



UNIVERSITY of NOVI SAD, SERBIA
FACULTY of AGRICULTURE



22nd International Symposium

»Food safety production«

PROCEEDINGS

Trebinje, Bosnia and Herzegovina, 19 – 25 June, 2011.

ISBN: 978-86-7520-219-6

UDC: 338.439.4:616-092.11

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Faculty of Agriculture, Trg Dositeja Obradovića 8, 21000 Novi Sad, Serbia.

Phone: +381 21 485-3500; <http://polj.uns.ac.rs/>

Printing: "TAMPOGRAF" Novi Sad.

PRESENCE OF ATRAZINE RESIDUES IN SOIL AND ITS CONTENTS IN GROUND WATER

Lazić, S., Šunjka, D., Pucarević, M., Grahovac, N., Jakšić, S., Vuković, S., Bursić, V.¹

SUMMARY: Soil and water of adequate quality are essential for food safety. However, the intensive use of pesticides, especially triazine based herbicides, in recent decades, has led to an accumulation of their residues in the environment. This essay presents the results of monitoring and analysis of atrazine residues in samples of ground water aquifer and soil collected in the vicinity of wells, in areas under intensive agricultural production in the region of Srem, where atrazine has been applied for many years. Residue levels of atrazine were analyzed by GC/NPD, and the results showed that its average value in samples of groundwater was 0.123 mg/l, and 0.038 mg/kg in soil. These values indicate that groundwater and soil from this region generally fulfill the requirements of agricultural production.

Key words: atrazine, residue, groundwater, soil, Srem

Introduction

Crop protection from weeds, pests and diseases is one of the most important measures in agricultural production. However, only a rational use of pesticides fulfill the criteria for organic food production and environmental protection. After the application, chemicals do not come in contact only with the crop and target organisms. A part reaches the ground and in the wash-out process gets to a lower layers of soil and groundwater [1], where the negative environmental impact is most expressed. The fate of pesticides in the environment depends, above all, on their persistence, but also on the characteristics of soil and water.

Water and land quality in conventional production, but especially in organic agriculture, are extremely important. The presence of pesticide residues in these matrices may cause yield reduction and decrease product quality [2], due to its uptake. In this way pesticides get into the human food chain.

One of the most commonly detected pesticide in groundwater and soil is triazine based herbicide- atrazine [3-6]. It has been applied since 1952 as total herbicide, but also for the control of weeds in corn [7]. Since the mobility of triazine and aminotriazine compounds through the ground varies from modestly to very high, they easily find their way to the surface and ground water in which they persist and present a potential risk because they are not subjected to hydrolytic or microbial degradation [8].

The intensive use of atrazine herbicides in the region of Srem during recent decades, has led to the accumulation of residues of atrazine and its metabolites in the environment, which endangers groundwater and soil. It is very important to have in mind that Srem is primarily agricultural region with vast areas under orchards and vineyards, where atrazine was used in large quantities.

Although, since 2008, the application of atrazine has been ceased in the Republic of Serbia [9], its residues are still present and require continuous monitoring. This study was conducted in order to verify the presence of atrazine residues in groundwater and soil in the region of Srem. It also provides the insight into possibility of safe food production in this area.

Material and Method

Samples of groundwater and soil were taken from 15 localities in the region of Srem (Figure 1). Ground water aquifer was collected from wells in areas under intensive agricultural production, where the atrazine based herbicides were used for many years. The soil samples were taken from the arable layer (0-30 cm), in the vicinity of wells that were used as source for water samples.

