WATER QUALITY AND IRRIGATION MANAGEMENT IN ORGANIC PRODUCTION[1]

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Abstract

The aim of paper is to present the specifics of irrigation in organic production, to point out the most important principles and parameters of water quality for irrigation.

Irrigation management in organic production is tasked with paying special attention to the quality of water. Irrigation in organic production may have an adverse effect on yield and product quality, if irrigation water contains toxic elements or is microbiologically contaminated.

The results from this study show that the water resources of the Republic of Serbia are suitable for organic production, but there are water sources that are contaminated. The best system of irrigation in organic production (vegetables, fruit growing) is 'drop by drop', because other ways increase the risks of spreading pathogens and spoilage of soil structure. In organic production, irrigation water must be of adequate quality.

The process of certification of organic production can include water analysis from the aspect of the content of elements, on physical parameters and microbiological correctness. If certain failures are identified, the manager is obliged to inform the certification body about this and to take appropriate actions.

Key words: *management, irrigation, water quality, organic production.*

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Introduction

Irrigation means the provision of plants with the necessary water for growth, development and fruiting. It has been applied in plant production since ancient times, and today it has developed into a modern applied discipline.

The paper starts from the assumption that irrigation is a factor that can contribute to stability and increase the economic and ecological effects of organic plant production.

Irrigation stabilizes yields at a high level, enables the production of products of satisfactory quality, and contributes to greater employment of capacity and workforce. However, irrigation in certain cases may also have negative effects on yield and quality, as well as on land. These are cases when irrigation is done with water of inadequate quality or if excessive amounts of water are added.

Therefore, the task of irrigation management in organic production is to prevent possible risks, such as contamination of plant organs and fruits, land, and to rationally dispose of water resources in an attempt to maintain or increase their quality.

The lack of precipitation (drought) occurs almost every year, lasts longer or shorter, and leaves serious consequences on yield. Bošnjak and Mačkić (2009), based on several years of research, found that drought is a regular occurrence, that 76% of the summer period has a lower or greater water deficit.

Irrigation in organic production should be carried out in a professional manner, ie it is necessary to perform rational irrigation with quality water in accordance with the needs of plants, the dynamics of water consumption, climatic conditions and water physical properties of the land. It is necessary to correctly determine the watering time, the watering rate, which depends on the way the irrigation and the technical condition and possibilities of the irrigation equipment are concerned.

Due to the existing climatic conditions, characterized by the lack of precipitation, irrigation is gaining importance. Vegetable production can not be imagined without irrigation. Irrigation of orchards and vineyards contributes to high yields and stable production of high quality (Mihailović et al., 2014). The second and posterior sowing is without irrigation.

Given the increasing trend in organic production areas, as well as the increasing demands for preserving water and land resources, we are motivated to explore management practices for irrigation, which could result in the development of organic production.

The aim of the paper is to present the specifics of irrigation in organic production and to indicate the most important principles and parameters of water quality for irrigation.

Water quality for irrigation

Irrigation water contains less or more soluble salts and solids. Water quality for irrigation is influenced by water temperature, presence of gases, microorganisms and chemical substances derived from wastewater and pesticides (Dragović, 2006).

Herbal organs and fruits are subject to a certain degree of pollution because in soil, water and air there are polluting substances. The risk of contamination is also possible through water for irrigation, due to the general trend of deterioration in its quality, the increase in areas under irrigation systems, and the use of waste water in irrigation (Dragović, Cicmil, 2008). The main cause of poor water quality is the lack of water management or poor farm management (Cesáreo Landeros-Sánchez et al., 2011).

In irrigation in organic production, water quality is of particular importance. Given that this is the era of technical prosperity and industrialization, irrigation water is also the recipient of huge quantities of wastewater. In nature, there is less water of good quality in the presence of the trend of further deterioration.

In organic production, the basic principle of irrigation is the tendency for us not to exploit the land, as if the last generation, that is land and water resources, must be treated as a natural resource, to which the future generations are entitled (Dragović, Cicmil, 2008).

