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Quality of Water for Irrigation

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Abstract

In the future, quality of irrigation water is expected to decrease due to the development of industry, therefore agriculture will be faced with less water and worse quality. In 2013 the increase in the yield of corn was created by irrigation, drip irrigation that max yield was 17,5 t / ha, and the yield of silage reached 112 ha. For better quality of agricultural production despite the type of irrigation affects of quality water from aliquot presence elements: nitrogen, phosphorus, potassium, and total salt content.

According to the Regulation on classification of waters in our country, there are 5 classes of clean water, where surface for corn, silage of the region Pelagonian is irrigation water used from tank Strezevo that is belongs to the second class, technical and raw, slightly mesotrophic contaminated water. The measured average monthly concentrations of outlet water from the reservoir Strezevo amounts: T^0C = 10,77±4,75; (O_2=10,43± 1,24; CO_2= 5,71 ± 3,23; NH_3= 0,0622 ± 0.047; PO_4= 0,03 ± 0,029; NO_3= 0,39 ± 0,130; Fe= 0,10 ± 0,056;) / mg/l); Fortress ^{0}dH = 1,69 ± 0,135; and pH = 7,51 ± 0,125.

In this paper, we try to contribute to the debate that it is possible to identify increasing crop productivity of maize silage in addition to the system of drip irrigation using the water quality, ensuring food security and securing livelihoods farmers.

Keywords: Irrigation, drip irrigation, quality water, elements of water, corn,

Introduction

In many parts of the world, water scarcity is increasing, and many people see reducing the amount of water for agriculture as one way to make more water available for cities and industries, and also for the environment. There is a need to increase water productivity (the ratio of the mass or value of the product to the volume or value of water depleted or diverted) without compromising food security (*Bouman, B. A. M., 2001*). Since the fresh water resources are essentially finite on earth, making more efficient use of the water must be a major thrust in the global effort to cope with the water scarcity (*Gleick, 2003*). World-wide agriculture is by far the largest user of water diverted by man. On the other hand, the efficiency of water use in agriculture is low. In an assessment of rain-fed agriculture, some concluded that only 15 to 30% of the rainfall is actually used in crop transpiration. Others indicated even lower percentages, as low as 5%. Low efficiency has also been indicated for irrigated agriculture. *Hsiao, T. C. et all.* (2000) suggested only 13 to 18% of the irrigation water delivered is actually transpiring by crops.

The Challenge Program on Water and Food (CGIAR) piloted new ways of increasing the resilience of social and ecological systems through better water management for food production. From 2002 to 2013, the program supported more than 120 research projects in ten of the world's largest river basins, is a research program on water and food security (*J. W. Kijne, T. P. Tuong at all.* 2003)

A systematic and quantitative approach is needed to analyze where the inefficiency lies, to assess quantitatively the potential improvements, and most importantly, to determine how to allocate limited available resource to maximize the improvement in water productivity. In the previous WASAMED conferences, a relatively simple and yet quantitative and comprehensive framework for the analysis and improvement of water use efficiency was proposed and described. The framework may be termed the concept of chain of efficiency steps *(Hsiao T.C., et all. 2007).*

The construction of the reservoir Streževo form akumulacionen space, so quite useful volume which enables the: provision of the necessary amount of water for irrigation of part of Pelagonija (project envisaged 20,200 hectares net arable land), partly to supplement the necessary amount of the unprocessed water for the needs of drinking water, shall ensure that part of the needs of technological water for part of the industry, the protection of overflow a part of Pelagonija *(Sonja Georgievska, 2014).*

The average annual yield of corn in Macedonia amounted to 4.2 tons per hectare, almost twice less than the regional average yields of 8 tons per hectare. Given the fact that new agricultural areas are difficult to access, the only way to achieve cost-effective production of corn is increasing yields on existing surfaces by applying new technologies and production protocols (USAID program, 2014-2020).

In areas that are planted in the world after rice, wheat and maize is third among cereals with 160 million hectares whose average yield is over 5 tons per hectare.

Corn is one of the most important crops for feeding livestock and is an integral part of the production of all the fattening mixtures used in the diet of cattle with 50% of the composition or use of the whole plant as silage. One of the most efficient ways to irrigate corn is irrigated with drip irrigation. Through this way the irrigation water is used up to 99%, while the stress in the vegetative development of the plant is reduced to a minimum (APRZ, National Extension Agency, 2014).

In Macedonia, in 2013, using the system for drip irrigation in corn yields was recorded. The irrigation of corn for grain is receives a maximum yield of 17.5 t / ha, while production of silage yields reached maximum 112 t / ha (Fig.1).

The more value per unit of ET can be achieved by improving the nutritional quality of crops, the quality of water and reducing pesticides and other agrochemical inputs through disease- and pest-resistant crops. How much scope is there to increase the grain yield relative to ET? Because of the biophysical relation between biomass and transpiration, there is possibly a little gain to be made in this are (top curve in Fig. 1). The yield versus transpiration index has already improved substantially because of changes in the harvest index in many places (*David Molden et all. 2010*).

The number of irrigation and cure norm depends on the quantity of the precipitations and the phase of development corn. In the beginning of the irrigation rate is smaller and amounted to 25-30 mm and later, in a phase of occurrence in the reproductive organs of 50-60 mm. The irrigation drop by drop gives great results (Fig.2), because at the same time when it can be done that ,,Typhon,, (*APRZ, 2008*).

