საქართველოს მეცნიერებათა ეროვნული აკადემიის მოამბე, ტ. 175, №3, 2007
BULLETIN OF THE GEORGIAN NATIONAL ACADEMY OF SCIENCES, vol. 175, no. 3, 2007

Plant Physiology

Influence of Simulated Acid Rain on Nitrate Reductase Activity of Some Legumes and Vegetables

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ABSTRACT. Seeds (kidney bean and basil) and leaves (kidney bean, basil, beet and cabbage) of experimental plants were treated with pH2.5 water solution of sulphuric acid. The activity of nitrate reductase of treated plants, which usually reveal high activity of this enzyme, has been investigated. Spraying plants with acid solution increased the enzyme's activity. Since nitrate reductase is regarded as detoxifier of polluted air, it may be supposed that tested plants are resistant to acid pollution of the environment. *© 2007 Bull. Georg. Natl. Acad. Sci.*

Key words: *acid rains, nitrate reductase, kidney bean, basil, beet, cabbage.*

Pollutant emissions of industry and transport, such as CO, NO_2, SO_2 etc., cause significant pollution of air on the territory of Georgia. These gases dissolve in rain water and return to the earth surface in the form of acidic precipitations [1, 2].

Recently the effect of acid rains on cultivated plants and woody plants has been investigated. The negative effect of metallurgical, chemical and other industries on vineyards, orchards and vegetables has been shown [3]. Acidic precipitations are responsible for disorders in plant vegetation, decreasing the assimilation area and growth, accumulation of toxic substances in roots, leaves and fruits. Increasing of titrable acidity and diminishing of dry matter accumulation has also been mentioned. Industrial gases cause inhibition of photosynthesis and photosynthetic productivity of plants, in particular, noncyclic phosphorylation and ATP synthesis, and related synthesis of CO sink are retarded, causing disbalance of the metabolic processes in plant [3].

The purpose of the given study was to investigate the activity of nitrate reductase, the main enzyme of plant nitrogen metabolism, in acid-treated cultivated plants. Two cultivars of kidney bean (*Phaseolus vulgaris* L.) with red and white seeds and vegetable cultures of beet (*Beta vulgaris* L.), red and white forms of cabbage (*Brassica capitata* L.) and red and green forms of basil (*Ocimum basilicum* L.) were taken for experiments.

In one series of experiments nitrate reductase activity was studied both in leaves of sprayed plants and those emerged from acid-treated seeds (kidney bean and basil).

Seeds and leaves of experimental plants were treated with pH2.5 water solution of H_2SO_4: seeds were soaked in acid solution for 24h, while leaves of tested plants were sprayed with acid three times with five days interval. Material for analysis was taken 10 days after the last spraying. The activity of nitrate reductase was studied after Mulder [4]. It was expressed in γ of NO_2 released during 30 min, per g of fresh material.

In the case of kidney bean and basil experimental material was picked in flowering and fruit-bearing phases, in the cases of beet and cabbage leaves for analysis were collected in the phase of intensive vegetation.

According to the obtained data it is clear that generally high activity of nitrate reductase was revealed in flowering phase (Table 1). Leaves of white-seed form of

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Table 1

Nitrate reductase activity in leaves of kidney bean and basil (amount of NO_2 in γ per g of fresh weight, released in 30min)

Plant	Variant	Nitrate reductase activity, γ	
		Flowering phase	Fruit-bearing phase
Red seed kidney bean	Control	49.8	32.8
	Soaked seeds	87.8	38.5
	Sprayed leaves	98.8	62.2
White seed kidney bean	Control	98.4	68.8
	Soaked seeds	99.4	72.4
	Sprayed leaves	109.4	90.6
Blue leaf basil	Control	22.8	18.4
	Soaked seeds	14.4	10.2
	Sprayed leaves	16.2	12.4
Green leaf basil	Control	16.0	12.4
	Soaked seeds	12.6	12.0
	Sprayed leaves	14.0	8.4

Table 2

Nitrate reductase activity in leaves of beet and cabbage (amount of NO_2 in γ per g of fresh weight, released in 30min)

Plant	Variant	Nitrate reductase activity, γ
Beet	Control	73.4
	Sprayed leaves	98.0
Red cabbage	Control	31.7
	Sprayed leaves	64.2
White cabbage	Control	18.4
	Sprayed leaves	19.0

kidney bean were distinguished for especially high activity of the enzyme.

Soaking seeds and spraying leaves with acid solution increased the activity of nitrate reductase in both cultivars of kidney bean in the studied phases of vegetation, while in basil both acid treatments caused the diminishing of enzyme activity. It must also be mentioned that soaking of seeds caused more negative effect, compared to leaf spraying.

Spraying of beet and cabbage plants with acid rain caused essential stimulation of nitrate reductase activity of leaves. From the obtained results it is clear that nitrate reductase activity was the highest in beet (Table 2). Spraying of leaves significantly increased the enzyme's activity in beet and red form of cabbage, while in white form of cabbage small differences were revealed between the control and experimental variants.

According to the experimental results, high index of nitrate reductase activity was revealed in white and red sorts of kidney bean and beet. Treating seeds and leaves with acid solution increased the index. Since nitrate reductase is regarded as a detoxifier of polluted air [5], we may suppose that the studied plants are resistant to polluted environment.

მცენარეთა ფიზიოლოგია

მჟავე ნალექების გავლენა ნიტრატრედუქტაზას აქტივობაზე ზოგიერთი პარკოსანი და ბოსტნეული კულტურის ფოთლებში

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საცდელ მცენარეთა თესლი (ლობიო და რეჰანი) და ფოთლები (ლობიო, რეჰანი, ჭარხალი და კომბოსტო) დამუშავდა pH2.5 მჟავიანობის მქონე გოგირდმჟავას წყალხსნარით. დამუშავებულ მცენარეთა ფოთლებში შესწავლილ იქნა ფერმენტ ნიტრატრედუქტაზას აქტივობა, რომელიც ნორმალურ პირობებში მაღალია ამ მცენარეებში. მჟავათი დამუშავებამ გამოიწვია ფერმენტის აქტივობის გაზრდა. ვინაიდან ნიტრატრედუქტაზა დაბინძურებული ჰაერის ერთგვარ დეტოქსიკატორად ითვლება, შეგვიძლია ვივარაუდოთ, რომ შესწავლილი მცენარეები გარკვეულ გამძლეობას ავლენენ მჟავე ნალექებით დაბინძურებული გარემოს მიმართ.

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Received November, 2006