In order to certify organic production, it must meet precisely defined conditions, which among other things include adequate water quality for irrigation (Petrović et al., 2016).

The basic criteria for assessing water quality for irrigation are the analysis of chemical and physical properties as well as microbiological correctness. The chemical properties analyze the quantitative salt content, as well as their qualitative composition, separately analyzing the content of cations and anions. Also, the participation of other elements from the waste waters is analyzed: microelements, heavy metals, so-called trace elements. Only those elements that show negative effects on soil and plants and pose a potential danger to humans and animals are analyzed. Physical properties analyze the application and temperature of the water. Analysis of microbiological properties consists in the consideration of the representation of species and number of pathogens.

Table 1. *Basic parameters for water quality assessment for irrigation*

Physically	Chemically	Biological
Temperature	Reaction (pH)	Number of coliforms
Suspended particles	Total soluble salts	Number of pathogenic calls
Color / Mutually	Species and concentration of anion	Biological need for oxygen
	Type and concentration of cations	
	Microelements	
	Toxic ions	
	Heavy metals	

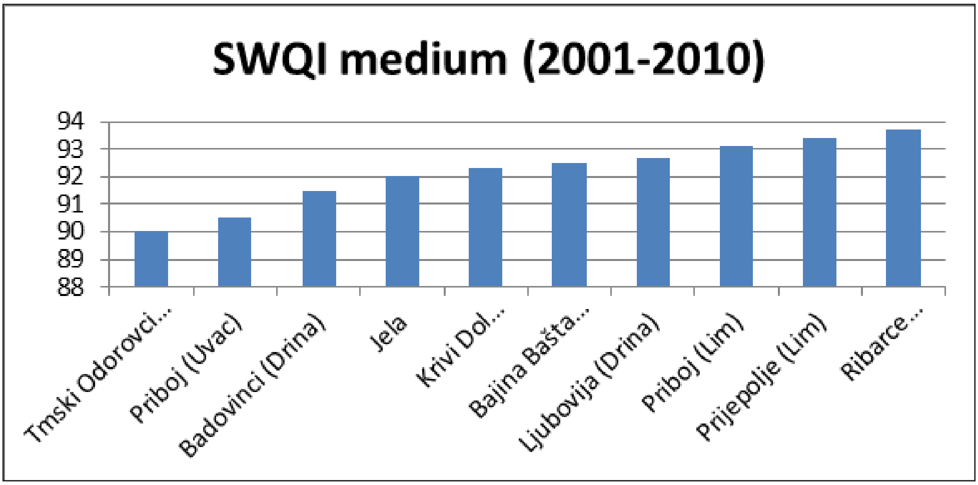
Source: *Romić, 2006.*

In addition to the mentioned quality parameters, the suitability of water for irrigation should be assessed on the basis of specific conditions of use, including cultivated culture, soil characteristics, irrigation practices, agro-technical measures and climatic conditions (Romić, 2006).

It is especially important to know the aquatic physical properties of irrigated soils, mechanical composition, texture, adsorption capacity, infiltration, filtration, natural drainage, etc. One of the criteria for irrigation of soil is rough texture (skeletal, sandy), and the other for heavier clay and organic soil. The climate is very important (arid/semiarid), ie whether there are conditions for natural salt rinsing or artificial drainage is necessary, or if there is precipitation outside the irrigation season. Then, plant species are of varying salt tolerance, so the right choice should be made. Only after the complete analyzes water is classified in the class and the final decision is made (Vučić, 1976).

Figure 1 shows ten watercourses of the highest quality, which have great impact and to which special attention should be paid when constructing irrigation systems.

