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Physiology of Damped-off Tomato Seedlings

By

M. MUTHUSAMY[1], P. VIDHYASEKARAN[2] and C. K. SOUMINI RAJAGOPALAN[3]

ABSTRACT

Tomato hypocotyls infected with *P. aphanidermatum* contained fructose, sucrose and glucose while the healthy hypocotyls contained only sucrose and glucose. Tartaric acid was detected only in the infected hypocotyls. Similarly glutamic acid, leucine, methionine and tryptophan were detected only in infected tissues. While phenolics content increased, nitrogen, phosphorus, potassium and calcium contents decreased due to infection.

INTRODUCTION

Pythium aphanidermatum (Edson) Fitzpatrick causes severe damping-off in tomato (Mc Carter and Littrell, 1970). The pathogen invades the young hypocotyls resulting in collapse of the seedlings. The present study is to assess the physiological changes taking place in the infected hypocotyls of tomato.

MATERIALS AND METHODS

Freshly isolated, virulent culture of *P. aphanidermatum* was used in the present studies. The pathogen was multiplied in sand-maize (95:5) medium. Ten-day old tomato (Co. 1) plants were inoculated with the pathogen by incorporating the fungus around the hypocotyl region. After three days, the hypocotyl regions were carefully removed from the soil, washed and analysed for the different chemical constituents. Comparable healthy plants were used as control. All the analyses were done in triplicate and the experiments were repeated.

Individual sugar content of the hypocotyls was analysed using anthrone reagent. Organic acids content was estimated semiquantitatively by the method followed by Mohanraj *et al.* (1971). Alcoholic extracts of the hypocotyls were obtained and the amino acids were analysed by paper chromatography (Block *et al.*, 1955). Total phenolics content was analysed using Folin-Deins reagent (Bray and Thorpe, 1954). Nitrogen content of the healthy and infected hypocotyls was analysed by Microkjeldahl method (Jackson, 1962). Phosphorus, potassium, calcium and sodium contents were analysed by obtaining triple acid (nitric acid, sulphuric acid and perchloric acid, 9:2:1) extract (Jackson, 1962). Phosphorus was estimated colorimetrically, while potassium, sodium and calcium, were estimated

1. Instructor, 2. Assistant Professor, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore 641003 and 3. Associate Professor of Plant Pathology, Agricultural College and Research Institute, Madurai.

TABLE 1. Changes in chemical constituents of tomato hypocotyls due to damping-off infection

Plant constituents	Tomato hypocotyl tissues	
	Uninfected	Infected
I. Sugars (mg/g fresh wt)		
Sucrose	39	32
Glucose	37	30
Fructose	0	26
Total sugars	76	88
II. Organic acids (μg/g fresh wt)		
Citric acid	425	425
Malic acid	375	350
Succinic acid	225	225
Tartaric acid	0	350
Total organic acids	1025	1350
III. Amino acids (μg/g fresh wt)		
Lysine	200	175
Arginine	925	1300
Asparagine	800	500
Glutamic acid	0	125
Alanine	250	200
Isoleucine	150	100
Leucine	0	75
Methionine	0	225
Tryptophan	0	400
Phenylalanine	250	425
Total amino acids	2575	3525
IV. Phenolics (μg/g fresh wt)	135	225
V. Minerals (mg/g dry wt)		
Nitrogen	36.0	22.0
Phosphorus	0.3	0.2
Potassium	4.5	3.3
Calcicum	3.6	2.6
Sodium	1.7	1.6

using Flame photometer (Ward and Johnston, 1962)

RESULTS AND DISCUSSION

The data in Table 1 revealed that one additional sugar, fructose, appeared in the infected hypocotyls. Similarly tartaric acid was detected only in the infected hypocotyls. Number of amino acids increased in the hypocotyls due to infection. Glutamic acid, leucine, methionine and tryptophan were detected only in the infected tissues. While arginine and phenylalanine content increased due to infection, asparagine content decreased in the hypocotyle. Phenolics content appreciably increased due to infection. However, sodium content decreased only negligibly in the infected hypocotyl.

The accumulation of fructose in the infected hypocotyls may be due to the breakdown of starch or due to the inhibition of starch synthesis. While both sucrose and glucose would have been utilized by the pathogen, fructose may be a poor carbon source for the pathogen (Muthusamy *etal.*, 1972). Accumulation of tartaric acid in the infected tissues might have resulted from the increased respiration (Ranson, 1965).

Increase in amino acid content in the infected hypocotyls may be due to the decomposition of host protein caused by the proteolytic enzymes of the pathogen (Kiraly, 1959). In general, due to infection amino acid pool seems to be considerably affected and some amino acids increased while some others decreased (Wu, 1969). Asparagine content decreased due to infection and Mc Comb and Winstead (1964, suggested that preferential utilization of particular amino acid by the fungus would result in the reduction of the amino acid in diseased tissues. Asparagine has been reported to induce the growth of *P. aphanidermatum* (Muthusamy *et al.*, 1972) and *P. afertile* (Agnihotri and Vaartaia, 1968).

The accumulation of phenolics in the infected tissues of tomato may be attributed to increase in activity of enzymes catalyzing various steps of the biosynthetic route or increased channelling of precursors towards phenolic synthesis (Goodman *et al.*, 1967).

Due to infection, all the minerals decreased in the hypocotyl. Minerals may be utilized by the pathogen in the form of specific compound or as free element. Sadasivan and Kalyanasundaram (1956) suggested that there may be derangement in absorption of plants due to infection. But Roberts and Jensen (1970) suggested that some of the elements like phosphorus and potassium are very mobile within the plant and they may be readily translocated from infection site to healthy sites. Anyone of the three reasons or all of them may be responsible for the reduction in the minerals content.

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