ICAFOF 2018

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Cesme-Izmir / Turkey

Proceeding Book

Editors

Asst.Prof.Dr. M.Cüneyt BAĞDATLI
Assoc.Prof.Dr. Erkan KALIPCI
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Invitation

Welcome to International Conference on Agriculture, Forest, Food Sciences and Technologies (ICAFOF-2018 Çeşme-İzmir/ Turkey). This Three Nights, Four Days conference will be held in Sheraton Cesme Hotel Resort & Spa , Çeşme-İzmir/ Turkey during April 2 - 5, 2018. The official presentation and writing language of the ICAFOF is abstract and Full Papers as English and Turkish will be uploaded to the Conference System. Participants can submit a maximum of two papers for a conference fee for this conference. It will be published as the Conference Proceedıng E-Book only at the end of web page. The ICAFOF, Çeşme-İzmir/Turkey 2018 aims at presenting current researches being carried out in the areas of Agriculture, Forest, Food and Veterinary for scientists, scholars, engineers and students from the universities, technologists, entrepreneurs and policy makers all around the World. Thus, The ICAFOF - Çeşme provides opportunities for the delegates to exchange new ideas and application experiences face to face, to establish business or research relations and to find global partners for future collaboration. We hope that you can join us in the ICAFOF - Çeşme 2018 with new insights. We look forward to welcoming you to Çeşme, where is a fascinating nature wonder in Turkey. It will be "KURTALAN EXPRES" Concert for Gala Dinner in ICAFOF. The conference will be organized by Nevşehir Hacı Bektaş Veli University and Galaksi Organizing Company

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Invited Speakers

Important Dates

March 11, 2018	Submission Deadline of Abstracts
March 15, 2018	Submission Deadline of Full Text Paper
March 20, 2018	Payment Deadline of Conference Fee
April 2-5, 2018	Conference Date of ICAFOF

Conference Topics

Agriculture Sceinces and Technologies

Land and Water resources, Climate Change, Hydrology, Irrigation, Agricultural Machinery, Agricultural Energy Systems, Agricultural Economy, Horticulture, Plant Protection, Animal Science, Field Crops, Soil Science and Plant Nutrition, Biology, Agricultural Structures, Agricultural Biotechnology, Remote Sensing and GIS, Agriculture Education, Biosystem, Chemistry, Organic Agriculture, Ecology, Fisheries Engineering and etc.

Forest Sceinces and Technologies

Forest Industry Engineering, Forest Engineering, Landscape Architecture, Wildlife Ecology and Management, Wood Mechanics and Technology, Forest Industry and Business Machines, Wood Technology, Chemistry and Technology of Forest Products, Forest Botany, Ecology, Geodesy and Photogrammetry, Watreshed Management, Forest Entomology and Protection Forestry, Forestry Construction, Forest Management, Forest Economics, Forestry Education, Remote Sensing and GIS, Plant Material and Culture, Landscape Planning and Design, Forest Conservation Biology Landscape Techniques and etc.

Food Sceinces and Technologies

Food Chemistry, Food Microbiology, Food Quality Control, Nutrition, Food Engineering Basic Operation, Meat Technology, Garin Processing and Engineering, Milk Processing and Engineering, Biotechnology, Oil Processing and Engineering, Fruit-Vegetable Processing and Engineering, The Packaging of Food, Chemistry, Food Education Food Economics and Industrial Technology and etc.

Veterinary Sceinces and Technologies

Basic Veterinary Sciences, Veterinary Pre-clinical Sciences, Veterinary Clinical Sciencesi, Veterinary Medicine Education, Veterinary Technology, Animals in Folklore, Stock Farming Entity & Economy, Veterinary Medicine History & Deontology, Aquatic Studies, Wildlife Medicine, Medical Biostatistics, Dairy Veterinary Sciences, Livestock Management & Production Technology, Tropical Veterinary Medicine, Experimental Animal Science and etc.

