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PHYSIOLOGICAL AND BIOCHEMICAL STEADINESS OF ROSES IN TRANSFORMED ENVIRONMENT

Some results of ecological steadiness researches for roses in conditions of polluted industrial environment are presented in dependence on content of pigment cyanidine-3,5-diglycoside, on asches elements and on building of coating tissue of leaves.

Наведено результати досліджень екологічної стійкості троянд в умовах трансформованого середовища залежно від вмісту пігменту ціанідін-3,5-диглікозиду, елементів золи та будови покривної тканини листків.

Introduction. Roses are used often for the planting of greenery at industrial enterprise territories but their reaction on the gas-laden atmosphere does not studied enough for today. In the literature there are only a few references about the laboratory experiments on some rose sorts concerning their gas-laden steadiness and some data about the reactions of Park and Polyantha roses in natural conditions, in zones of industrial environment pollution.

Plants react on the gas-laden of environment in different manner. That is why the different types of gas steadiness are distinguished: the plant ability to renew its overground organs few times during one season; morphological and anatomical building of coating leaf tissue; physiological – ability of plant organism to bound up and to neutrolize adsorbed toxic substances.

Basing on this it is possible to consider that some rose sorts have types of gas-laden steadiness described above. Roses renew their grafts 2–5 times during the vegetational period. They can accumulate enough quantity of ashes elements, due to this – to bound up and to neutrolize toxic products adsorbed in them and to clean an air in such a way. Many sorts have the coarse or leather-like coating tissue of leaves that is an obstacle for the penetration of gases and sprays into the plant organism.

The main factor in the rose gas-laden steadiness against the harmful activity of industrial products is an active type of immunity: organism ability to bound up, to neutrolize and to utilize the different penetrated compounds of salts, acids and alkalies. These roles play charged cations – Na, K, Ca, Mg that are adsorbed, diluted into the cell inner content. Due to their functions the cation-anion balance in the plant organisnm may be renewed if this balance was changed as the result of toxic industrial products accumulation.

In the process of observations of damaged assimilation apparatus for the different rose sorts in conditions of transformed environment we have registered that the most steady in ecological meaning were the sorts with the leaves coloured by anthocyans. They were damaged rarely and in the less degree in comparison with other sorts. The positive role of pigments in toxin neutralizations was already described in literature [1].

Our purpose was to study the ecological steadiness of sorts that represented the seven rose groups from collection of Botanic garden named after Academician O.V. Fomin in dependence on the accumulation in their leaves of ashes elements and content of cyanidin-3,5-diglycoside.

Object and methods of researches. Experiments were carried on at the territory of machine-building factory in Kiev and simultaneously in Botanic garden named after Academician O.V. Fomin (at Kiev State University named after Taras Shevchenko). In the spray mixtures of this factory were oxides of sulphur, nitrogen, chromium and titanium. Concentration of some of them exceeded the limits of permissible norms in near-earth air in 10 and more times according to data from laboratory of factory. The summarized action of these ingredients on the roses planted there was taken into account that characteristically for transformed environment

The main object of our investigations were the sorts of the seven garden rose groups: Polyantha, Hybrid Polyantha, Floribunda, Grandiflora, Hybrid Tea, Climbing and Park sorts from the Botanic garden collection. Morphological and biological changes in assimilation apparatus for these rose sorts were studied in the process of phenological observations simultaneously at the territory of factory and at Botanic garden. The levels of the gas-laden steadiness were studied according to the methodics [2]. Content of the asches elements in leaves of roses were examined at laboratory conditions trice per season: Mg, Ca – by titration with Trilon, K, Na – using photometer [3]. Pigment content in leaves was studied according to the methodics of Kolesnikov P.A. and Zere S.V. [4]. In the present article the quantity of pigment is given in mg of Congo red per 1 g of the green leaf mass [5]. Used agrotechnic methods were already described [6].

Results and discussion. Table 1 demonstrates that the roses during the vegetation process can adsorb and accumulate the great quantity of asches elements at the territory of industrial enterprise as well as at the territory of Botanic garden. This fact may be explained as the result of every year addition to the ground of fertilizers and organic manures with Na, K, Ca, Mg and other compounds. Calcium is accumulated in the leaves in the highest degree, sodium is accumulated in the lowest degree, quantities of potassium and magnesium are approximately the same.

Basing on these data it is possible to suppose that the roses reactions of defence against the toxic substances is determined in some degree by their ability for accumulation of significant amounts of ashes elements. In this way the cation-anion balance in organism is renewed and the plant steadiness against the toxic substances is increased.

Table 2 demonstrates the results of investigations of ecological steadiness for 12 sorts of 7 garden rose groups in dependence on the content of cyanidin-3,5-diglycoside and on the structure of the leaf coating tissue.

