Cladosporium* spp had shown least mean association recorded 2.41, 1.58 and 1.16 per cent respectively. *Fusarium oxysporum* was found to be the most common fungus, followed by *Aspergillus Niger* and *Aspergillus flavus*.

It was observed that the standard blotter paper method had a highest per cent association of seed borne mycoflora in the range (1.50 to 39.25%) followed by agar method (1.25 to 31.25%) and in pretreatment blotter method had association of seed borne mycoflora represented in the range of (0.75 to 24.25%) similar result given by, Tobin-West *et al.,* (2018) [6] and Ranasingh *et al.,* (2019) [5].

Table 1: Detection of seed borne mycoflora with different methods

Fungi	Per cent association of seed borne mycoflora in different methods			Total	Mean
	Blotter	Pretreatment blotter	Agar plate method		
Fusarium oxysporum	39.25	24.25	31.25	94.75	31.58
Aspergillus niger	35.00	17.75	25.25	78.00	26.00
Aspergillus flavus	16.50	4.50	10.75	31.75	10.58
Alternaria alternate	3.25	1.25	2.75	7.25	2.41
Curvularia lunata	2.50	1.00	1.25	4.75	1.58
Cladosporium spp	1.50	0.75	1.25	3.50	1.16

Fusarium oxysporum

Aspergillus Niger

Aspergillus flavus

Plate 4a: Seed borne mycoflora

Alternaria alternate

Curvularia lunata

Cladosporium spp

Plate 4b: Seed borne mycoflora

Effect of *Fusarium oxysporum* on germination, shoot, root growth and seedling vigour index on sesamum seeds

Significant variation in germination was observed between the inoculated and uninoculated seed samples of different varieties of sesamum. The uninoculated seed samples exhibited germination in the range of 83.25% to 96.50% while the inoculated seed samples showed germination ranging from 52.50% to 65.25%. The highest germination percentage was recorded in variety JLT-408 (65.25, 96.50) followed by GT-10, PKV NT-11 and AKT-101 recording (60.75, 93.75), (53.50, 89.25) and (52.50, 83.25) percent respectively in inoculated and uninoculated seeds.

From above data it was indicated that similar trend was also noticed in shoot and root length of seedling varied significantly between inoculated and uninoculated seeds of sesamum varieties. Shoot length were ranged from 2.8 to 3.4 cm in inoculated seed samples and 6.3 to 7.2 cm in uninoculated samples. Root length was ranged from 4.6 to 5.5 cm in inoculated seeds and 6.9 to 8.1 cm in uninoculated seeds. It was observed that shoot and root length of sesamum varieties reduced due to *Fusarium oxysporum* over an uninoculated seeds. Among all the varieties highest shoot length was recorded in GT-10 followed by AKT-101 recording 7.2 and 6.8 cm respectively in uninoculated seeds. Maximum shoot length was observed in JLT-408 followed by GT-10, recording 3.4, 3.1 cm. PKV NT-11 and AKT-101 exhibiting 2.8 cm each in inoculated seed. Similarly the highest root growth was noticed in JLT-408 followed by PKV NT-11, AKT-101 recording 8.1, 7.9 and 7.4 cm in uninoculated seed respectively whereas maximum root growth was observed in JLT-408 followed by PKV NT-11 and GT-10 recording 5.5, 5.1 and 5.0 cm respectively in inoculated seed.

In seedling vigour index it was observed that reduction in seedling vigour index take place by *Fusarium oxysporum* inoculated seeds over an uninoculated seeds. A seedling vigour index ranged from 388.50 to 580.70 in inoculated seeds and it was ranged from 1182.10 to 1389.60 in uninoculated seeds. In variety JLT-408 580.70 seedling vigour index in inoculated seeds over an uninoculated seeds (1389.60). In GT-10 492.00 seedling vigour index in inoculated and 1321.80 in uninoculated seed. In variety PKV NT-11 422.60 in inoculated while 1321.80 in uninoculated. In variety AKT-101 388.50 in inoculated and 1182.10 in uninoculated. Thus it was observed that singnificant variation was noticed in seedling vigour index in inoculated and uninoculated seeds.

Similar types of result were also reported by Murli Krishna (2006) [2], Nagraja *et al*., (2009) [3], Patil *et al.*, (2018) [4].

Fig A: Rolled Towel Paper

Table 2: Effect on germination per cent and seedling vigour index after inoculating seed with *Fusarium oxysporum*

Variety	Germination Per cent		Shoot Growth (cm)		Root Growth (cm)		Seedling vigour Index	
	In	Un	In	Un	In	Un	In	Un
AKT-101	52.50	83.25	2.8	6.8	4.6	7.4	388.50	1182.10
PKV NT-11	53.50	89.25	2.8	6.5	5.1	7.9	422.60	1321.80
GT-10	60.75	93.75	3.1	7.2	5.0	6.9	492.00	1321.80
JLT-408	65.25	96.50	3.4	6.3	5.5	8.1	580.70	1389.60

In-Inoculated Un-Uninoculated

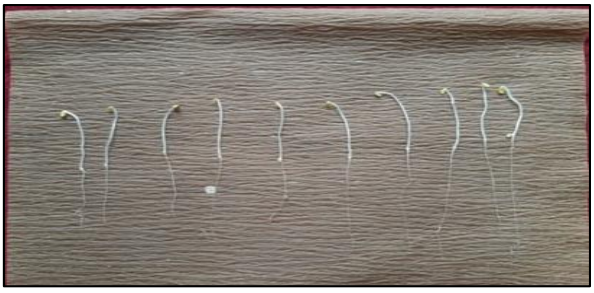

Fig B: Uninoculated seed germination

Fig C: Germination in inoculated seed with *Fusarium oxysporum*

Conclusion

Sesamum seeds were associated with six fungal species *viz.*, *Fusarium oxysporum*, *Aspergillus Niger*, *Aspergillus flavus*, *Alternaria alternata*, *Curvularia lunata and Cladosporium spp*. After artificial inoculation with *Fusarium oxysporum*, significant differences were recorded in germination, seedling length, and seedling vigour index.

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