INTERNATIONAL CONFERENCE ON AGRICULTURE, FOREST, FOOD SCIENCES AND TECHNOLOGIES
2-5 April 2018 Cesme-Izmir/Turkey

Poster Presentation

Assessment of water quality for irrigation in the Mačva region by using traditional and contemporary classifications

Radmila PIVIĆ*, Dragana JOŠIĆ, Zoran DINIĆ, Jelena MAKSIMOVIĆ, Aleksandra STANOJKOVIĆ-SEBIĆ

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Abstract

In the area of Mačva region of the Republic of Serbia, during 2017, it was carried out a survey which included assessment of the quality of available irrigation water.
The agricultural areas in which the survey was conducted were in ten locations under the type of drop-type irrigation system, four are irrigated by artificial rain, and eleven plots intended to apply some of the irrigation methods in the near future. Of the 26 tested water samples, according to the FAO classification, 65.4% belongs to the class of drinking water and irrigation, out of which 34.6% are irrigation water. According to the US Salinity Laboratory classification, the samples of irrigation water belong to the following: 7.7% to the class C1-S1, 69.2% to the class C2-S1 and 23.1% to the class C3-S1. According to Nejgebauer classification, the tested water samples belong to Ia (88.5%) and Ib (11.5%) class. According to the RSC-Residual Sodium Carbonate classification, 92.3% of the samples tested belong to the class of good waters, and 7.7% of the water samples are at the margin of usability. In all tested samples, the content of microelements and heavy metals, with the exception of nickel content, is below the maximum allowable concentration (MAC). In samples N^o. 3, 12, 21, 23, 24, the content of nickel is slightly above MAC value for irrigation water. In the tested water samples, the content of ammonia (NH_4-N), nitrate (NO_3-N) and nitrite (NO_2-N) nitrogen was analysed. The content of ammonia and nitrate nitrogen is within the prescribed limits, but in 65.4% of the analysed samples of irrigation water, the content of nitrite nitrogen is above the MAC. As the nitrate-nitrite ratio is dynamic, it is necessary to monitor the contents of these parameters at least twice a year (if the water from these wells is used as a technical one). When water from the wells is used for drinking and livestock watering, water quality control should be monitored every week according to EPA (USA) criteria.

Keywords: agriculture soil, water quality, heavy metals, microelements

Introduction

The water resources sustainability largely depends on the proper management and efficient utilization of agricultural water (Fasakhodi et al., 2010). Water for irrigation is a major limitation to agricultural production in many areas in the World (Letey et al., 2011). Poor quality of the irrigation water can significantly reduce the expected economic benefit of agricultural production (Caper et al., 2016; Towfiwul Islam et al., 2017). For a comprehensive assessment of the quality of surface and groundwater, it is necessary to assess physical, chemical and biological parameters of water quality.

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One of the main problems of water quality studies is the number of parameters that can be examined and thus associate the time and costs of collecting, analyzing and interpreting these data (Hector Hernandez-Romero et al., 2004). To overcome this, specific indicators for water quality have been adopted, in order to implement an effective water quality classification. Specific indicators are based on a set of water quality parameters, and widely accepted as informative (Ferhad et al., 2017). Irrigation of crops uses water from natural and artificial sources. Natural sources are streams, rivers and lakes, while artificial can be wells and artificial lakes. In addition, water for irrigation can also derived from wastewater from settlements, production processing and industrial capacities (Stojićević, 1996). For irrigation, water should be of adequate quality. Water quality control for irrigation is very important in order to assess the impact of its application on soil and plants. Water of unfavorable quality can cause salinization, alkalization and deterioration of water-physical properties of the soil (Dragović et al., 2006; Belanović, 2012). It is very important to assess the salinity risk of irrigation water sources of any agricultural area to obtain maximum agricultural yield (Shammi et al., 2016). Poor water quality may result in slow growth of plants, deformation of fruits and plants, and in some cases the application of bad quality water may lead to draying of the plants.

For the evaluation of the quality of water for irrigation there are several methods and classification. None of them can be considered absolutely applicable to all conditions in plant production. Methods that are in use for water quality classification for irrigation are divided to modern and traditional. They are based on the determination of the total amounts of salt in water, the ratio of the concentration of ion Na^{+} to the content of ion Ca^{2+} and Mg^{2+}, the presence of the Cl and B salts and electro-conductivity. The most important chemical properties that have to be controlled at the daily level (Šikić, 2016) are: pH value and electro-conductivity, which corresponds to the presence of dissolved salts.

