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Nodular Physiology of Urd Bean as Affected by Urd Bean Mosaic Virus

V. Effect on Some Enzymatic Activity

By

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Summary

SINGH A. K. & SRIVASTAVA S. K. 1985. Nodular physiology of urd bean as affected by urd bean mosaic virus. V. Effect on some enzymatic activity. – Phyton (Austria) 25 (2): 213–217. – English with German summary.

In the present investigation the effect of urd bean mosaic virus infection on the enzymatic activity of the nodules of urd bean (*Vigna mungo* [L.] HEPPER) cv. Type-9 was studied in soil and sand potting media. Virus infection decreased the activity of catalase and nitrogenase while increased the activity of peroxidase and nitrate reductase in the nodules of diseased plants than the nodules of healthy control plants in both soil and sand pottong media. The enzymatic activities were found higher in the nodules of soil grown plants than in the nodules of plants grown in sand.

Zusammenfassung

SINGH A. K. & SRIVASTAVA S. K. 1985. Die Physiologie der Knöllchen von *Vigna mungo* nach Infektion mit urd bean mosaic virus. V. Wirkung auf die Aktivität einiger Enzyme. – Phyton (Austria) 25 (2): 213–217. – Englisch mit deutscher Zusammenfassung.

In der vorliegenden Arbeit wird der Einfluß des urd bean mosaic virus auf die Aktivität von Enzymen in den Knöllchen von *Vigna mungo* (L.) HEPPER (urd bean, cv. Type-9) in Erd- und Topfkulturen untersucht. Durch die Virusinfektion sank die Aktivität der Katalase und der Nitrogenase, während die Aktivität der Peroxidase und der Nitratreduktase in den Knöllchen erkrankter Pflanzen diejenige in den gesunden Kontrollen überstieg; dies gilt für Erd- wie für Topfkulturen in Sand. Die Enzymaktivitäten in den Knöllchen der in Erde gewachsenen Pflanzen lag über der in Sand kultivierter Pflanzen. (Editor transl.)

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Introduction

Most of the legume have nodules on their root containing bacteria which have the quality of fixing atmospheric nitrogen into avialable nitrogen. Although effect of viruses on the nodular physiology of a number of legumes have been studied (SINGH & SINGH 1979), but information regarding the influence of virus on the enzymatic activity of nodules is not properly studied. Therefore, the present investigation was undertaken to study the effect of urd bean mosaic virus infection on the some enzymatic activity of urd bean nodules in soil and sand potting media.

Materials and Methods

All the experiments were done in insect proof chambers. Urd bean (*Vigna mungo* [L.] HEPPER) cv. Type-9 and urd bean mosaic virus (SINGH & SINGH 1978) maintained on urd bean, as host and virus, respectively, throughout the experiments. The plants were inoculated with infective sap of UBMV, using 600 mesh carborundum powder as an abrasive, at cotyledonary stage. The control plants were teated similarily using neutral phosphate buffer solutions only.

The first group of the plants were raised from *Rhizobium* treated seeds in clay pots containing sterlized soil (Sand, loam and compost mixture in 1 : 1 : 2 ratio). The second group of the plants were raised from *Rhizobium* treated seeds in clay pots filled with purified sterlized sand. Sixty pots (25 cm diameter) containing 5 plants per pot were taken for each subgroup. Harvesting were done 10 days after inoculation with an interval of 10 days till 60 days.

The details of the treatments are as follows:

Media	Subgroup	Treatments
Seil	H	*Rhizobium* treated healthy control.
	D	*Rhizobium* treated + UBMV
Sand	H	*Rhizobium* treated healthy control.
	D	*Rhizobium* treated + UBMV

In the case of sand medium, nitrogen free nutrient solution as described by HEWITT 1966 was supplied twice a week (100 ml/pot). The enzymatic analysis were done with fresh samples. Three replicates were taken for each estimation and average of the three observations has been presented in the results.

The activity of catalase, peroxidase, nitrate reductase and nitrogenase were measured by the methods described by DEKOCK & al. 1960, PERUR 1962, SRIVASTAVA 1974 and SRIVASTAVA & al. 1980, respectively.

Results and Discussion

The finding of the present investigation as shown in Table 1 indicate that catalase and nitrogenase activity were lower in nodules of virus infected plants whereas peroxidase and nitrate reductase activity were higher in nodules of virus infected plants in comparison with the nodules of healthy plants in both soil and sand potting media.