Chart 1. *Watercourses with best quality*



Source: *Veljković, Jovičić, 2011.*

There are numerous classifications in the world for water quality assessment for irrigation. A few of them are universal in the application around the world. This first classification was provided by the US Salinity Laboratory, whose presentation was made by Vučić (1976) for our conditions. Then, Ayers (1979) gave a more recent classification, so that the FAO would employ more than 30 leading world experts, who gave the most complete classification for water quality assessment for irrigation, and published by Ayers and Westcat (1985). It is widely used around the world, and it was presented by Bošnjak (1994) and Belić et al. (1996).

Chemical properties of irrigation water

Table 2 shows the guidelines for the interpretation of the chemical quality of water for irrigation, ie water quality and the possibilities of its use under certain conditions. Irrigation water is classified into three categories.

Category I include water that can be used for irrigation of all plant species on all land without risk of harmful consequences. In the second category are water which cannot have a negative impact on the quality of plant products, but it is possible to partially shade the soil, and reduce the yield by 5-10%. Some low to medium intensity measures should be taken to prevent unwanted consequences (meliorative irrigation). In category III, water with a high risk of adverse effects on plants and land and their use requires strict implementation of the necessary measures, so as not to cause adverse effects. In organic production, standards and policies allow the use of the first two categories of water.

Table 2. *Guidance for interpretation of water irrigation quality*

Potential irrigation problems		**Unit**	**Degree of limitation of use**		
			No	**Weak to medium**	**Sharp**
Category water			I	II	III
pH normal level		6,5-8,4			
SOIL SALINITY:					
ECw		dS/m	<0,7	0,7-3,0	>3
Total salts		mg/l	<450	450-2000	>2000
Na SAR			<3	3-9	>9
INFILTRATION:					
SAR = 0-3	ECw =		>0,7	0,7-0,2	<0,2
3-6	=		>1,2	1,2-0,3	<0,3
6-12	=		>1,9	1,9-0,5	<0,5
12-20	=		>2,9	2,9-1,3	<1,3
20-40	=		>5,0	5,0-2,9	<2,9
TOXICITY OF SPECIFIC IONS:					
Cl					
surface irrigation		me/l	<4	4-10	>10
sprinkling plants		me/l	<3	>3	
B		me/l	<0,7	0,7-3	>3
DIVERSITY IMPACT:					
NO_3		me/l	<5	5-30	>30
HCO_3					
Artificial rain		me/l	<1,5	1,5-8,5	>8,5

Source: *Ayers, Westcat, 1985.*

Nešić et al. (2003), they examined the quality of water for irrigation in AP Vojvodina. The results indicate increased mineralization, but not the risk of alkalisation. The content of microelements and heavy metals is generally below the maximum acceptable toxicant concentration (MATC), except in three samples in which the slightly increased nickel content is observed above the MATC. The situation is not bad regarding the quality of water for irrigation in conventional production, while for organic production a large part of the sources in Vojvodina is not of adequate quality.

Table 3. *Usability of surface water for irrigation in Republic of Serbia*

Watercourse	Profile	Classification						
		Stebler	US SL	Neiggeb	FAO		Miljković	
					Salinity	Toxicity	Salinity	Salin. type
Dunav	Novi Sad	> 18	C2 - S1	Ia	I	I	I	b
Tisa	Martonoš	> 18	C2 - S1	II	I	I	I	b-s, b-h
Tisa	Novi Bečej	> 18	C2 - S1	II	I	I	I	b-s, b-h
Sava	Sr.Mitrovica	> 18	C2 - S1	Ia	I	I	I	b
Kan. DTD	Sombor	> 18	C2 - S1	Ia	I	I	I	b
Kan. DTD	Melenci	> 18	C2 - S1	II	I	I	I	b-h, b-s
Kan. DTD	N.Miloševo	> 18	C2 - S1	II	I	I	I	b-h, b-s
Drina	B.Bašta	> 18	C2 - S1	Ia	I	I	I	b
Kolubara	Draževac	> 18	C2 - S1	Ia	I-II	I	I	b
V.Morava	Lj.Most	> 18	C2 - S1	Ia	I	I	I	b
V.Morava	V.Plana	> 18	C2 - S1	Ia	I	I	I	b
Z.Morava	Kraljevo	> 18	C2 - S1	Ia	I	I	I	b
J.Morava	Aleksinac	> 18	C2 - S1	Ia	I	I	I	b
J.Morava	Vl. Han	> 18	C2 - S1	II	I-II	I	I-II	b, b-s
Beli Timok	Zaječar	> 18	C2 - S1	Ia	I	I	I	b
Lim	Priboj	> 18	C2 - S1	Ia	I	I	I	b
Nišava	Pirot	> 18	C2 - S1	Ia	I	I	I	b
Ibar	Raška	> 18	C2 - S1	Ia	I	I	I	b
Vlasina	Vlasotince	> 18	C2 - S1	Ia	I	I	I	b
Zobnatica	B.Topola	> 18	C3 - S1	IIIb	II	II	II	b-s