Experimental procedure

Description of the study area and sampling methodology

On the territory of the Mačva region, located in the western part of the Republic of Serbia, which extends from 44°09' to 44°93' north latitude and from 19°10'do 20°00' eastern geographical longitude and covers an area of about 2668 km^2, research conducted in 2017 is presented in this paper. Positions of observations are presented in Figure 1, and the coordinates along with the results of the analysis in Table 3. The agricultural areas under which the survey was conducted, in ten locations drip irrigation system was applied; four plants are irrigated by artificial rain, and within eleven plots it was planned to apply some of the irrigation methods. Water samples used for irrigation or which will be used for irrigation were taken from or near the locations where the tests were conducted. A total of 26 samples of water were sampled, with the note that at the site 6 water was sampled from two wells. Water samples were collected using 1000 ml plastic bottles. The sampling bottles for heavy metal determination were pre-soaked overnight with 10% HCl, then, rinsed with distilled water and also rinsed using river water before sample collection. Sampling bottles for the determination of physico-chemical parameters were cleaned and rinsed using distilled water only. Preservation of water samples was done by adding 2 drops of concentrated HNO_3 to each water sample before storage below 4°C until it was analyzed.

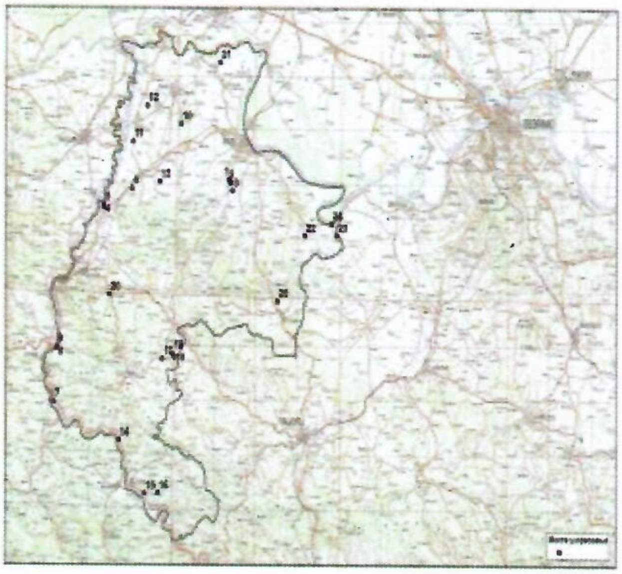

Figure 1. - Locations of observation

Research methods

The measured parameters were determined by the following methods: pH - potentiometric (SRPS H.Z1.111:1987), electrical conductivity (EC) - conductiometric (SRPS EN 27888:1993), total dissolved solids (TDS) - gravimetric (Greenberg et al., 1998), CO_3^{2-} ; HCO_3^- ; Cl^- - volumetric, K^+; Na^+ - plamenfotometric (APHA, 1992). The acid-available fractions of heavy metals and other microelements (As, B, Cd, Cr, Cu, Hg, Fe, Ni, Pb, Zn) and SO_4^{2-}; Ca^{2+} ; Mg^{2+} were determined using EPA 200.7 methods, as well as an ICAP 6300 ICP optical emission spectrometer (ICP-OES). Sodium Adsorption Ratio (SAR) was calculated (Rhoads et al., 1992). The concentration of Hg was determined by a flame atomic adsorption analyzer SensAA Dual (GBC Scientific Equipment Pty Ltd, Victoria, Australia), according to Nelson and Sommers, 1996. The dry residue, ionic balance and the SAR value, as an indicator of the relative activity of a water-soluble Na in the adsorption reaction, were determined according to the methods described by JDPZ (1966). Ammonia and nitrate nitrogen content was determined by distillation with MgO and Devard's alloy, and nitrite nitrogen spectrophotometrically, using sulphanilic acid reagents and α-naphthylamine (JDPZ, 1966).

Research Findings and Discussion

There are a variety of methods for assessing the usability of water for irrigation, based on the determination of the total amounts of salt in water, the ratio of Na^+ to the content of Ca^{2+} and Mg^{2+}, the presence of the Cl, B and electro-conductivity (EC) salts. Water suitable for irrigation can contain 1.1-1.7 g l^{-1} of various salts. It is preferred that irrigation water has a pH value from 6.5 to 8.5 (FAO 1985; DoE, 1997). pH values higher or lower can cause harmful effects in soil and on plants. Water for irrigation with a pH value above the normal range can cause irregularity in plant nutrition or affect increased accessibility of toxic ions.

