# STUDIES ON SOME FUNGI CAUSING ROT TO TOMATO FRUITS

By

MOHAMMED ABD EL-LATIF NOFAL
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## THESIS

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Faculty of Agriculture
Ain Shams University
Cairo, Egypt

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APPROVAL SHEET

Approved by :

T. Abdel Hak

Nour El Dine Nemat

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Date : 24 / 5 / [illegible]

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# A C K N O W L E D G M E N T

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# INTRODUCTION

Egypt is considered as the most important tomato producing country in the Middle East. During the period from 1965 to 1969, the total production of Egyptian tomato amounted to about 62% of the total production of tomato produced in the Middle East, and about 430% and 110%* of the total tomato production in Netherland, and Spain respectively.

Tomato is produced during the whole year and exported during the year especially during the period from December to March. The tomato exported to foreign markets increased from 3610 metric tons, 1965 to 4420 metric tons,** 1969.

Tomato fruits suffer considerable loss in the field and during shipping and storage especially from tomato fruit rotting fungi. Tomato rot is considered as one of the most important limiting factors governing the expansion in exportation. This necessitates development of knowledge concerning relationship between rot fungi and keeping quality of tomato fruit.

This work was designed to investigate the following :

1) Isolation and identification of tomato fruit rot fungi.
2) Physiological studies on tomato fruit fungi to determine the effect of media, temperature, relative humidity, pH

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* F.A.O. Production Year Book Vol. 23 (1970).
** F.A.O. Trade Year Book Vol. 23 (1970).

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value and glucose/peptone ratio.

3) Determination of metabolites excreted by fungi and determination of its toxicity to bacteria, and the retarding and stimulating effects of the substances.
4) Pectolytic and cellulolytic activities of tomato fruit rotting fungi.
5) Effect of cultural treatments, i.e. distance between plants , methods of pruning, and level of nitrogen fertilizer on the spread of fruit rot during storage.
6) Effect of handling tomato fruits, pedicel elimination on the spread of fruit rot fungi during storage.

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## REVIEW OF LITERATURE

Causal Organisms :

A great number of fungi causing deterioration and fruit rot to tomato fruits during storage has been recorded.

The causal organisms causing fruit rots were, *Alternaria tenuis* Nees ( 1, 6, 10, 18, 20, 22, 23, 24, 31, 39, 50, 51, 55, 58, 60, 77, 88 ). *Alternaria* spp. ( 9, 17, 27, 31, 38, 87 ), *Fusarium oxysporum* Schlect,em Sny.and Hans. ( 29, 55 , 66, 78, 82, 88 ). *Fusarium* spp. ( 6, 12, 17, 27, 31, 38, 44, 60, 65, 77, 78, 82, 87 ), *Aspergillus flavus* Link ( 22 ), *Aspergillus* spp. ( 12, 67, 18 ), *Trichothecium roseum* Link ( 12, 15, 27, 65, 78 ), *Penicillium verruculosum* Peyrone(20), *Penicillium* spp. ( 66 ), *Oospora lactis parasitica* Prit. and Porte ( 20, 23, 87 ), *Botrytis cinerea* Auct. ( 10, 18, 25, 31, 38, 88 ), *Rhizopus* spp. ( 10, 18, 20, 22, 67, 68, 87 ), *Rhizoctonia solani* Kuhn ( 4, 19 ), *Phoma destructiva* Plowright ( 31, 38, 86 ), *Colletotrichum coccodes* Saccardo ( 6, 87 ), *Geotrichum candidum* Link ( 10 ), *Phomopsis* spp. ( 6 ), *Helminthosporium* spp. ( 67 ), *Monilia* spp. ( 67 ), *Mucor* spp. ( 87 ), *Pleospora herbarum* Person ( 10 ) , *Stemphelium* spp. ( 31 ) and *Didymella* spp. ( 31 ).

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Physiological Studies :

Growth of fungi causing tomato fruit rots varies according to the environmental conditions among which media, degrees of temperature, relative humidity, pH values, C/N ratio in the media, are the most important.

Effect of Media :

The most favourable media for the growth of the different fungi varies considerably. For A. tenuis it was glucose-peptone ( 60 ), potato-dextrose ( 3, 4, 26, 39, 88 ) and Richard's ( 4, 26 ), whereas for F. oxysporum it was Dox's ( 60 ), potato-dextrose ( 14, 88 ) and Richard's ( 26, 32 ).

Effect of temperature :

The optimum temperature for the growth of A. tenuis was 25°C ( 1, 4, 16, 23, 26, 33, 59, 60, 88, 90 ) and 26°C ( 49 ). for F. oxysporum the optimum temperature was 25°C (59, 88, 90), 27°C ( 14 ), and grew on a wide range from 13° to 32°C ( 72 ), and from 10 to 40°C ( 21 ). El-Helaly et al. ( 20 ), found that the rotting of the artificially wounded tomato fruits took place at 20 to 35°C for A. tenuis, P. verruculosum , O. lactis parasitica,&Rh. nigricans.

Relative humidity :

The best growth was obtained at a relative humidity of 73.5% ( 3, 26 ), 75.5% ( 4 ), for A. tenuis and 80% for A. flavus ( 61 ).

