# PATHOLOGICAL AND PHYSIOLOGICAL STUDIES ON SOME STORAGE DISEASES OF TOMATO



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# INTRODUCTION

The cultivated area of tomato production (*Lycopersicon esculentum* L. ) has been continuously increasing in Egypt during the last years ( Anon. 1968 & 1970 ) due to the increase in population, the development of the tomato processing industry, and the increase in exportation of both fresh fruits and canned tomato products.

The increase in tomato production can be achieved by increasing the cultivated area; increasing the yield through the use of better varieties and more suitable, modern cultural practices to approach the maximum possible yield and quality under local conditions, and by minimizing fruit losses during harvesting, handling, storage and marketing.

The addition of chemicals to wash water of the fruits, one of the first methods of application of a post-harvest fungicide, is still extensively used. The main aim of this post-harvest treatment is to prevent the primary infection and the spread of rotting from field infected berries, during the potential storage life of the fruits.

Thus, there is no doubt that finding means to control or minimize decay of tomatoes, would be of great value to the grower, the retailer, and the consumer.

The present dissertation was conducted in order to elucidate the following points :

1) Isolation and identification of causal organisms of tomato rots during storage at various temperatures.

2) Effect of picking stage and artificial ripening by acetylene on the incidence of tomato storage diseases.

3) Effect of picking stage and storage on ascorbic acid content of tomato fruits.

4) Effect of foliar application of tomato plants with microelements and growth regulators on the incidence of decay of fruit rot fungi in storage.

5) The influence of chemical treatments on the causal oragnisms of tomato storage diseases.

## REVIEW OF LITERATURE

I. The Causal Organisms :

The fungi that most commonly affect tomato fruits in storage were presented by several workers.

Different species of *Alternaria* and *Macrosporium* cause the spotting and rotting of tomato fruits. *Alternaria tenuis* Nees was reported as the causal organism of tomato fruit rot by Ramsey and Bailey ( 1929 ), Thomass and Freckle ( 1944 ), Taha ( 1949 ), McColloch ( 1951 ), Mostafa and Taha ( 1952 ), El-Shehedi ( 1955 & 1965 b ), Kapoor and Hingorani ( 1958 ), Butler ( 1959 ), Günther and Grümmen ( 1959 ), El-Helaly *et al* ( 1962 ), Tandon and Chaturvedi ( 1965 ), Amara ( 1966 ), Assal ( 1967 ), Lucic ( 1967 ) , Hasija ( 1968 ) and Lockhart *et al* ( 1969 ).

On the other hand, Briton-Jones ( 1925 ),Appel (1933), Eastham ( 1933 ), Nightingale and Ramsey ( 1936 ), Baker ( 1940 ), Brock ( 1950 ), Carilli ( 1952 ), Günther and Grümmen ( 1959 ), White ( 1960 ) and Assal ( 1967 ) demonstrated that fruit rots of tomato were due to *Macrosporium tomato* Cke. and *Alternaria solani* (Ell. & G. Martin) L.R. Jones and Grout.

Robert ( 1951 ), Ragab ( 1956 ) and Girgis ( 1963 ) recorded that Trichothecium roseum Lk. ex Fr. attacked tomato fruits in storage.

Different species of Fusarium could cause the fruit decay of tomato, i.e. F. acuminatum (Ell. & Ev.) Wr. (Appel, 1933), F. semitectum Berk. et Rav. Wr. and Rg. ( Taha, 1949; Mostafa and Taha, 1952, and Taha and Sharabash, 1960 ), F. moniliforme Sheld., F. sambucinum FKl. pr.p.Wr. and Rg.(Taha and Sharabash, 1960 ), F. redolens Wr. Wr. and Rg. (Grainger, 1968) and Fusarium spp. Nightingale and Ramsey,(1936 ), Baker ( 1940 ), Sharabash ( 1957 ), Günther and Grümmen(1959), White ( 1960 ), Girgis ( 1963 ) and Lockhart et al ( 1969 ).