The pH is an important factor that determines the suitability of water for a variety of purposes, inter alia, for irrigation. The pH values in tested samples ranged from neutral to slightly alkaline.

Electrical conductivity (EC) is a measure of the ability of an aqueous solution to carry an electric current. Increasing levels of conductivity and cations are the products of decomposition and mineralization of organic materials (Begum et al., 2008). The aqueous salt solution and dissociated are broken down into positive and negative ions. EC in natural waters is generally within the values less than usual. Measurement of the conductivity is performed at a specific temperature and it corresponds to the presence of dissolved salts. These are most commonly sodium chloride, and may be present, and sodium sulfate, calcium chloride, calcium sulfate, magnesium chloride, etc. Absolutely de-mineralized water does not conduct electricity, but even with small additions becomes a good conductor. Salts dissolved in the water influence on increase of the water conductivity values. Conductivity values are obtained indirectly by calculation of the amount of salts. If the measured value is 1 µS per liter of water it means that it was dissolved approximately 0.7 g of salt (Dragović et al., 1994.). Some of a large number of different elements dissolved in the water favor the plant and their presence is helpful, but sometimes useful for these elements may become hazardous if their concentration is high.

Total dissolved solids (TDS) are an important characteristic for determination of the quality of water for irrigation because it expresses the total concentration of soluble salts in water. Dissolved solids in water include all inorganic salts, silica and soluble organic matter (Atekwana et al., 2004; Ahipathy and Puttaiah, 2006). Pure water must be freed from most suspended particles responsible for turbidity.

The sodium adsorption ratio (SAR) describes the relationship between soluble Na^{+} and soluble divalent Ca^{2+} and Mg^{2+}cations (Alrajhi et al., 2015). It is a measure of the sodicity of the soil determined through quantitative chemical analysis of water in contact with it (Shammi et al., 2016).

The largest contributions to the study of water quality and its classification in relation to the suitability for irrigation of crops were given by experts of Laboratory for saline soil University Riverside, USA.

The method they have defined as the "US Salinity Laboratory Classification" is applied worldwide. The basis for the assessment of the above method is the determined value of the EC and SAR values. To class C1-S1 belongs 7.7% of the tested samples. It is distinguished by $EC \leq 0{,}250$ dSm^{-1}; SAR 0-10. These are waters where there is a small risk of dredging / alkalization, or water suitable for irrigation. 69.2% of the tested samples belongs to the class C2-S1 class of water, where EC values range from 0.250 to 0.750 dSm^{-1}, and therefore can be used for irrigation of plants with medium tolerance to salt. The remain 23.1% of the tested samples belongs to the class C3-S1, in which EC values range from 0.750 to 2.250 dSm^{-1} and their use requires the application of special measures in the prevention of soil salinization.

Modified FAO classification (Ayers and Westcot, 1994) analyzes in detail the influence of dissolved salt in irrigation water and the impact on the water-physical properties of the soil, primarily on infiltration. The above classification considers the risk of salinization, based on the values of EC and TDS in the tested sample.

Table 1. shows the values of the parameters on the basis of which the estimated irrigation samples have been assessed in accordance with this classification. It was found that 65.4% of the samples belongs to the class of drinking water and water for irrigation (EC <0.7 dS m^{-1}; TDS <500 mg l^{-1}) and 34.6% to the class for irrigation water (EC: 07-2 dS m^{-1}; TDS 500-1500 mg l^{-1}). An additional assessment using the possible influence of some elements dissolved in irrigation water, by analyzing the effect of Na^+ through various relationships with other solutes, by examining the content of the residual Na_2CO_3 can be determined using the classification RSC-Residual Sodium Carbonate, which is defined according to Joshi et al. (2009). In relation to this, 92.3% of the tested water samples belongs to the class of good waters (RSC<1.25) and 7,7% belongs to the class with the usability limit (RSC = 1.25-2.50).

The classification of Nejgebauer (1949) is also applied, and is based on the estimation of the total amount of salt in water and the interaction of Na^+ to Ca^{2+} and Mg^{2+} concentrations. In relation to the classification of irrigation water according to Nejgebauer, of the tested samples, 88.5% belongs to the Ia class, in which the dry residue is less than 700 mg l^{-1}, the ratio (Ca + Mg):(Na + K) is greater than 3 and 11.5%, and to the Ib class, where the dry residue is less than 700 mg l^{-1}, and the ratio (Ca + Mg):Na is greater than 3. These are impeccable water with ameliorative characteristics of flushing salt marsh.