(Salin. type b-HCO_3 , s-SO_4 , h-Cl)

Source: *Belić et al., 1997.*

Belić et al. (2003) find that most of the potential irrigation water in the Republic of Serbia is from I to II class. Also, a part of the water source is contaminated, which places them in a category that is not suitable for irrigation, even in conventional production.

The basis of the Neiggebauer classification is the degree of salinity, expressed through the dry residue, as a sign of the danger of shading and the ratio of Ca and Mg to Na, as an indicator of the danger of soil alkalisation (Pejić, 2011). In the United States salinity remains the most dangerous water irrigation problem affecting one third of all irrigated areas (Cesáreo Landeros-Sánchez et al., 2011).

Table 4. *Classification of irrigation water according to Neiggebauer*

Class of water	Subclass	Conditions	Usability of water
I	a	S.O.<700 mg/l (Ca+Mg):(Na+K)>3	Waterless water
	b	S.O.<700 mg/l (Ca+Mg):Na>3	
II		S.O.<700 mg/l (Ca+Mg):(Na+K)>1	Good quality irrigation water
III	a	S.O.700-3000 mg/l (Ca+Mg):Na>3	Waters to be examined under our conditions
	b	S.O.700-3000 mg/l (Ca+Mg):Na>1	
IV	a	S.O.<700 mg/l (Ca+Mg):Na<1	Water unsuitable for irrigation
	b	S.O.700-3000 mg/l (Ca+Mg):Na<1	
	c	S.O.>3000 mg/l (Ca+Mg):Na>3	
	d,e	S.O.>3000 mg/l (Ca+Mg):Na>1	

Source: *Pejić, 2011.*

The FAO classification considers the risk of shading over the total salt concentration, expressed in mg/l or most often through electrical conductivity dS/m. The first category does not have a danger of shading; in the second category there is a possibility of shade, it can be used on the soil of medium to good natural drainage, where there are natural conditions for washing the salt with precipitation outside the irrigation season. For lower Ecw values, measures for preventing the shading are rarely applied. In arid conditions, occasional salt rinsings should be carried out, with an increase in the Ecw value to 3. In lightweightly well drained soils, more frequent occasional rinses are required, while on heavy soils of poor drainage, artificial drainage and occasional rinsings are required. Under these conditions, it is medium-sensitive to medium-tolerant plant species towards salts. If it is used for Irrigation Water Category III, severe measures are needed to prevent shading. They can be used on lighter lands of rough texture, it is always necessary that artificial drainage is occasional as well as permanent and rinsing of salt by cultivating high tolerance plants.

The danger of alkalisation is overlooked SAR[4] values, ie the absolute content of Ca, Mg and Na cations, and their relative relationship. The SAR value is combined with Ecw and the waters are classified into six classes, and each class is divided into three categories. In fact, the emphasis is on the danger of alkalisation with increasing salt concentration in irrigation water. If there is a higher Ecw value then smaller SAR values pose a great risk of alkalisation (Pejić, 2011).

