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Tomato and Pepper Plants Growing in the Waters of South Morava River within the Vranje Region

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Abstract: Various harmful substances emitted from industrial and other sources cause environmental pollution (air, water, soil) and they have bad influence on the live nature and plants which represent the main link in material circulation.

Therefore, the aim of this work was to investigate, by using the method of water cultures, the influence of harmful effluents in the course of South Morava River within the Vranje region on tomato and pepper vegetable plants growing in comparison with the controlled plants which were grown in distilled water.

The results show differences in percents of tomato and pepper plants growing depending on the point from which the water sample was taken i.e. the concentration of water pollution. The differences are shown among plants, and among plant organs such as root, stem and leaves.

The greatest percentage of growing is measured for tomato and pepper plants which were grown in the water sample at the place before the empty of factory effluents and it is 80.7 % for tomato and 80.1 % for pepper plants in comparison with the control. The least percentage of growing is measured for tomato plants which were grown in the

sample water after the empty of factory waste waters and it is 55.9 % in comparison with the control.

Also, the growth of all plant organs of pepper is bigger than the growth of plant organs of tomato plant in all measuring points of the water sample. Thus, the percentage of dried mass of pepper plant organs is bigger than of tomato plant organs in all tested water samples.

Tomato and pepper plant growing is inhibited in all tested points in comparison with the controlled plants and it shows that the water of this river is polluted and therefore such water can not be used for human purposes (drinking or watering cultures).

Our results can be used as water pollution indicators for biological monitoring.

Key words: river, water, pollution, pollutants, vegetable, growing.

Introduction

Nowadays, the mankind is faced with exaggerated urbanization and industrialization, with more and more polluted environment (water, air, soil), with disappearance of many plant and animal species, and many frequent diseases which are caused by different pollutants. The pollutants emitted by emitters go to the atmosphere and then they fall on the ground because of the wet and dry precipitation and they also influence on the water systems and the whole environment by causing harmful effects. Biological effects of pollution are especially important and worrying. Thus, we can say that the protection and advancement of the environment represent a long – lasting process and the obligation of the mankind to find a solution to it.

Plants, as food producers, take the central part in the environment. They are also the most sensitive to pollution, more than other organisms.

Toxic materials in water, soil and air (SO_2 , NO_x, fluorides, heavy metals etc.) can harm fine structures of vital plant organs, leaves and the root system above all (Seinfeld, 1975).

Plant effects caused by industrial pollutants depend on the distance of plants from the emitters. Wheat plants which were grown near the source of the industrial pollution had decreased growth and crop, and at the same time the disorder of biochemical parameters in comparison with plants which were grown at the place that was at a distance from emitters (Marthur *et al.*, 1987).

Low concentrations of SO_2 and NOx in air inhibit the growing and cause aging and the falling of leaves of pea plants. While these pollutants in separate action and low concentrations have positive effect upon the sprout growing, the number of leaves and the quantity of fresh and dry mass of pea plants (Edelbaner and Maier, 1988).

Some, very toxic pollutants (Hg) from water accumulate in bigger concentration in plant organs during the watering of plants with such water, which negatively influence on people and animals because they use products made of plants from these terrains as food.

Although, the danger for human health is big people are not aware enough of damages that toxic materials put into the environment. A great number

of people use polluted water for watering vegetables. In that way toxicants enter into the process of the material circulation and nutrition chain i.e. they enter into the human organism.

Having in mind all of this, we decided to examine the influence of the waters of South Morava River within the Vranje region, on the growing tomato and pepper vegetable plants which are considered to be the main source of food in this region. Namely, through the process of growing and the influence of the existing pollutants on biological – physiological parameters which are important for plant growing.

Material and method

For the monitoring of the growth, tomato (*Solanum lycopersicum* L., *Lycopersicom lycopersicum* ASVF-F_1) and pepper (*Capsicum annum* L., white long) plants were used. The plants grew in the water sample taken from four measuring points in the course of South Morava River within the Vranje region:

1. before the empty of industrial effluents,
2. after the empty of effluents i.e. after industrial installations,
3. before the town i.e. near the town
4. at the exit of the river from town.