The content of the studied microelements and heavy metals was analyzed in accordance with the Regulation on the permitted quantities of hazardous and harmful substances in soil and irrigation water and the methods of their testing (Official Gazette of RS 23/1994) and Ayers and Westcot (1994).

Table 1. -Maximum permitted amount of hazardous and harmful substances in irrigation water

Element	As	B	Cd	Cr	Cu	Fe*	Ni	Pb	Zn	Hg
	(mg l^{-1})									
MAC	to 0.05	to 1.0	to 0.01	to 0.5	to 0.1	to 5	to 0.1	to 0.1	to 1.0	to 0.001

MAC- maximum allowable concentration; Official Gazette of RS 23/1994; * - Ayers and Westcot (1994).

The contents of trace elements and heavy metals in the samples of water are generally below the MAC (Table 1). In sampling points No. 3, 12, 21, 23 and 24 it was recorded an increased Ni content above the MAC (0.1 mg l^{-1}).

In addition to the above estimates, the content of ammonia (NH_4-N), nitrate (NO_3-N) and nitrite (NO_2 -N) nitrogen was analyzed. The water quality assessment criterion from the point of view of the MAC for these parameters was taken from the regulations of the European Union (EU), EPA (USA) and WHO (World Health Organization) (Table 2).

Table 2.- Criteria for evaluation of water quality based on directives

Parameter	EPA (SAD)	WHO	EU
	(mg l^{-1})		
NO_3-N	45.0	50.0	50.0
NO_2-N	-	0.2	0.2
NH_4-N	1.0	1.0	1.0

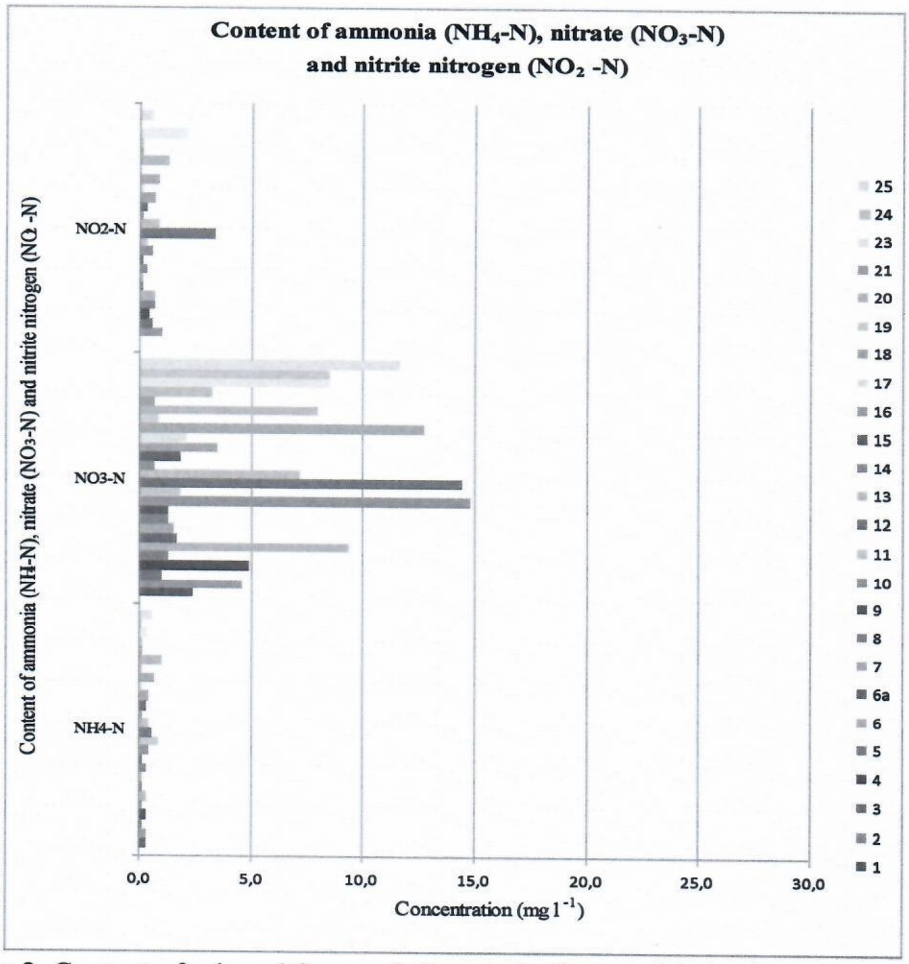

Figure 2. Content of mineral forms of nitrogen in the tested irrigation water samples