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The growth rate of A. tenuis and F. semitectum slightly increased with the increase of relative humidity ( 77 ). The relative growth rate of F. semitectum increased to an optimum at about 90% R.H., above which it decreased ( 60 ).

pH value :

The optimum pH for the growth of A. tenuis was 4.1, on both Dox's agar and glucose/peptone ( 88 ), 5.4 ( 33 ), 5.9 ( 1 ), 6.0 ( 3,60 ), 6.5 ( 39 ), 6.7 ( 23 ). The favourable range of pH for the growth of A. tenuis was from 3.6 - 10.5 ( 26 ), 3.9 - 6.7 ( 4 ) and 2.7 - 8.0 ( 33 ), while its mycelial growth showed a pronounced staling at pH 8.0 ( 77 ). The susceptibility of tomato tissues to infection with F. culmorum and F. oxysporum increased with the increase of their pH value ( 82 ).

The optimum pH value for the growth of Fusarium oxysporum was 4 - 7 ( 45 ), 5.1 ( 88 ), 6.0 ( 4 ), 3 - 5 ( 44 ). The range of pH for growth of F. lycopersici was 2.7 to 7.2 ( 60 ).

Carbon/nitrogen ratio :

The C/N ratio of the media exerted a marked effect on the amount and rate of growth of fungi.

Fusarium oxysporum f. vasinfectum gave the best growth on medium containing 10 g glucose and 5 g peptone. It

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produced **minimum growth** on medium containing 10 : 10 or 2.5 : 5 as sole sources of carbon and nitrogen respectively (14).

The **dry weight** of *A. tenuis* increased with the increase in C/N ratio ( 33 ).

Fungal metabolites :

A great number of substances has been recorded to be secreted from the fungal mycelia. Some of these substances have a phytotoxic effect ( 89 ).

Fungal filtrates had an inhibitory effect on growth of *Bacillus subtilis* ( 2, 8, 42, 70, 80, 89 ). Fusaric acid, a wilt inducing toxin produced by *F. oxysporum* f. *lycopersici* was determined by means of paper chromatography ( 7, 89 ).

On chromatogram of the filtrate of *F. oxysporum*, zones of inhibition of *B. subtilis* were found with substances having $R_f$ 0.87 - 0.88 ( 7 ). Toxins of *F. oxysporum* f. *lycopersici* were found to be fusaric acid, succinic acid, ethyl alcohol and inulin. They affected root growth, while high dilutions of lycomarasmin stimulated it ( 52 ).

The filtrate of *F. oxysporum* f. *lycopersici* completely inhibited growth of tomato seedlings. Dilutions of 1 / 10 caused slight inhibition, while 1/100 or 1/1000 increased root elongation ( 54 ). The culture filtrates of *A. tenuis* either boiled or unboiled caused wilting of tomato cuttings

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( 71 ).

Neither indole acetic acid nor other derivatives were detected in culture filtrates of two strains of F. oxysporum f. lycopersici. It was suggested that the growth promotion associated with infection, was not due to auxins, although they might be induced in vivo ( 54 ).

Fusarium lycopersici, and F. oxysporum produced toxic substances when grown on modified Richard's medium. They affected the cut seedlings, i.e. not rooted ones ( 87 ).

Fusaric acid produced by F. oxysporum f. lycopersici inhibited the growth of B. subtilis resulting a halozone on plates inoculated with the organism ( 89 ).

Pectolytic and cellulolytic activities :

The tomato fruit rotting fungi, A. solani, Asp. flavus, Aspergillus spp., F. oxysporum f. lycopersici, and Penicillium sp. were demonstrated as highly active to exert pectolytic enzymes that hydrolyze the pectic constituents of cell walls of tomato fruit tissues ( 11, 13, 28, 62, 78 ).

On the other hand, these fungi were able to hydrolyze pectin when added as carbon source to synthetic media ( 66, 69, 85 ).

Aspergillus flavus, Aspergillus sp., F. oxysporum f. lycopersici, Penicillium sp., and T. roseum were demonstrated

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as active cellulolytic fungi to degrade either cotton fibers or cellulose added to synthetic media ( 34, 35, 43, 47 ). Moreover, fungal strains differed in their cellulolytic activity ( 84 ). In addition, cellulose decomposition by fungi was highly affected by low C/N ratio ( 76 ). On the other hand, tannins, and leucoanthocyanins of the host tissue could inhibit cellulase production by F. oxysporum f. lycopersici ( 30 ).

Relationship between Culture Treatment and Spread of Rots During Storage :

Generally, fresh fruits and vegetables become more susceptible to invasion by pathogens as they are ripened. Ripening process involves physiological changes in the host tissue which makes them more suitable for rapid development of the pathogens ( 83 ).

Mature Prichard tomato fruits tended to suffer a higher percentage of decay than nearly-mature fruits under all storage temperatures. This might be to its faster and normal conditions of ripening. Acidity of tomato juice tended to decrease slightly during storage, the minimum acidity was at the ripe stage ( 37 ).

The percentage of decay and loss of tomato fruit weight increased consistently during storage ( 73, 88 ).The rate and weight of decay increased during storage ( 88 ).

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The wide spread of tomato moulds *A. solani* and *Colletotrichum phomoids* Sacc. often produced only minor lesions on fruits, while *Oospora*, *Rhizopus*, *Fusarium* and *Mucor*, which were generally less frequent in the field, were the most active agents of rot during storage. Tomatoes inoculated with *Rhizopus sp.* developed cracks. Juice from trimmed tomatoes had a higher mould count than juice from untrimmed ones. High mould counts were occasionally obtained where visible rot was minimal and *vice versa* ( 87 ).

Tomato plants grown under glass in inert media and supplied with nutrient solutions containing different levels of nitrogen and Phosphorus, produced fruits with pH values from 4.21 to 4.61. Fruits from plants receiving low levels of both nutrients consistently had low pH values. Those from plants, given high levels of phosphorus or nitrogen had high pH, while the level of the other element remained unchangeable ( 57 ).

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