The toxicity of specific ions, such as Na, Cl and B, is also considered. Na and Cl are accumulated in plant tissue mainly in perennial plantations, are particularly harmful to stone fruit, cause yield reductions, damage the trees and lead to the rapid aging of the orchard. Even small quantities of these elements, by long-term irrigation, cause harmful levels of their content in the tissues of perennial plants. B is a beneficial microelement in small concentrations, and in large quantities it is harmful, and also toxic to plants (Bosnjak et al., 1994).

The diversity of negative impacts on plants and land is shown by nitrates (NO_3) and bicarbonates (HCO_3). Nitrogen is a macroelementate, yield carrier, if NO_3, especially NO_2 (nitrite) are found in larger quantities in irrigation water, are very harmful to the soil and plants and are dangerous to humans and animals. They are mainly accumulated in plants in large quantities, deposited in proteins, where they form nitroamines, which are carcinogenic compounds (Cesáreo Landeros-Sánchez et al., 2011).

The FAO classification specifically considers the maximum allowed concentration of trace element (trace elements) in irrigation water, and which are not

4 Sodium Adsorption Ratio (SAR). The classification is based on electroconductivity values as indicators of salt concentration - SAR values as a relative activity indicator On in removable reactions with soil, ie, potential adsorption indexes Na. If the proportion of Na great danger of alkalisation is high, if Ca and Mg dominate the risk of alkalisation is small (Pejić, 2011).

included in routine analyzes. It is necessary to analyze them in the use of water, which are also recipients of wastewater. These elements are analyzed, which can be expected depending on the pollutant. At higher concentrations, they accumulate in plants, most often slow down, and they stop growth or cause other damage. Several experts in this field conducted numerous studies, which served as the basis for determining MATC elements in traces of irrigation water (Table 5).

Table 5. *Maximum allowed concentration of trace elements in irrigation water*

Element	MDC (mg/l)	Observations
Al	5,0	It can cause acidic soil to be non-productive (pH <5.5), but in pH> 7 ions, precipitates and eliminates any toxicity.
As	0,10	Plant toxicity varies in a wide range, from 12 mg/l in sudan grass to 0.05 mg/l in rice.
Be	0,10	Plant toxicity varies from 5 mg/l for honey to 0.5 mg/l for beans.
Cd	0,01	For several plant species, it is toxic at a concentration of 0.1 mg/l in a nutrient solution. There is a potential risk of accumulation in soil and plants in concentrations that can be very dangerous to humans.
Co	0,05	It is toxic to tomatoes in concentrations of 0.1 mg/l in a nutrient solution. It has a tendency to inactivate in neutral and alkaline soils.
Cr	0,10	It is not known as a biogenic growth element. The limit is determined based on toxicity.
Cu	0,20	It is toxic for many species with a content of 0.1-1.0 mg/l in a nutrient solution.
F	1,00	It is inactivated in neutral and alkaline soils.
Fe	5,00	It is not toxic to plants in aerated land, causing soil acidification and loss of affordable P and Mo. When irrigated by artificial rain, it is deposited on plants and equipment for irrigation.
Li	2,50	It is tolerated by many plants, it is mobile in the soil. It is toxic to citrus in low concentrations (> 0.75 mg/l) by activity is similar to boron.
Mn	0,20	It is toxic to plants at a concentration of several tens of to a few g/l, but usually only in acidic soils.
Mo	0,01	It is not toxic to plants at normal concentrations. Cattle can be toxic if food is produced on highly concentrated soils.
Ni	0,20	It is toxic for many plant species at a concentration of 0.5-1.0 mg/l, its toxicity is reduced in neutral and alkaline environment.

Element	MDC (mg/l)	Observations
Pb	5,00	It can inhibit the growth of plant cells at very high concentrations.
Se	0,02	It is toxic to plants at very low concentrations of about 0.025 mg/l. It is toxic to livestock if food is produced on high-level Se sites. It is one of the essential elements for animals, but at very low concentrations.
Sn, Ti, W	/	Plants do not tolerate them, specific tolerance is unknown.
V	0,10	It is toxic to many plants at relatively low concentrations.
Zn	2,00	It is toxic to many plants in fairly variable concentrations. Its toxicity is reduced at pH> 6, in fine texture lands and organogenic soils.

