Some changes in metabolism of TMV infected tomato plants

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As we know, infection of plants with tobacco mosaic virus causes some serious disorders in their metabolism. First of all, the two essential physiological processes: photosynthesis and respiration undergo a change. The results of these disorders are: a lower yield of infected plants and a decrease in the production of carbohydrate. It is confirmed also, that the uptake of some nutrient elements is usually changed.

It was interesting to investigate, to what extent the phosphorus and nitrogen metabolism in the TMV infected plants may be changed. Phosphorus and nitrogen, as we know, play an important role in the metabolism of plants; they are also fundamental elements of virus particles.

In the present report changes in some fractions of phosphorus and nitrogen in TMV infected tomatoes are presented. Tomato, variety Karzełek Puławski, was used as an experimental plant. The plants were grown under greenhouse conditions in pots filled with pure quartz sand. Mineral nutrient elements, major and minor ones were supplied in optimal doses before the tomato seedlings were transplanted. When the plants were in the four leaves stage of growth, the first and second leaf of each plant were mechanically inoculated with tobacco mocaic virus suspension.

TMV inoculum was prepared as a water extract from the dry powder of mosaic-infected tobacco leaves of the variety Virginia Joyner showing strong symptoms of the disease.

In order to find out a relationship between the main fractions of phosphorus and nitrogen and TMV infection, the infected as well as the uninfected plants were harvested at different intervals: 2, 6, 10, 20 and 30 days after inoculation. Harvest times were determined on the basis of appearance of visual virus symptoms. Plants harvested 2 and 6 days after inoculation were symptomless. The first of sign virus infection was visible 10 days after inoculation. At the next samplings the symptoms were already fully developed.

In the harvested plant material three fractions of phosphorus (total, inorganic and organic) and some fractions of nitrogen (total, protein, nitrate) were determined. The content of inorganic phosphorus was determined in fresh material by the Fiske and Subbarow procedure as modified by Brzeski and Kaniuga [2]. Total phospho-

rus was determined colorimetrically as blue molibdate in the dry material. The content of organic phosphorus was calculated from the difference between the inorganic and total phosphorus content. Fractions of nitrogen were determined in dry material: total nitrogen by Kjeldahl method, protein nitrogen by thanin method [4] and nitrate nitrogen by ksylenol method [1, 3, 5]. The results are summarized in two Tables.

Table 1

Some phosphorus fractions in tops of healthy and TMV infected tomato plants (mean of 3 experiments)

Symptoms of infection	Days after inoculation	P — total		P — inorganic		P — organic	
		uninfected	infected	uninfected	infected	uninfected	infected
		(a) Percentage of P_2O_5 in dry weight					
No symptoms	2	0.75	0.92	0.07	0.14	0.68	0.78
„ „	6	0.67	0.73	0.04	0.10	0.63	0.63
Weak symptoms	10	0.60	0.65	0.05	0.05	0.55	0.60
Optimum	20	0.52	0.47	0.05	0.05	0.47	0.42
Strong symptoms	30	0.43	0.50	0.04	0.04	0.39	0.46
		(b) P_2O_5 in mg/pot in dry weight					
No symptoms	2	0.885	1.322	0.071	0.201	0.814	1.121
„ „	6	1.635	1.709	0.108	0.189	1.527	1.520
Weak symptoms	10	3.087	3.282	0.248	0.224	2.839	3.058
Optimum	20	9.837	7.536	0.948	0.794	8.889	6.742
Strong symptoms	30	15.255	16.424	1.491	1.341	13.764	15.083

It was found, that the difference in inorganic phosphorus content between the above studied plants depended on the length of the period after inoculation (Table 1). The inoculated plants harvested two and six days after inoculation, when the symptoms of TMV infection were not yet visible contained twice as much inorganic phosphorus as the control ones. These differences disappeared in plants harvested in the next term, when the first signs of the virus infection were already visible; it occured about 10 days after inoculation. At the next harvest times the level of inorganic phosphorus in the diseased plants was even lower than in the healthy ones. However, the total and organic phosphorus contents in the top parts were slightly higher in infected plants than in the control in each harvest time.

In spite of previous assumptions, no distinct differences in the contents of total and protein nitrogen were found between the control and infected plants (Table 2). No differences were also defected in the content of nitrate nitrogen; so it would be an evidence, that the nitrate reduction in plants was not influenced by the virus. Probably, more precise methods should be used to investigate this problem in detail.

These results markedly demonstrate changes in the phosphorus metabolism

Table 2

Some nitrogen fractions in tops of healthy and TMV infected tomato plants

Symptoms of infection	Days after inoculation	N — total		N — protein		N — nitrate	
		uninfected	infected	uninfected	infected	uninfected	infected
		(a) Percentage of N in dry weight					
No symptoms	2	5.60	5.10				
„ „	6	4.66	4.71	3.70	3.81	0.25	0.21
Weak symptoms	10	4.34	4.00	3.64	3.21	0.21	0.20
Optimum	20	3.45	3.61	2.90	3.03	0.18	0.21
Strong symptoms	30	2.99	2.81	2.59	2.32	0.14	0.10
		(b) N in mg/pot in dry weight					
No symptoms	2	5.26	5.66				
„ „	6	10.81	11.07	8.58	8.95	0.58	0.50
Weak symptoms	10	19.18	16.16	16.09	12.97	0.92	0.82
Optimum	20	43.61	42.85	36.66	35.97	2.25	2.47
Strong symptoms	30	78.04	85.09	67.60	70.25	3.71	3.15

of the TMV infected tomato plants, particularly in the first stage of infection, when the symptoms of the infection are not yet visible.

Difference in the inorganic phosphorus content occurring between the infected and healthy plants in the period of two and six days after inoculation, could result from the mobilization of the host cell to accumulate the fundamental material needed for virus replication.

It may be supposed, that a more detailed study of virus infected plants would give a clearer picture of changes arising under the influence of that infection.

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