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Quality of the water from the sources, intended for irrigation of the experimental fields of Institute of Agriculture, Kyustendil, Bugaria

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Abstract

The waters from the river Bistritsa River, Drenov dol Reservoir and Industrial Drillhole, intended for irrigation of the experimental agricultural fields of Institute of Agriculture, Kyustendil, Bulgaria during the performed study were determined as *Very good – Blue*. All three types of waters actually are the same water of the Bistritsa River, type P3-Mountain. The waters correspond to the type of soils low-acid and they are appropriate for irrigation of the existed cultivated plants apple, cherry and plum trees as also some other fruit and vegetable plants.

Key words: water, soil, irrigation, fruits, vegetables

Introduction

The town of Kyustendil is located in Southwestern Bulgaria, near the Osogovo Mountain. It is located in the central part of the Balkan Peninsula at an altitude of 512 m. The climate of the city is transitional continental to Mediterranean. Rainfall is not very intense with an annual size of about 589 mm. They are almost evenly distributed by seasons. Snow falls from November to March as the average snow thickness is 30 cm, which lasts about 15 days. Despite the small amount of rainfall, there are many sources of water in the area - rivers, springs, lakes, mineral and groundwater (Ivanchev, 1996). In recent years, there has been an uneven distribution of precipitation, alternating very humid with very dry periods, which is probably due to the global increase in temperatures. The largest river in the region is the Struma River. Bistritsa River is the biggest tributary of Struma River on the territory of the municipality

of Kyustendil. The Bistritsa River is one possible source for irrigation of the experimental fields of the Institute of Agriculture in Kyustendil. It is 51 km long and borders directly to the studied experimental fields. It rises at 2182 m above sea level in Osogovo Mountain, northeast of Mount Ruen. Bistritsa flows on the right into the Struma River at 462 m above sea level, southwest of the village of Konyavo (BAS, 1988). The second studied by the present work irrigation water source is the industrial well, located in the experimental fields of the institute, exactly on the border with the bed of the Bistritsa River and has a depth of 5 m. The third water source studied in the present work is the Drenov Dol dam, which is located 2 km western of the experimental fields intended for irrigation, and there is an infrastructure – a pipeline that is built exactly for this purpose, but needs repair. Information on ecological monitoring of these water sources has been published by Sotirov (2014), Vitov & Sotirov (2014) and Sotirov et al. (2014).

Materials and methods

Measurements were done by applying the method "In situ" during October 2023. Radiation of the water and the common radiation background were measured with a Geiger counter "Radex"RD1503. Physico-chemical measurements were performed with an instruments "SensoDirect 150". Lazer spectro-photometer "Lovibond MD 600" was used for chemical study. Nitrate and nitrite content in the water were measured by using of test strips with a range of 0-10-25-50-100-250-500 mg/l. Arsenic content in the water is measured by using of test strips with a range of 0.005-0.0010-0.0025-0.05-0.1-0.25-0.5 mg/l and reagent malonic acid. Bromine is determined through test strips with range 0-0.5-1-2-6-10-20 mg/l, Fluoride 0-25-50-100-200 mg/l, and Iodine 0-0.02-0.04-0.08-0.10-0.15 mg/l. The content of lead Pb is determined through colorimetric method with testing tapes with ranges 20-40-100-200-500 mg/l and reagent Blei-Test.

Results and discussion

As a result of the conducted research, it was found that the waters of all three studied water sources intended for irrigation of agricultural crops, mainly fruit trees, but also vegetables are clean and can be used for irrigation. The soil on the territory of the experimental fields of the Institute of Agriculture in Kyustendil is defined as leached Cinnamon Forest (Chromic Luvisols) (FAO-ISRIC-IUSS, 2006), as the soil pH varies from 5.0 to a depth of 0-10 cm and reaches 5.4 at a depth of 100 cm, and the humos is 0.98% at the surface and decreases to 0.40 at 100 cm (Zdravkova, 2012). In the experimental field are grown mainly different varieties of apples, cherries and plums, which are typical for Kyustendil valley. Fewer areas are planted with other species such as pears, quinces, sour cherries, grapes and vegetables – cabbage, carrots, cauliflower, broccoli. According to Mitov et al. (2008) apples and pears develop best in a weakly acidic to neutral soil reaction, while cherry and sour cherry on a rootstock tolerate acidic soils, although they prefer an alkaline reaction. The soil is poor in humus, so the fruit trees rely on good soil structure and drainage properties, and also on the mineral composition as an adsorbent. What has been said so far corresponds well with the measured pH values of the waters. The measured values of the three types of water – from the Bistritsa River, the water from the Drenov Dol Dam, which is also fed by the Bistritsa River and an industrial well in the regulation of the experimental fields, on the border with the Bistritsa River itself, show identical values - just under 7.0, which attributes them to weak-acidic waters, and the soils to weak - to medium-acidic soils (Ganev, 1990). These are identical waters that are of the same catchment area and the same origin from different water sources, the water being of the type P3 mountain of the Ministry of Environment and Water and according to the physico-chemical results of the studies the water corresponds without changes to the specified type. Chemical contaminations from the studied chemical elements are not established (table 1, 2, 3), very little presence of nitrates and nitrites is present in the water of the river Bistritsa. The hardness and $CaCO_3$ content of the three water