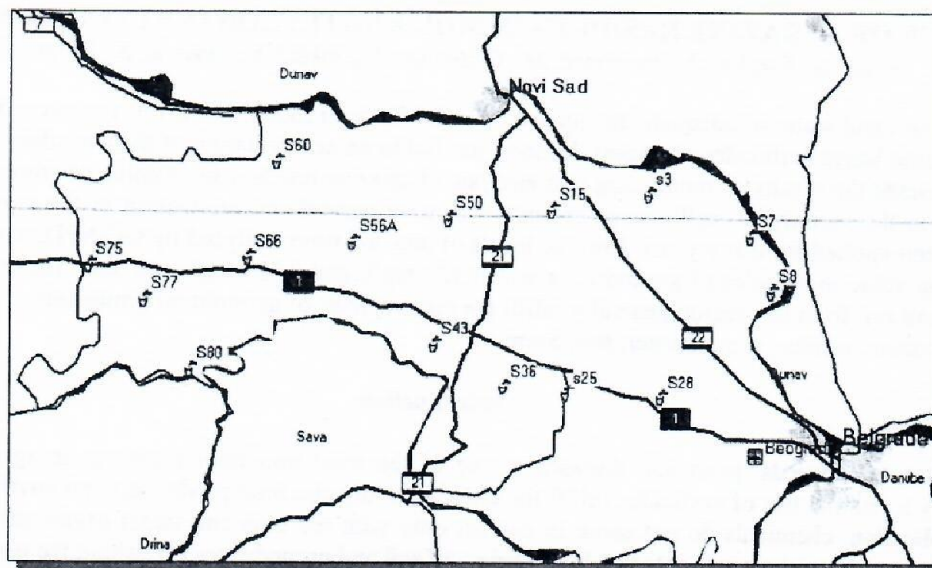
Original scientific paper

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From groundwater, atrazine was extracted with methanol, using 47mm C-18 SP disk [1] while the extraction from soil samples was conducted with glass equipment for Soxhlet extraction with methylene chloride [10]. Residue levels of atrazine in the samples of groundwater and soil were analyzed by GC/NPD. Statistical data analysis was performed [11].

Figure 1. The geographic position of samples of groundwater and soil in the area of Srem (MapSource)



Results and Discussion

In the region of Srem, the average pH value of groundwater is 7.9 [12]. In these conditions, atrazine is very stable, because its water solubility, in the range from pH 3 to pH 10 almost does not change [13].

The results of chromatographic analysis of atrazine contents in the samples of groundwater and soil are presented in Table 1. The residues were found in all analyzed samples of groundwater. In 47 % of tested samples, content of atrazine was above 0.1 mg/l [14]. The high level of residues of this active substance was found in groundwater sampled at all sites in orchards and vineyards, where atrazine has been applied for years as a total herbicide. The highest value of atrazine (0.430 mg/l) was detected in the water sample collected at site with the highest level of underground water (~ 0.5 m), while lower values of analytes were determined in specimens from localities under intensive maize production.

Table 1. Average values of atrazine in groundwater and soil in the region of Srem

| SREM n=15 | Atrazine | |
|--------------|--------------|--------------------|
| | Soil (mg/kg) | Groundwater (µg/l) |
| Min | 0.001 | 0.001 |
| Max | 0.155 | 0.430 |
| Mean | 0.038 | 0.123 |
| % ↑ MRL | 7 | 47 |

Residues of atrazine were detected in all analyzed soil samples. Their average value of 0.038 mg/kg was lower than the maximum one in soil, which is declared respectively for sensitive crops, ranging from 0.06 to 1 mg/kg [15]. The highest values of atrazine residues in soil and groundwater were determined in the same locality (Šašinci).

Since the residues of atrazine were established at all sites in the region of Srem, it is possible to make a correlation between the content of this active substance in groundwater and soil (Figure 2). Analysis of two sets of values showed the positive linear correlation ($r = 0.584$) between the presence of atrazine in groundwater and soil near wells. Therefore, detection of residues of atrazine in one matrice indicates its presence in second one from the same location.

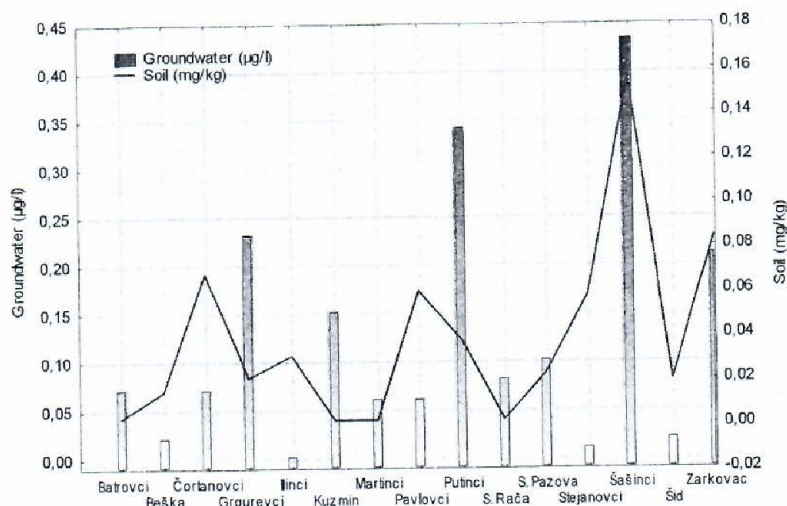


Figure 2. Correlation between the presence of atrazine in groundwater and soil in the same localities

Conclusions

The work contains the results of atrazine residues monitoring in soil and groundwater in the region of Srem. The average values of content of this active substance in analyzed samples (0.123 mg/l, 0.038 mg/kg) are the result of intensive and long-term usage of this group of herbicides, as well as the high level of groundwater in this region. Considering the fact that the atrazine based herbicides have been excluded from use in R. Serbia since 2008, we can expect a gradual reduction of its residues in this region.

The results of this study indicate that ground water and soil of this region generally meet the requirements of agricultural production.

Acknowledgements

The research is a part of the project III43005 funded by the Ministry of Science of the Republic of Serbia.

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