The distilled water was used as a control. The method of work assumed determination of the influence of effluent waters of the South Morava River on tomato and pepper plants growing by using the method of water cultures. The growth of plants was monitored for 30 days, after that the height of the stem and the length of roots and leaves were measured as well as the weight of dry mass of the whole plants. The results are shown in tables.

The relation of grow of tomato and pepers were determined on the base of relative numbers of co-ordinates, index of constant base, verage index and structure index.

Results and discussion

Growing is the process where little becomes big. Living systems and plants above all accumulate different substances from their environment which change and build completely different compounds increasing their volume.

The influence of the waters of South Morava River on the growing tomato and pepper vegetable cultures was examined by using the method of water cultures. Four measuring points that are considered as the capital points of pollution were used for growing.

The South Morava River which runs through the Vranje region is mainly polluted by substances of industrial origin. Namely, this river pollution is mainly done by the textile industry “Yumko”, the factory “Simpo” and the meat packing plant “Jugokop”.

The main pollutants of these factories are: detergents, phenols, cyanides, oils, sulphates, nitrates, phosphates and hard metals which are emitted in the environment from the traffic. Beside this inorganic pollution , the meat packing plant

"Jugokop", in its emissions, emits organic pollutants such as blood, different kinds of fat, hair etc. The factories emit waste waters directly to the South Morava River without refining or filtering them.

The pollution of this river is done by many illegal trash piles which are situated all over the river banks.

Additional environmental pollution of the Vranje region was done during the NATO bombing with different types of pollutants which pollute the whole ecosystem.

The obtained results concerning the growing tomato and pepper plants show differences in percents of their organs growth (root, stem and leaves) depending on the place where the water sample was taken.

Thus, the biggest percentage of plant organs growth is measured for tomato and pepper roots which grew in the water before the industrial zone (factory) and it is 91.16% for tomato and 90.51% for pepper in comparison with the control (table 1 and 2), which indicates that it is the same, unpolluted water with no industrial pollutants. The same measuring point for both tomato and pepper plants showed the biggest quantity of dried plant mass, and it was 50% in comparison with the control.

Plants which were grown in the water sample after the industrial zone show the least percentage of the root growth of tomato (52.48%) and pepper (75.91%) in comparison with the control (Table 1 and 2) and also the decreasing in percents of dried mass. This growth inhibition of roots for tomato and pepper plants is caused by high concentration of pollutant cocktails of industrial origin from the factories which emit waste waters into the river.

At a distance from the river and capital points of pollution towards the city we can observe the increasing in percents of the root growth for tomato (77.35%) and pepper (81.02%) in comparison with the control. The reason of the increasing in percents of the root growth of tomato and pepper plants is the decreased concentration of toxic materials in the South Morava River because of the auto purification. The plant samples which grew in the water sample taken from the point at the exit of the town showed the decreased root growth of tomato (68.54%) in comparison with the controlled sample (table 1), probably because of the increased concentration of pollutants which came into the river from the town drainage, and the village cultivated fields (mineral fertilizers).

The obtained results of the experiment for the stem growth show that the least percentage of the stem growth was measured for plants which grew in the water sample at the point after the industrial zone and they are (71.07%) for tomato stems and (64.92%) for pepper stems in comparison with the controlled sample. The biggest percentage of the stem growth, 80.90% for tomato and 91.10% for pepper plants, was measured for the plants which grew in the water at the point near the town (tables 1 and 2) which indicates that low concentrations of pollutants can have a stimulative effect upon the plant growth because they probably influence on the activation of enzymes and hormones which are responsible for the plant growth.

Tab.1. Plant organs growth (root, stem and leaves) of tomato plants which were grown in the waters of South Morava River.