types is relatively high. The radioactivity of all three types of water, of the sediments, of the total radiation background are normal. The largest tributary of the Bistritsa River is the Lebnitsa River and there is a pollution found in it, mainly with surfactants and wastewater (Sotirov, 2023). The Bistritsa River itself has environmental pressure from illegal landfills along its river and wastewater discharges (Sotirov et al., 2016).

Table 1. Measured parameters of the water of Bistritsa River next to the Institute of Agriculture, Kyustendil, Bulgaria

Measured water parameter	Result
Acidity pH	6.60
Temperature of water t, °C	16.9
Conductivity EC, µS/cm	355
Total Dissolved Solids TDS, ppm	177
Salt, ppm	178
Salt, %	0.01
Specific gravity S.G.	1.000
Eh, mV	140
Hardness, mg/l	250
Free Cl, mg/l	<0.05
Total Cl, mg/l	<0.05
Free Br, mg/l	0.00
Fluoride Fl, mg/l	0.00
Iodine, mg/l	0.00
Iron Fe, mg/l	<0.02
Copper Cu, mg/l	<0.05
Lead Pb, mg/l	<20
Nitrite NO_3^-, mg/l	10
Nitrate NO_2^-, mg/l	1
Cyanuric acid CYS, mg/l	<2
$CaCO_3$, mg/l	80
Total alkalinity, mg/l	120
Arsenic As, mg/l	<0.005
Radiation background, µSv/h	0.15
Radiation of water, µSv/h	0.19
Color, foam, turbidity, smelt, taste	no

Table 2. Measured parameters of the water from Industrial Well, depth 5 m intended for irrigation of the Institute of Agriculture, Kyustendil, Bulgaria

Measured water parameter	Result
Acidity pH	6.91
Temperature of water t, °C	15.8
Conductivity EC, µS/cm	295
Total Dissolved Solids TDS, ppm	148
Salt, ppm	147
Salt, %	0.01
Specific gravity S.G.	1.000
Eh, mV	174
Hardness, mg/l	100
Free Cl, mg/l	<0.05
Total Cl, mg/l	<0.05
Free Br, mg/l	0.00
Fluoride Fl, mg/l	0.00
Iodine, mg/l	0.00
Iron Fe, mg/l	<0.02
Copper Cu, mg/l	<0.05
Lead Pb, mg/l	<20
Nitrite NO_3^-, mg/l	<10
Nitrate NO_2^-, mg/l	<1
Cyanuric acid CYS, mg/l	<2
$CaCO_3$, mg/l	80
Total alkalinity, mg/l	120
Arsenic As, mg/l	<0.005
Radiation background, µSv/h	0.18
Radiation of water, µSv/h	0.20
Color, foam, turbidity, smelt, taste	no

Table 3. Measured parameters of the water „Drenov dol" Reservoir intended for irrigation of the Institute of Agriculture, Kyustendil, Bulgaria

Measured water parameter	Result
Acidity pH	6.92
Temperature of water t, °C	15.6
Conductivity EC, µS/cm	160
Total Dissolved Solids TDS, ppm	80
Salt, ppm	147
Salt, %	0.01
Specific gravity S.G.	1.000
Eh, mV	176
Hardness, mg/l	50
Free Cl, mg/l	<0.05
Total Cl, mg/l	<0,05
Free Br, mg/l	0.00
Fluoride Fl, mg/l	0.00
Iodine, mg/l	0.00
Iron Fe, mg/l	<0.02
Copper Cu, mg/l	<0.05
Lead Pb, mg/l	<20
Nitrite NO_3^-, mg/l	<10
Nitrate NO_2^-, mg/l	<1
Cyanuric acid CYS, mg/l	<2
$CaCO_3$, mg/l	20
Total alkalinity, mg/l	40
Arsenic As, mg/l	<0.005
Radiation background, µSv/h	0.16
Radiation of water, µSv/h	0.17
Color, foam, turbidity, smelt, taste	no

Conclusion

The waters from the river Bistritsa River, Drenov dol Reservoir and Industrial Drillhole, intended for irrigation of the experimental agricultural fields of Institute of Agriculture, Kyustendil, Bulgaria during the performed study were determined as *Very good - Blue*, according to Cheshmedzhiev & Marinov (2008). All three types of waters actually are the same water of the Bistritsa River, type P3-Mountain. The waters correspond to the type of soils low-acid and they are appropriate for irrigation of the existed cultivated plants apple, cherry and plum trees as also some other fruit and vegetable plants.

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