Source: *Ayers, Westcat, 1985; Dragović, Cicmil, 2008.*

Not all trace elements are harmful; many are in low concentrations useful, such as biogenic growth elements and microelements.

According to the recommendation of this classification, MATC values refer to intensive irrigation with an irrigation norm of 10,000 m^3/ha of water annually. If the irrigation norm is higher, the allowed maximum concentration is reduced proportionally. In the application of smaller irrigation norms, the criteria are not alleviated (Ayers, Westcat, 1985). In our country, the criterion for concentrating some of these trace elements is regulated by the Law on Waters, which is interesting for organic agriculture, to which the interested parties are referring to this issue.

Physical properties of irrigation water

Physical properties consider the temperature of the water and the application, are much less important for the quality of water for irrigation of chemical properties, they rarely occur locally and do not leave more severe consequences. Low temperatures occur when using water from mountain reservoirs, in which water from ice and ice melts, it can be below 10 °C. Also, when using groundwater, the temperatures are low 10 - 14 °C. Low temperatures slowly slow down, and they stop the growth of plants, which in difficult cases begin to yellow. Although the process most often takes a short time, it is negatively reflected, because it prolongs the vegetation, reduces yields and impairs the quality of the product. The minimum irrigation water temperatures are 19 – 20 °C, optimal 25 - 30 °C and maximum 34 - 35 °C (Bosnjak, 1999).

Application in river waters is analyzed by quantity, primarily by mechanical composition. Large particles of 0.1 mm are undesirable, easy to settle in the channels and tubes. From 0.1 - 0.05 mm favorably affect physical properties, especially heavy soils, reducing their attachment, but they are poor in nutrients. Particles larger than 0.05 mm are rich in nutrients, but in large quantities adversely affect the physical properties of the soil, reduce infiltration, filtration and aggravate aeration. This application is very favorable for sandy soils. The chemical composition of the coating is very similar to the composition of clay, it consists of oxides Si, Al, Fe, Ca, Mg, K, Na and organic matter (Belic, 1997).

Microbiological properties of irrigation water

Organic production pays great attention to health food safety, therefore it is of special importance microbiological correctness of water for irrigation. Irrigation water can transmit pathogenic microorganisms, infect plants and their products, which can cause human diseases, such as Salmonella, Escherichia coli 0157: H7, Cryptosporidium parvum and others (Kljujev, 2012). In surface waters there is a greater possibility of microbiological contamination of wastewater from cities, as well as from agroindustry. If groundwater is watered, the risk of microbiological contamination is reduced to a minimum.

Contaminated plant products are difficult to clean, because it is impossible to completely remove the bacteria by washing with water only. Also, contamination of the product depends on the irrigation mode, and the highest is in irrigation by rain. There are considerably fewer contamination possibilities for surface irrigation and drip irrigation. Also, the type and variety of pathogens and their ability to survive on plant products depends on the infection and the onset of disease in humans and animals. Some pathogens such as *E. coli* and her are similar if they are fed with just a few bacteria (less than 10) causing illness. For the analysis of the microbiological properties of irrigation water, the presence of the total number of pathogens is observed, then the presence of faecal pathogens and *E. coli* bacteria (Kljujev, 2012) is analyzed in particular. *E. coli* K-12, from contaminated water for irrigation, often superficial and endophytic, colonizes the root of the green salad and through the vascular system has reached the leaves of plants. Therefore, constant monitoring of the microbiological correctness of water is necessary (Kljujev, 2012). According to Jones (2005), a total of 1000 pathogens per liter of water are allowed, of which 100 bacteria *E. coli*.

