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A Fruit Rot of Chillies (*Capsicum annuum L.*) caused by *Alternaria solani* (Ell. & Mart.) Jones & Grout

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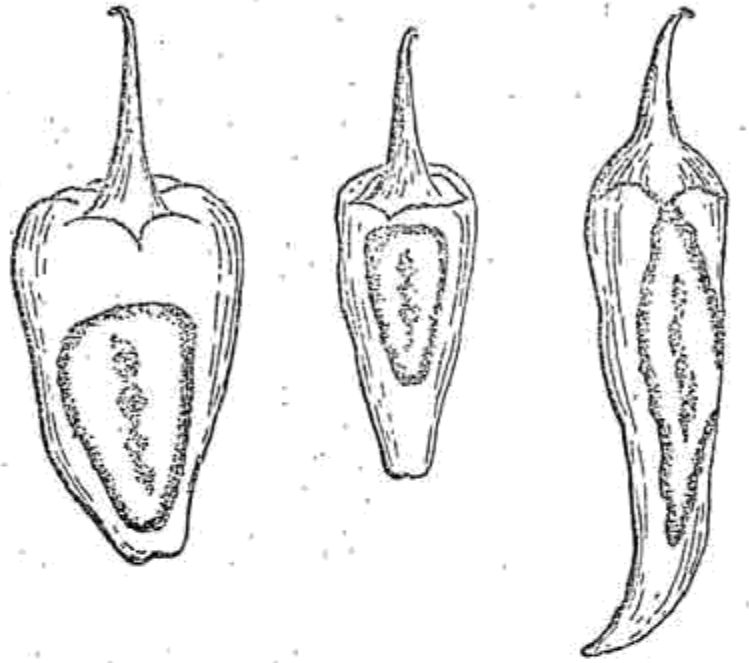
Introduction: Fruit rot of chillies is a disease of economic importance prevalent in many parts of the world. The causal organism differs in different places and more than one fungus has been found to be responsible for this disease. *Glomerella cingulata* (Stonem.) Spauld. & v. Schrenk (*Colletotrichum piperatum* Ell. & Ev.) has been recorded from India (Dastur 1920), America (Halsted 1890) and elsewhere causing anthracnose (fruit rot) of *Capsicum*. *Colletotrichum capsici* Syd., was first observed in South India, infecting fruits and young twigs of chillies (Mc Rae 1914). Dastur (1921) has described this disease in detail from North India. More than one species of *Alternaria* have been reported to be responsible for the fruit rot of chillies. *A. solani* (Ell. & Mart.) Jones & Grout has been recorded from Georgia by Higgins (1925). Wallace (1929) reported a fruit rot of chillies caused by *A. tenuis* Nees., in Tanganiyka. In Spain, Unamuno (1934) found *A. tenuis f. genuina* Una., to be associated with the rotting of chilli fruits. Bremer (1945(from Turkey stated that *A. longipes* (Ell. & Eve.) Tisd. & Wadk. was the causal agent for the rotting of chilli fruits in that country. *A. capsici-annui* Savul. and Sandu has been known to be responsible for this disease in Rumania (Savulescu & Kulea 1948). Dutt (1938) reported a fruit rot of chillies from Delhi, caused by *Alternaria* but the species was not determined.

In recent years, specimens of chilli fruits affected by *Alternaria* have been collected from Mathurai and Guntur districts. This disease occurred along with the fruit rot caused by *Colletotrichum capsici* Syd., and often passed off for infection by the latter fungus. The present paper is concerned with the isolation of the fungus and study of its pathogenicity, cultural characters and host range.

Material and Methods: The pathogen was brought into culture by the single spore isolation method and its growth on a number of agar media was studied. Inoculation experiments were conducted on fruits kept in moist chambers after surface sterilisation or on those growing on the plants themselves. Leaf and twig inoculations were carried out on young plants grown specially for the purpose. For the study of the rate of growth of the fungus, equal quantities of the inoculum were used and the media were adjusted to the same reaction. The colour nomenclature described in Ridgeway's "Colour Standards" has been adopted for describing the colour of the growths on the various media.

Symptoms of the disease: Fruits which were nearing maturity were ordinarily infected. Brown lesions surrounded by a yellow

halo developed on one side of the fruit. These enlarged and resulted in the formation of irregular sunken patches with a dark brown margin and light grey centre. The latter was overgrown by olive-brown fungal growth. The fruit lost its red colour and usually dropped down. Sometimes the entire fruit was involved in the rot.



Chilli fruits showing the symptoms of the disease

The incidence of fruit-rot was very high if the humidity increased or it rained during the maturing stages of the fruits, resulting in a heavy loss of fruits. This disease can be distinguished from the fruit rots caused by *Colletotrichum capsici* Syd. or *Glomerella cingulata* by the absence of the characteristic acervuli on the diseased spots.

The fungus and its cultural characteristics: To start with, the mycelium is internal and after the collapse of the tissues, brown mycelial growths develop on the surface of the lesions. Numerous light brown, septate, unbranched conidiophores are found in clusters of 3 to 6 from the external mycelium, measuring 105 x 4μ (90–144 x 3–6·5). Obclavate, muriform conidia, olive brown in colour are formed, often in chains on the conidiophores and measure 65 x 18μ (49 to 112 x 12 to 25) on the average. The number of cells in the spores varies; 8 to 12 transverse septa and 3 to 6 longitudinal septa are found in each spore. The beak is usually small.