Table 3. Chemical and physical properties of water samples for irrigation

N°	Coordinate X	Coordinate Y	pH	EC 25°C (dSm^{-1})	TDS ($mg\ l^{-1}$)	SAR ($mg\ l^{-1}$)	As ($mg\ l^{-1}$)	B	Cd	Cr	Cu	Fe	Ni	Pb	Zn
1	393594	4949926	7.60	0.479	240	0.33	bdl	0.017	bdl	bdl	bdl	0.022	0.036	bdl	0.008
2	394057	4949376	7.20	0.707	353	0.38	bdl	bdl	bdl	bdl	bdl	0.014	bdl	bdl	0.013
3	393912	4948188	7.80	0.520	260	0.47	0.010	bdl	bdl	bdl	bdl	bdl	**0.128**	bdl	0.007
4	363842	4945067	7.60	0.602	301	0.04	0.010	0.038	bdl	bdl	bdl	bdl	0.007	bdl	0.007
5	363828	4945395	7.60	0.552	276	0.01	0.010	0.018	bdl	bdl	bdl	0.009	bdl	bdl	bdl
6	370538	4948308	7.60	0.624	312	0.13	0.008	0.006	bdl	bdl	bdl	0.003	0.011	bdl	0.013
6/1	370538	4948308	7.60	0.607	304	0.06	bdl	bdl	bdl	bdl	bdl	0.125	0.005	bdl	0.013
7	351809	4908770	7.80	0.293	146	0.01	0.012	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.008
8	352450	4918795	7.80	0.184	92	0.11	0.011	0.005	bdl	bdl	bdl	bdl	0.005	bdl	0.008
9	352502	4918778	8.10	0.277	139	0.11	0.014	0.010	bdl	bdl	bdl	bdl	0.005	bdl	0.009
10	382238	4960064	7.50	0.772	386	0.11	0.010	0.007	bdl	bdl	bdl	bdl	0.006	bdl	0.011
11	370802	4956824	7.70	0.437	218	0.01	0.010	0.001	bdl	bdl	bdl	bdl	bdl	bdl	bdl
12	374248	4963386	7.80	0.765	383	0.01	0.008	bdl	bdl	bdl	bdl	0.007	**0.113**	0.006	0.016
13	377069	4949505	7.60	0.552	276	0.14	0.011	bdl	bdl	bdl	bdl	0.006	0.011	bdl	0.010
14	367366	4901862	7.90	0.339	169	0.01	0.011	bdl	bdl	bdl	bdl	0.005	bdl	bdl	0.008
15	373600	4892316	7.80	0.522	261	0.01	0.011	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.005
16	376685	4892369	7.40	0.516	258	0.01	bdl	bdl	bdl	bdl	bdl	0.002	bdl	bdl	0.005
17	377703	4916707	8.10	0.654	327	0.01	0.011	bdl	bdl	bdl	bdl	bdl	0.004	bdl	0.006
18	380574	4917005	8.00	0.469	235	0.05	bdl	bdl	bdl	bdl	bdl	0.003	bdl	bdl	bdl
19	380254	4917713	7.90	0.444	222	0.01	bdl	bdl	bdl	bdl	bdl	0.004	0.005	bdl	bdl
20	365165	4928554	7.50	0.755	378	0.17	0.012	0.053	bdl	bdl	bdl	bdl	bdl	bdl	0.008
21	391457	4971293	7.90	0.801	400	0.14	0.011	0.009	bdl	bdl	bdl	0.004	**0.101**	0.012	0.019
22	411701	4939576	7.60	0.866	433	0.57	0.012	0.002	bdl	bdl	bdl	bdl	0.008	bdl	bdl
23	419410	4939571	7.40	1.146	574	0.36	bdl	0.006	bdl	bdl	bdl	bdl	**0.109**	bdl	0.009
24	418130	4942054	7.70	0.691	346	0.53	0.012	0.163	bdl	bdl	bdl	0.002	**0.101**	bdl	0.007
25	405180	4927418	7.60	0.936	468	0.60	bdl	bdl	bdl	bdl	bdl	0.016	bdl	bdl	0.011