Table 1

Effect of urd bean mosaic virus infection on the investigated enzymes: catalase (unit/g FW), peroxidase (O.D.), nitrate reductase (mol $NO_2 \cdot h^{-1} \cdot g^{-1}$ FW), nitrogenase (10^{-4} mol $NH_3 \cdot h^{-1} \cdot g^{-1}$ FW). Days = days after inoculation, H = nodules from healthy plants, D = nodules from virus infected plants.

Days	Treat-ment	Catalase		Peroxidase		Nitrate - reductase		Nitrogenase	
		Soil	Sand	Soil	Sand	Soil	Sand	Soil	Sand
10	H	1.15	1.00	0.114	0.106	810	500	3.85	2,70
	D	1.08	0.92	0.136	0.120	890	540	3.64	2.88
20	H	1.26	1.18	0.125	0.115	780	580	3.54	2.98
	D	1.14	1.02	0.158	0.140	840	620	3.24	2.85
30	H	1.45	1.30	0.150	0.138	710	490	3.12	2.65
	D	1.27	1.15	0.192	0.170	790	550	2.76	2.44
40	H	1.62	1.58	0.176	0.166	680	395	2.70	2.30
	D	1.40	1.32	0,210	0.200	720	480	2.45	2.00
50	H	1.78	1.48	0,198	0.158	620	305	2.50	2.15
	D	1.50	1.26	0.240	0.280	590	370	2.24	1.75
60	H	1.70	1.40	0.180	0.140	560	240	1.98	1.65
	D	1.42	1.19	0.215	0.162	610	280	1.72	1.34

F calculated value	Catalase	Peroxidase	Nitrate reductase	Nitrogenase
Healthy : diseased	50.4^{++}	40.9^{++}	24.5^{++}	14.5^{++}
Soil : sand	39.3^{+}	28.7^{+}	543.9^{+}	67.5^{+}
Days interval	35.2^{++}	27.4^{+}	57.5^{++}	51.0^{++}

$^{+}$ = significant at 5 % level; $^{++}$ = significant at 1 % level.

YAMAFUJI 1943 reported that at least a part of the catalase molecule is incorporated in virus protein, and catalase thus incorporated can show its action only after the virus is split under the suitable condition. In the present investigation the decrease in catalase activity may be due to incorporation of catalase molecule into viral protein.

Increase in peroxidase activity in nodules of infected plants is accordance with the earlier reports (LOEBESTEIN & LINSEY 1961, ORLAB & ARNY 1961; CHANT 1967, SINGH & MALL 1973, 1974). The high peroxidase activity in nodules of virus infected plants might be the consequence of greater

breack down of carbohydrate through monophosphate shunt due to which the precursors of phenolic compounds are produced which are oxidized by peroxidase to quinones in presence of H_2O_2 to overcome pathogen. (LOEBESTEIN & LINSEY 1961).

Increased nitrate reductase activity in the present study is similar to the previous reports (NARAYANSWAMI & RAMAKRISHNAN 1966, SINGH & SINGH 1979). Nitrate reductase is known as enzyme inducible by its substrate, the nitrate (BEEVERS & al. 1965). WALLACE & PATE 1965 observed that within two hours applying nitrate to the rooting media, nitrate reductase can be detected in both shoot and root. In the present study, a higher level of nitrate reductase was observed in the nodules of urd bean mosaic virus infected plants than in the nodules of healthy plants, both in soil and sand media. The higher amount of substrate (nitrate nitrogen) in virus infected plants could obiously enhance the enzymatic activity as recorded here.

Urd bean mosaic virus infection reduced the nitrogenase activity in the nodules of infected plants than in nodules of healthy plants both in soil and sand potting media. The retardation of nitrogenase activity due to accumulation of nitrate nitrogen and amino acids have been reported (RIGAUD & PUPPO 1977, PLANQUE & al. 1978). Nitrogenase activity of nodules could be reduced due to reduced synthesis of leghaemoglobin (BISSELING & al. 1978, BROUGHTON & al. 1978).

Further, the results given in Table 1 indicate that the nodules of plants grown in soil had more enzymatic activity than those growing in sand. Since soil has been known as direct mineral substrate of terrestrial plants, all nutrients with the exception of carbon from the soil (EPSTEIN 1972) as a medium for the growth of the plants. VAN SCHREVEN 1958 working on the uptake of nitrogen by legumes concluded that numerous factors such as environment, soil acidity, nutrition, rhizobial population and carbon compound avialability etc. affect nodulation. Thus, it may be possible that due to the changed physiological status of the root is responsible for low enzymatic activity in nodules of the plants grown in sand than soil media.

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