Profuse aerial growth usually develops on agar media. In the initial stages, the hyphae are hyaline forming a whitish aerial mycelium. Later, the growth becomes dark grey and forms an olivaceous black mat on the surface of the agar. The dark

discolouration extends into the medium also. Profuse sporulation was evident on most of the media. The cultural characters of this fungus and the average rate of daily growth on various media adjusted to pH 5·7 are given below:

TABLE I

Cultural characters on various media

Name of medium	Average rate of daily growth in m.m.	Cultural characters after 7 days
1. Oat agar	6·6	Good growth, aerial mycelium dark grey, olivaceous black on agar surface, reverse black, spores plenty in 48 hours.
2. French bean agar	7·5	Fluffy white aerial mycelium, good and uniform growth; the older mycelium tends to be mineral grey, reverse purple black, spores numerous within 48 hours.
3. Maize agar	7·0	Aerial mycelium light mineral grey over a dark dull yellow substratum, reverse sooty black, growth was good and uniform. Spores abundant within 48 hours.
4. Carrot agar	7·0	Loose aerial mycelium, pearl to storm grey, adpressed over a dusky olive-green growth on the surface of the agar medium. Zonations noticed on the reverse; reverse black, spores plenty in 48 hours.
5. Czapek Dox's agar	7·0	Aerial mycelium white to ash-grey in the centre, on olivaceous black background reverse french grey to light violet grey; no spores in 48 hours.

French bean agar appears to be the most satisfactory medium for the growth of this fungus.

Pathogenecity: Repeated inoculations were carried out on surface-sterilised fruits of chillies, brinjal and tomato kept in sterilised moist chambers and those growing on plants. Leaves and twigs of *Capsicum annuum*, *Solanum melongena*, *Lycopersicum esculentum*, *Datura stramonium*, *Nicotiana tabacum*, *Gossypium hirsutum* and *Cyamopsis tetragonaloba* were inoculated. The following table shows the results of inoculation.

TABLE II.

Results of Inoculation with the Fungus.

	Name of plant	Part inoculated	Method of inoculation	Number inoculated	Number infected
1.	*Capsicum annuum*	Leaves and twigs	Wounded	12 plants	Nil
		Leaves and twigs	Unwounded	12 plants	Nil
		Fruits	Wounded	24 fruits	15 fruits rotted within 7 days after inoculation
		Fruits	Unwounded	24 fruits	14 fruits rotted within 7 days after inoculation
2.	*Solanum melongena*	Leaves and twigs	Wounded	6 plants	No infection
		Leaves and twigs	Unwounded	6 plants	No infection
		Fruits	Unwounded	12 fruits	10 fruits rotted within 7 days after inoculation
3.	*Lycopersicum esculentum*	Leaves and twigs	Wounded	6 plants	No infection
		Leaves and twigs	Unwounded	6 plants	No infection
		Fruits	Wounded	6 fruits	4 fruits rotted within 7 days after inoculation
		Fruits	Unwounded	6 fruits	3 fruits rotted within 7 days after inoculation
4.	*Datura stramonium*	Leaves and twigs	Wounded	6 plants	No infection
			Unwounded	6 plants	No infection
5.	*Nicotiana tabacum*	Leaves and twigs	Wounded	6 plants	No infection
			Unwounded	6 plants	No infection
6.	*Gossypium hirsutum*	Leaves and twigs	Wounded	6 plants	No infection
			Unwounded	6 plants	No infection
7.	*Cyamopsis tetragonaloba*	Leaves and twigs	Wounded	6 plants	No infection
			Unwounded	6 plants	No infection

Suitable controls were kept in all cases and they remained healthy throughout the experiment.

The results of inoculation show that the fungus is pathogenic on the fruits of chillies, brinjal and tomato. There was no infection on the leaves of any of the plants tried. The symptoms of infection on the fruits were evident on the fourth day after inoculation. The infected fruits were completely rotten in the course of one week. In all cases the fungus was reisolated from the infected fruits.

Identity of the Fungus: Four species of *Alternaria* have been recorded on *Capsicum*. A comparative statement of the chief distinguishing characters of the different species of *Alternaria* recorded on chillies is given below:

TABLE III

Character of the species of *Alternaria* recorded on Chillies

	Name of species	Conidial measurements in μ	Chief distinguishing characters	Authority
1.	*A. longipes*	30 — 50 × 10 — 13	Infects only wounded chilli fruits and incapable of infecting tobacco or chilli leaves	Bremer 1945
2.	*A. solani*	145 — 370 × 16 — 18	Infects the leaves of almost all solanaceous plants	Higgins 1925
3.	*A. tenuis*	30 — 36 × 14 — 15		Wallace 1929
4.	*A. tenuis f. genuina*	27·5 — 62·5 × 12 — 17·5	Found on leaves, peduncles floral buds and unripe fruits of chillies	Unamuno 1934
5.	*A. capsici-annui*	33 — 82 × 7 — 21	Capable of infecting tobacco and chilli leaves also	Savulescu and Hulea 1948
6.	*Alternaria* sp.	14 — 50 × 7 — 19	Capable of infecting all portions of chillie plant	Dutt 1938
7.	The present isolate under study	49 — 112 × 12 — 25	Capable of infecting only the fruits of chillies, tomatoes and brinjal	

From the above characters of the various species it can be inferred that the isolate under study does not completely agree with any of the others. But, it exhibits affinities to *A. longipes* in being incapable of infecting tobacco and chilli leaves but infecting the fruits. But the spores are much bigger than those of *A. longipes*. In this character, it comes near *A. solani*, but differs from the latter in its failure to infect the leaves of any of the solanaceous

plants tried. It is considered that it is more likely that the present isolate is a strain of *A. solani* which infects only fruits and not the leaves of chillies, brinjal and tomato.

Control: Diseases caused by *Alternaria* are amenable to control by Bordeaux spray. Since it is customary to spray chillies for the control of fruit rot caused by *Colletotrichum capsici* the same treatment will be useful for the control of the disease caused by this fungus.

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