bdl - belov detection limit

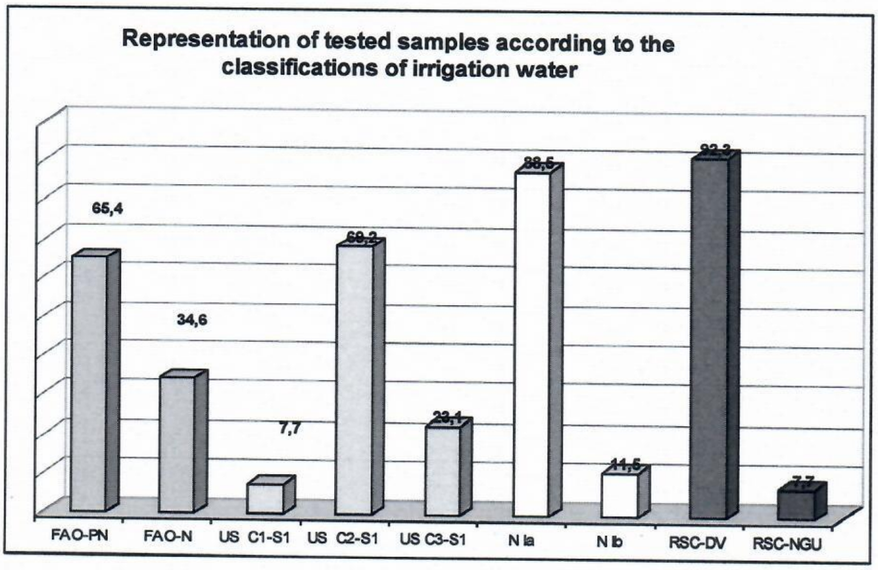

Figure 3. Representation of tested samples according to the classifications of irrigation water

Results and Suggestions

Chemical and physical properties of water for irrigation samples are shown in Table 3. On Figure 3, it is presented a percentage of representation of the samples of water for irrigation by applied classification. Among 26 tested water samples, according to the FAO classification, 65.4% belongs to the class of drinking water and water for irrigation (PN), out of which 34.6% is irrigation water (N). According to the US Salinity Laboratory classification, the samples of irrigation water belong to the following: 7.7% to the class C1-S1, 69.2% to the class C2-S1 and 23.1% to the class C3-S1. According to Nejgebauer classification, the tested water samples belong to Ia (88.5%) and Ib (11.5%) class. According to the RSC-Residual Sodium Carbonate classification, 92.3% of the samples tested belongs to the class of good waters, and 7.7% of the samples classifies water at the margin of usability. In all tested samples, the content of microelements and heavy metals, with the exception of Ni content, was below the maximum allowable concentration (MAC). In samples No. 3, 12, 21, 23, 24, the content of Ni was slightly above MAC value for irrigation water.

On Figure 2, it is presented the content of the form of mineral nitrogen in the samples tested. The appearance of nitrate is a common characteristic of the wells with a reduced oxygen and high content of Fe^{3+} ions. As the ratio of nitrate-nitrite is dynamic quantum, it is necessary to monitor the content of these parameters at least twice a year (if the water from these wells is used as a technical water).

In the case when the water from wells is used for drinking and livestock watering, water quality should be monitored every week according to the EPA (US) criteria. Nitrate Directive requires that more than 50 mg l^{-1} of NO3-N should not be found in the surface and underground waters. The areas identified as potentially affected (nitrates sensitive zone) should be subjected to analysis more frequently than usual. Water from such areas can be banned from further use as they may have adverse effects on human or animal health, or restrict measures should be implemented, such as reducing the intake of organic and mineral fertilizers, reducing the number of cattle and so on.

Based on the obtained and analyzed results of testing the quality of water for irrigation, it can be concluded that this water can be used for irrigation of crops and soil in the vicinity of said water flow to the restrictions and frequent quality checks during the summer months.

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