Tomato	Rot					Stem					Leaf					Dry mass
	cm	Rang	r.b %	I sb %	I vr %	cm	Rang	rb%	I sb %	I vr %	cm	Rang	rb%	I sb %	I vr %	%
Control	9.05	1	25.67	100.00	-	30.25	1	24.44	100.00	-	12.75	1	23.10	100.00	-	100.00
Before the factory	8.25	2	23.40	91.16	91.16	24.00	3	19.39	79.64	97.96	10.75	4	19.47	84.31	89.58	50.00
The exit of the factory	4.75	5	13.48	52.48	76.61	21.50	5	17.37	71.07	91.48	7.25	5	13.13	56.36	48.26	26.47
Town	7.00	3	19.86	77.35	84.85	24.50	2	19.80	80.90	80.99	12.00	3	21.74	94.12	96.38	23.52
The exit of the town	6.20	4	17.59	68.50	88.57	23.50	4	18.99	77.69	91.48	12.45	2	22.55	97.65	97.65	23.52

Tab.2. Plant organs growth (root, stem and leaves) of green pepper plants which were grown in the waters of South Morava River.

Pepper	Rot					Stem					Leaf					Dry mass
	cm	Rang	rb%	I sb %	I vr %	cm	Rang	rb%	I sb %	I vr %	cm	Rang	rb%	I sb %	I vr %	%
Control	6.85	1	23.14	100.00	-	23.75	1	22.35	100.00	-	8.75	1	22.21	100.00	-	100.00
Before the factory	6.20	2	20.95	90.51	90.51	20.15	4	18.96	84.89	85.75	8.30	2	21.07	94.86	94.86	50.00
The exit of the factory	5.20	5	17.57	75.91	93.69	15.30	5	14.40	64.92	75.93	6.80	5	17.26	77.71	90.67	33.33
Town	5.55	4	18.57	81.02	95.69	23.55	2	22.16	99.1	99.10	8.05	3	20.43	92.00	96.98	41.60
The exit of the town	5.80	3	19.59	84.67	96.68	23.50	3	22.12	99.00	99.79	7.50	4	19.04	85.71	93.17	66.66

The obtained results of the leaves growth show, too, that the least percentage of the leaves growth for tomato and pepper plants is measured for plants which grew in the sample water which was taken at the point after the industrial installations and expressed in percents the growth is 56.36% for tomato leaves and 77.71% for pepper leaves in comparison with the controlled plants, and the biggest percentage is measured for the leaves which growth in the water sample before the industrial installations. This confirms again the assumption that the water before the factories is unpolluted and that it stimulates the growth of leaves.

Our results of tomato and pepper plants growing in the waters of South Morava show that there is the difference in the plant organs growth, among plant species and water samples from different measuring points of the South Morava River, after 30 days vegetation. Namely, judging by the percentage of the dried mass of plants and the plant organs growth, pepper plants are more resistant towards the pollution than tomato plants, probably because of the genetic constitution.

Stimulation or inhibition of plant organs growth for tomato and pepper plant species depend on the concentration of pollutants. High concentrations of pollutants inhibit growing while low concentrations stimulate plant organs growth, which means plant growth.

Our results are completely in accordance with the literature results.

Namely, heavy metals decrease seed germination and slow the plant growth (Pand and Misra, 1981). Low concentrations of Pb – acetate (10^{-5} M) stimulate the stem growth of barley and lucerne and it is 150 % compared with the control, while high concentrations of Pb – acetate inhibit the stem growth of barley and lucerne (Trajkovic R., 1995).

Hard metals (Pb, Cd, and Zn) are doing the inhibition of wheat growth and cause the decrease of crop (Singh and Nayyar, 1981). It is supposed that vitamins soluble in fat (A, E, D), unlike humin acids decrease toxic effects of pollutants, and as a result we have plants growing faster, (Kristof, 1956). Thus, the increased growth of plant organs (root, stem and leaves) for tomato and pepper plants in the examined water samples of the South Morava River can be connected with some materials which play the role of helator and also exist beside pollutants, and they diminish harmful effects of water pollutants emitted from factories. This can be the aim of further research of the South Morava River and their influence on the living systems, and biological monitoring should consider this.