Table 6. *Criteria for irrigation water quality of microbiological aspect (Canadian Ministry of Environment)*

Types of irrigation	*E. coli*	*Enterococci*	*P. aeruginosa*	Fecal coliforms
Vegetables and fruits that are consumed fresh	≤ 77/100 ml	≤ 20/100 ml		≤ 200/100 ml
Public areas and pastures	≤ 385/100 ml	≤ 100/100 ml	≤ 10/100 ml	
Generally	≤ 1000/100 ml	≤ 250/100 ml		≤ 1000/100 ml

Source: *Kljujev, 2012.*

Reducing the risk of contamination of plant fruits by irrigation can be achieved by choosing an appropriate irrigation method, such as drip irrigation system, by selecting the water source and purifying water, if economically justified (Dragović, Cicmil, 2008).

Specificity of irrigation in organic production

Organic production primarily involves plant species in which people eat green products in the diet of people, creating a large green mass with very high water content and a relatively poorly developed root system. For these reasons they have high water requirements and require a higher level of soil moisture (Dragović, Cicmil, 2008).

Organic production requires high water quality for irrigation, due to increased demands for healthy food safety. An authorized controller may also request water analysis for irrigation, where samples must be taken directly on the plot during irrigation, as water can be contaminated by water from the water intake to the plot (Prodanović, 2015).

In organic production, irrigation is carried out with respect to the basic standards IFOAM and Codex Alimentarius. Irrigation in organic production requires the application of a larger amount of organic fertilizers in order to avoid deterioration of soil structure and elution of elements. It is recommended, as in conventional production, that it is less frequent and more abundantly watered (20-30 ml/m^2) (Dragović and Cicmil, 2008), in order that the plants form the root deep and be less sensitive to the lack of moisture. It would be preferable to use hot water, preferably rainwater and water from the river and the channel, in order to avoid cold water and water from the water supply (Water Management in organic production, 2017).

Irrigation water must not contain more than 0.15% soluble salts and must be free from harmful pesticide residues, heavy metals and other harmful substances. Irrigation should be done in the morning, when the smallest difference between the water temperature and the temperature of the plant, in order to avoid thermal stress in the plants. It should be cautious, because when water is stagnant more than 10 l/m^2, the possibility of soil compaction and rinsing of nutrients increases (Dragović, Cicmil, 2008).

Table 7. *Desired water parameters for irrigation in organic production*

Parameter	Values
pH	5,5-6,5
Electrical conductivity	< 2,0 mS/cm
Salts	< 1,5 g/l
Bicarbonates	< 5 meq/l
Sulphates	< 2200 meq/l
SAR	< 10
Nitrates	< 120 ppm

Source: *Irrigation, 2017.*

Artificial rain (spilling) is not suitable for organic production, because in some species, which are sensitive to certain diseases, losses can occur, and the soil structure deteriorates.

Drip irrigation is suitable for some types of organic production (vegetables, fruit growing), for crops requiring high soil moisture and low humidity. In order to avoid clogging of the drops, which can be mechanical, chemical and biological, the system must be properly maintained. Permanently, water filtration is performed. Occasionally rinsing of the pipe is required. Irrigation by drop-in stroke should be applied to wide-spread vegetable production and in a protected area.

Prior to irrigation, it is advisable to require the organic production inspector to conduct a chemical analysis of water in accredited laboratories, such as the Institute for Health Protection. When certifying organic production, it may be required that the manufacturer submit to the authorized certification house the results of the water analysis, which is used for irrigation.

Irrigation specifications in organic orchard

Thanks to the powerful and deep root system, most fruit trees are well tolerated by dry periods, but yields are of low and poorer quality. The importance of irrigating fruit trees is reflected in the fact that droughts have a negative effect on the next season, since there are not enough floral buds formed. In some fruit species (apple, pear, plum), the so-called alternative birth (Dragović, Cicmil, 2008). Modern intensive production of organic fruit is without irrigation, and the installation of irrigation systems, as well as anti-grid networks, has recently become a standard in the area of AP Vojvodina (Keserović et al., 2008).