Obtained data evidences that between the gas-laden steadiness of the roses and their pigment – cyanidin-3,5-diglycoside content exists the noticeable positive correlation. The sorts of roses with the higher content of cyanidin-3,5-diglycoside have the higher steadiness against the toxic substance influences. The sorts of roses with the higher pigment contents are more steady for toxic pollution. Only exclusion were the sorts of Rosemary Rose and Super Star – they have not demonstrated such positive correlation. From our point of view, this fact may be explained by the observation that the first sort was very sensitive for the drought, the second one – was able for damaging by Sphaerotheca pannosa Lev. greatly. Such double "overloading" of plant organism influenced negatively on its gas-laden steadiness.

Conclusions. During the vegetation process the roses can accumulate significant amounts of ashes elements and renew, in such a way, in their organisms the cation-anion balance, necassary for the successful defence against the toxic substances.

Our experiments evidence that there is a positive correlation between the gas-laden steadiness and the content of pigment cyanidin-3,5-diglycoside. The sorts with the highest anthocyan content have, simultaneously, the highest steadiness.

***Table 1*. Ashes accumulation in the rose leaves during the vegetation period in Botanic garden named after Academician O.V. Fomin and in conditions of industrial atmosphere pollution. Kyiv, 1991**

Sort	Group	Data of investigation	Content of ashes and ashes elements, %									
			Ca		K		Mg		Na		Ashes	
			BG	IP	BG	IP	BG	IP	BG	IP	BG	IP
Orange Triumph	Pol	05,05	2,56	2,32	0,45	0,70	0,78	0,58	0,018	0,022	11,14	13,68
		08,06	2,48	0,92	0,45	0,53	0,58	0,53	0,012	0,016	11,42	13,32
		13,09	2,80	1,92	0,67	0,68	0,58	0,73	0,018	0,022	11,48	15,08
Pink Poulsen	HPol	05,05	2,00	2,00	0,35	0,50	0,39	0,39	0,012	0,012	9,68	11,36
		08,06	–	–	–	–	–	–	–	–	–	–
		13,09	2,40	2,64	0,40	0,50	0,58	0,53	0,014	0,030	11,06	12,12
Kordes' Sondermeldung	Fl	05,05	1,68	1,84	0,54	0,62	0,58	0,58	0,010	0,020	8,70	8,12
		08,06	1,28	–	0,60	–	0,39	–	0,010	–	6,38	–
		13,09	1,76	2,88	0,90	0,78	0,58	0,63	0,022	0,020	8,82	11,30
Mercedes	Fl	05,05	1,76	1,36	0,50	0,60	0,56	0,48	0,011	0,010	9,44	8,16
		08,06	–	–	–	–	–	–	–	–	–	–
		13,09	2,64	1,60	0,58	0,70	0,58	0,58	0,012	0,010	11,18	12,20
New Dawn	LCl	05,05	1,28	1,44	0,50	0,50	0,58	0,73	0,010	0,010	6,44	7,40
		08,06	1,76	1,44	0,40	0,55	0,68	0,63	0,011	0,010	8,78	8,19
		13,09	1,28	1,60	0,60	0,60	0,78	0,58	0,020	0,014	9,06	10,60
Paul's Scarlet Climber	LCl	05,05	1,76	2,40	0,32	0,30	0,49	0,68	0,008	0,010	7,42	9,90
		08,06	1,84	2,16	0,45	0,37	0,53	0,53	0,010	0,011	8,34	10,30
		13,09	1,60	2,48	0,52	0,42	0,56	0,82	0,012	0,014	8,36	11,70

Note: BG – Botanic garden; IF – industrial factory.

***Table 2*. Ecological steadiness of roses in dependence on the content of pigment cyanidine-3,5-diglycoside and on the leaf structures. Kyiv, 1991**

Sort	Group	Degree of gas-laden steadiness	Cyanidin-3,5-diglycoside, Congo red per 1g of green mass weight	Leaf surface
Orange Triumph	Pol	+ +	1,1 ± 0,02	coarse
Rosenmärchen	HPol	+	0,9 ± 0,03	leather-like
Salmon Spray	HPol	+	0,8 ± 0,01	coarse
Kordes' Sondermeldung	Fl	+ + +	2,4 ± 0,04	– " –
Prominent	Fl	+ + +	2,0 ± 0,05	leather-like
Plamja Vostoka	Fl	+ + +	2,1 ± 0,03	coarse
Rosemary Rose	Fl	+	2,6 ± 0,03	– " –
Centenaire de Lourdes	Fl	+ +	0,8 ± 0,02	– " –
Queen Elizabeth	Gr	+ +	1,1 ± 0,04	leather-like
Super Star	HT	+	1,3 ± 0,05	– " –
Paul's Scarlet Climber	LCl	+ + +	1,7 ± 0,03	coarse
Conrad Ferdinand Meyer	HRug	+	0,9 ± 0,01	leather-like

Note: + + + – high steadiness;+ + – middle steadiness; + – weak steadiness.

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