The toxic effects of pollutants on seed germination and especially the plant growth, Pb, Cd and Zn effects are decreased mainly by the presence of EDTA in solution. (Trajkovic, 1995). Namely, by adding EDTA to the solution of Pb – acetate we can see that plant organs growth is very close to the controlled plants.

Renu et al. (1990), found that different pollutant concentrations of alcohol factory waste waters have effect upon the pea plant growth. Low concentrations of pollutants (10 – 25%) cause the increasing of sprout length, and higher concentrations show the inhibitory effect upon the growth of these plants compared with the control.

Stimulative or inhibitory effect of the waters of South Morava River cause the increasing or decreasing of biomass for tomato and pepper plants before the appearance of morphological changes. Thus, the pollutants from the

waters of South Morava River have an affect upon biochemical – physiological systems which are included and responsible for the plant mass increasing which means for normal growing.

Conclusions

Considering the obtained results and a great number of literature data we can conclude that the waters of South Morava River within the Vranje region have different percentage of pollution and it can be seen by observing the growing of tomato and pepper plants, and generally there are 2 much polluted places.

The biggest percentage of plant organs growth of root, stem and leaves is measured for both plant species which grew in the water samples before the industrial installations, where the biggest dried mass is measured and it is (50%) for tomato and (50%) for green pepper plants compared with the control.

The growth percentage of plants in all examined water samples of the South Morava River is less than the controlled plants, which indicates that the examined part of the course of this river is polluted and cannot be used for human consumption (drinking, watering cultures, not even like technical water).

Our results represent the beginning of the water pollution examination of this river and its influence on plants. Therefore, we consider that these results will be of great value and they can be used for biological monitoring of waters.

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RASTENJE BILJAKA PARADAJZA I PAPRIKE U VODAMA REKE JUŽNE MORAVE U REGIONU VRANJA

- originalni naučni rad -

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Rezime

Razne štetne materije emitovane iz industrijaskih i dr. izvora izazivaju zagađenje životne sredine (vazduha, vode, zemljišta) što štetno utiče na živi svet, pa i na biljke, koje predstavljaju glavnu kariku u kruženju materije. Shodno tome cilj ovog rada bio je da se metodom vodenih kultura ispita uticaj štetnih efluenata vodenog toka reke Južne Morave u regionu Vranja na rastenje povrtarskih biljaka paradajza i paprike u odnosu na kontrolne biljke koje su rasle u destilovanoj vodi. Rezultati pokazuju da postoje razlike u intenzitetu rastenja biljaka paradajza i paprike u zavisnosti od tačaka uzorkovanja voda, tj. od koncentracije zagađenosti voda, kao između biljnih vrsta i biljnih organa korena, stabla i listova. Najveći intenzitet rasta izmeren je kod biljaka paradajza i paprike koje su rasle u vodi uzorkovanoj na mestu pre ulivanja fabričkih efluenata i on iznosi 80,7 % kod paradajza, a kod biljaka paprike 80,1 % u odnosu na kontrolu. Najmanji procenat rastenja zabeležen je kod biljaka paradajza koje su rasle u vodi uzorkovanoj posle ulivanja fabričkih otpadnih voda u reku i ono iznosi 55,9 % u odnosu na kontrolu. Takođe, rast svih biljnih organa paprike je veći u odnosu na rast biljnih organa paradajza u svim mernim tačkama uzorkovanja vode. Stoga je procenat suve mase biljnih organa paprike veći u odnosu na biljke paradajza u svim probama uzorkovanja vode. Rastenje biljaka paradajza i paprike inhibirano je u svim mernim tačkama uzorkovanja vode u odnosu na kontrolne biljke, što ukazuje da je voda ove reke zagađena, i stoga se ne može koristiti za ljudsku upotrebu (za piće, zalivanje kultura). Naši rezultati mogu da se koriste kao indikatori zagađenja voda za biološki monitoring.