El-Shehedi ( 1955 ) mentioned that Aspergillus flavus Lk. caused tomato fruit deterioration.

El-Helaly et al ( 1962 ) reported that Penicillium spp. were isolated from deteriorated tomato fruits.

Several workers reported that Rhizopus stolonifer (Ehr. ex Fr.) Lind (R. nigricans Ehr.) was the causal organism of Rhizopus rot on tomato fruits ( Ramsey et al, 1952; El-Shehedi, 1955 and 1965a; El-Helaly et al; 1962 and Girgis, (1963). In addition, Girgis ( 1963 ) and Ratnam and Nema ( 1967 ) isolated Rhizopus arrhizus from tomato fruits.

Effect of temperature :

Wardlow and Guire ( 1933 ) found that tomato fruits could be preserved for as long as 24 days without infection with different storage fungi if held at 47.5° F. The green fruits escaped infection if kept in cold storage at 45.5° F.

Nightingale and Ramsey ( 1936 ) recorded that the minimum, optimum and maximum temperatures of Alternaria tomato growth in vitro were 41°, 75 - 80° and 93° F respectively, while that for spore germination was 80° F. Under moderate temperature and moisture conditions the spores were able to germinate and infect uninjured immature-green fruits. They added that Fusarium spp. on tomatoes grew rapidly at temperatures that were optimum for tomato ripening and caused maximum decay at 75° F. Temperatures of about 40° F practically stopped the growth of the causal fungi and the development of the decay, but these were too low for tomatoes.

Alternaria solani grew well over a wide range of temperature, with an optimum growth ranged between 24 - 30° C. ( Pound, 1951; Sirry and Roushdi, 1961, and Assal, 1967 ).

McColloch ( 1951 ) mentioned that once A. tenuis infection had become established, the rot progressed faster at 70 to 80° F than at lower temperatures. The infection was not prevented, however, by reducing the temperature in transit. Temperature below 60° F delayed fruit ripening but permitted slow development of *Alternaria* rot even at 32°F.

McColloch and Pentzer ( 1952 ) recorded that *Alternaria* injury was induced by storing fruits for 9 days at 40°F or 6 days at 32°F.

McColloch and Worthington ( 1952 ) found that storage temperatures below 50°F were especially harmful to mature-green tomatoes. These temperatures made the fruit susceptible to *Alternaria* decay during subsequent ripening.

Ramsey *et al* ( 1952 ) reported that *Rhizopus* rot on tomato fruit advanced most rapidly at temperatures of about 75° to 80°F. The rate of development fall rapidly with a decrease in temperature to near 50°F. Practically, no growth of the fungus or advance of decay occurred below about 40 to 45°F. They added also that most of the decay of tomato fruits at low temperatures was caused by *Alternaria* sp.

The optimum temperature for *A. tenuis* (*A. alternata*) *in vitro* was estimated by several workers. It was 25-26°C ( Dorn, 1956 ), 28-29°C ( Kapoor and Hingorani, 1958 ), 30°C ( Yehia, 1966 ), 25°C ( Ashour and El-Kadi, 1960; Amara, 1966 and Assal, 1967 ), 26°C ( Lucic, 1967 ) and 28°C ( Saad *et al*, 1970 ).

Chupp and Sheref ( 1960 ) found that *Fusarium* sp. caused light infection below 65°F. It was most virulent between [illegible]7° and [illegible]°F, and retarded if temperature remained at 100°F for more than a few days.

Parsons et al ( 1960 ) mentioned that mature green tomatoes stored directly at 38°F became injured by low temperature, and then developed extensive Alternaria rot. They added that mature-green fruits ripened slowly at 48°F, developed less decay than tomatoes showing some colour when stored for the same period of time. Tomatoes ripened at 55 or 65°F were kept better at 32° than at 38°, but the slow ripening at 55° followed by storage at 32° and 38° favoured extensive decay. Tomatoes ripened at 65° and stored at 32° and 38°F were kept satisfactorily for about 3 weeks. They then concluded that the successful method for extending the storage life of tomatoes was to ripen mature-green fruits at a moderate rate at 58°F, and then store them at 32° to 35°F.