In the world, insufficiently worked on the study of irrigation problems in orchards (Ferreres, Goldhammer, 1990), with the most studied apple, while for other species much more research is needed. Vučić et al. (1980), they established the needs of apples for water 550 - 600 mm for varieties for winter consumption. Bošnjak et al. (1994), they determined the need for pear water of the Viljamovka 470 mm plus/minus 10 % for the fruiting period, but this should be added to the precipitation outside this period of 200-300 mm. In fact, for our conditions it is estimated that the annual needs of orchards for water are 600 - 800 mm depending on the species and variety, ie from its era of maturation, as well as from the applied biotechnology, primarily the breeding form. In our conditions, orchards for high and stable yields of good quality should be provided during the vegetation season by months of the following amount of water: April 40-60 mm, May 70-100 mm, June 90-120 mm, July 110-130 mm, August 100 - 130 mm and September 50 - 60 mm, totaling 460-600 mm. It is necessary to add the consumption of water outside the vegetation season 150 - 250 mm (Vučić et al., 1980).

The water regime according to soil moisture is rarely applied in practice, but the critical period method is used, which is the period when the fruit has high demands on water (period of intensive growth of fruits), (Dragović, Cicmil, 2008). If the technical minimum is used, it is at the level of the water constant of the lentocapillary moisture, which separates the easily movable from the heavier moving water spore in the soil. It amounts to medium to medium to heavy soil 60-65% of the Polish water capacity (PWC), to 65-70% of PWC hard, it is lighter and can be 30% PWC on the sand. Fereres and Goldhamer (1990) suggest for US conditions the measurement of soil moisture for local irrigation of drops by a tensiometer, and for other gypsum blocks or electrometric methods, where there are several types of accessories and a neutron for measuring soil moisture.

The most commonly used is the flooding regime in critical periods in practice, since the procedure is the simplest. Vučić (1976) recommends that the first watering be done 10 - 20 days after flowering, if the winter was sparse, and the spring is dry. This watering is rarely done under our conditions. Roughly watering is done until the end of June, because in most years there are enough water from winter reserves, which are supplemented with spring rainfall. The season of irrigation irrigation in our conditions is in July and August in the stages of intensive growth of fruits, the formation of organic matter and the formation of flower and foliage for the next year. In our conditions, when watering an orchard, it is most acceptable to apply water balance as the basis of the water regime.
The most suitable way to irrigate an organic orchard is drip irrigation system, although other methods can also be used. drip irrigation system is at least stressful for fruit trees, at the very least it is compaction of soil, the most precise is the addition of water, it allows for fertigation and constant humidification in the root zone, water is rationally used and it is possible to specify the inlet norm. Water filters are obligatory, and if slope of the parcel is higher than 5%, compensatory droplets should be used (Vukoje, 2015).

The economic effects are the result of regular and regular agro-technology inherent in organic production, the selection of good varieties, the use of manure, as well as the drip irrigation system.

Conclusion

Irrigation in organic production is specific because it requires high water quality, rational disposal of it and irrigation systems that will not impair the soil structure and cause the spread of the pathogen. The best way of irrigation in organic production in most vegetable crops, even in perennial plants, is the drip irrigation system, since other ways increase the risks of spreading pathogens and deterioration of soil structure. The process of certification of organic production may include water analysis from the aspect of the content of elements, physical parameters and microbiological correctness. In organic production, irrigation water must be of adequate quality.

The results of the research show that the water resources of the Republic of Serbia are suitable for organic production, but there are water sources that are contaminated. The monitoring of the quality of water for irrigation in organic production must be carried out continuously and that all possible changes and factors that could endanger the quality will be reported to an authorized certification house in order to take appropriate measures.

The task of agrarian policy is to provide support for investments in irrigation systems, in order to develop organic production, produce quality food products and save production resources.

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