El-Helaly et al ( 1962 ) recorded that no significant rot took place at 5° and 10°C in fruits. They also found that artificially wounded fruits became rotted at 20 to 35°C.

Korobinikova ( 1962 ) found that 18 - 23°C seemed to be the most favourable for F. oxysporum to induce tomato rot.

Girgis ( 1963 ) recorded that the cardinal temperatures for growth and spore germination of Rhizopus nigricans (R. stolonifer) were 7, 28 and 33°C. He added that at 20°C the uninjured fruits were not attacked, while the injured ones were still susceptible at 10°C.

Tomkins ( 1966 ) mentioned that losses in tomatoes stored at more than 10°C were usually caused by over-ripening and wilting. On the other hand, losses in fruits kept at the lower temperature were due to rots.

Yehia ( 1966 ) reported that the optimum temperature for the growth ( in cultural and on tomato fruits )and spore germination of _F. oxysporum_ was 25°C.

Emara ( 1966 ) recorded that tomato fruits were more susceptible to infection with _A. tenuis_ when stored at 5°C for one week and transferred to room temperature at 17-25°C, than those stored for 4 weeks at 5°C or at room temperature.

Assal ( 1967 ) recorded that the optimum temperature for infection and development of rot of _A. solani_ was over than 20°C and less than 35°C, while that for _A. tenuis_ was more than 25° and less than 35°C.

Koushik _et al_ ( 1970 ) found that maximum infection with _A. alternata_ occurred at 30 - 35°C and 70 - 90% R.H.

## Effect of picking stage on decay :

Ramsey and Bailey ( 1929 ) reported that the rate of development of nail head spots was rapid in green tomatoes and decreased as the fruits mature.

Wardlow and Guire ( 1933 ) showed that infection of green fruits by tomato rots started in the field and lead to the development of fungal rots during storage. If fruits escaped infection with fungi, they would possess good quality in cold storage.

Brakes ( 1937 ) investigated that the flavour and quality of tomatoes in which ripening has been delayed by waxing were similar to those of tomatoes in which ripening has been equally delayed by low temperature.

Weber ( 1939 ) recorded that mature-green tomatoes were not attacked in field by Alternaria rot.

Tomkin ( 1951 ) reported that fresh fruits,and vegetables generally, became more susceptible to extensive invasion by pathogens as they ripen. He added that ripening processes involves physiological changes in the host tissue which makes it a more suitable substrate for rapid development of the pathogen.

Ramsey et al ( 1952 ) demonstrated that Rhizopus nigricans may affect tomato fruits when they were ripened either in transit or in the ripening room. Occassionally it affects green fruits. They added that fruits affected with this decay are a total loss. On the other hand, the writers found that *Fusarium* rot is most destructure on ripe tomatoes in the field and not seldom responsible for loss in mature green tomatoes, but it may cause some loss during the ripening of the fruits.

McColloch and Worthington ( 1952 ) mentioned that in storage the mature-green tomato was the most susceptible stage of fruits to the *Alternaria* rot.

Saleh ( 1953 ) reported that the red fruits were more susceptible to *Fusarium* rot than the green ones.

Sharabash ( 1957 ) reported that red fruits showed, however, higher susceptibility to attack with a species of *Fusarium* than the corresponding green ones.

Kabeel ( 1959 ) found that mature picked fruits tended to suffer a higher percentage of decay than nearly-mature fruits. He added that it may be due to its faster and normal condition of ripening.

Chupp and Sherf ( 1960 ) reported that *Alternaria* sp. can infect green fruit but infection on ripe tissue took place much more easily and advanced more rapidly.

Parsons *et al* ( 1960 ) mentioned that mature-green tomatoes ripened slowly at 48° F developed less decay than those showing some colour, when stored for the same period of time.