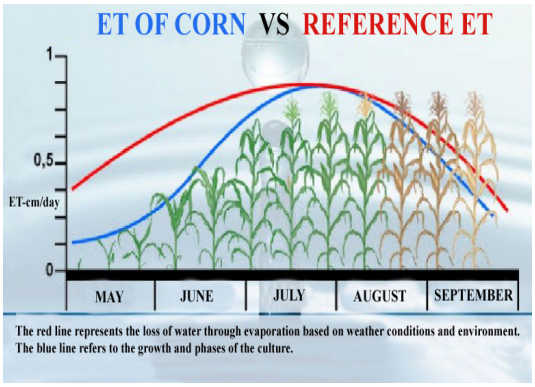

Fig.1. Irrigation (red line shows a loss of water from evaporation and transpiration, the blue line shows the growth stages and phases of culture)

The mean interval of the applied water is 14.1 mm / day or seven time irrigation during the total growing season. How appropriate are proposed strategy for irrigation selected in the system drop by drop with 60% covering the surface defiance and schedule the irrigation at a moment when the contents of the moisture in the soil will fall to 70% of less accessible humidity, at to the normative cure amounts to 22 mm. (*Trajkova Fidanka, 2004*).

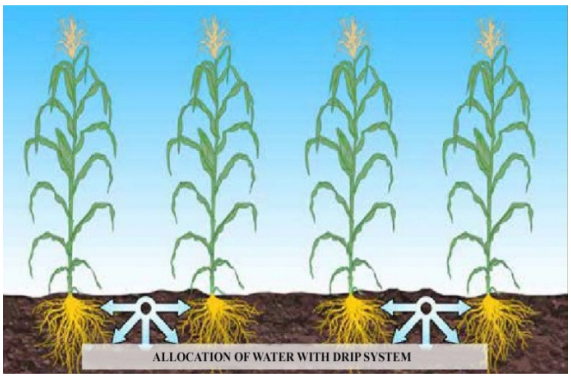

Fig.2. Dissemination of water with drip irrigation

Besides the way for irrigation contribution quantity of corn is uses water. The quality of over one year of monitoring parameters in the presence water elements: nitrogen, phosphorus, potassium, and total salt content contributing to better growth and quality of corn.

Acid of water (pH) affects most chemical processes in water and determined the structure living communities. pH below 4 and above 10 represents unfavorable conditions for life in the water biotype. Nitrates are very important for plants because of their willingness to break down and release nitrogen for plant growth, and because of their solubility, nitrates can be absorbed through the root hair. The content of dissolved oxygen (O_2) in water is one of the main characteristics of water quality and the basic conditions for normal life. Oxygen is an important parameter in the classification of the water and the analysis of dissolved oxygen in water is of great importance (*GLOBE Protocol Water Research, Dragovic. S., 2006*). The amount of oxygen is essential for the organisms in the water, taking oxygen diffusion, and the plant is not an important factor.

The quality of water used for irrigation in most samples indicates increased mineralization, but not at the risk of alkalization.

Materials and Methods

Collecting and stocking of material collected for determination of certain parameters be done with standard methods (Standard methods for the examination of water and waste water, 2005). The forms of nitrogen and presented as nitrate nitrogen NO_3 (N) and ammonium-nitrogen NH_3 (N), phosphate and iron determined by the standard method in scope UV-VIS spectrophotometer SPEKOL. The water temperature is measured with an ordinary mercury thermometer $0,1^0$C of pitches, the same as for measuring air temperature. pH of the water is measured with a pH meter Testo 230. Indicators of oxygen regime - dissolved O_2 and biochemical consumption O_2 is determined by Winkler method in 100ml Winkler bottles. These methods were used reagents: $MnCl_2 \cdot 4H_2O$, NaOH, KJ, NaN_3, H_2SO_4, soluble starch p.a, and $Na_2S_2O_3$. Consumption of $KMnO_4$ is determined titrimetric method of Kelman Klain, using $KMnO_4$, $H_2C_2O_4 \cdot 2H_2O$ and H_2SO_4. The next parameter was down free carbon dioxide (CO_2) determined titrimetric using phenolphthalein indicator, the titrant NaOH or Na_2CO_3. The total water hardness is determined by titrimetric indicator Erio-T-chromium buffer NH_4Cl + NH_4OH and 0,1M Complexion III.

1. The determination of ammonia in water

This method works according to the standard of HACH METHOD 8038, and MAC in drinking water of amounts to 0.50 mg / l ammonia.Procedure: In test tubes is put assay 20 ml of water and added 2 ml of reagent -1, one spoon of reagent -2. The solution stays 5 minutes, after adding 2 -3 drops, from the reagent 3. Thus prepare solution is stated 7 minutes during which in the presence of ammonia is color is with yellow-green color. Rating of color is an indicator of the eventual presence of ammonia, in which derived color comparable with aliquot finished with standards. The range of this method is from 0025 to 0.4 mg / l ammonia.

2. The determination of nitrite in water

Methods work is being done according to the standard of HACH METHOD 8507, and MAC in drinking water of amounts to 0.10 mg / l of nitrite. Procedure: In 20 ml of water is added research spoon washing powder of sulfanilic acid. It is said the solution is 3 minutes, and if there are nitrites emerges pink colors. Range of measurement of this method is from 0.005 to 0.1 mg / l of nitrite.

3. The determination of nitrates in water

The methods work is being done according to the standard of HACH METHOD 8039, and MDK in drinking water of amounts to 50.00 mg / l nitrate. Procedure: The concentration of nitrates in the water with the apparatus shall define the refract quaint. Test strip of this apparatus is swamped in search water, and within a period of 60 seconds to read results. If in the water had nitrates form a nitrate test strip the color pink. The range of this method is over 3-90 mg / l nitrate.

Results and discussion

Chemistry output water from accumulation reservoir Strezevo in 2009 year, shown in Table 1, Parameters: T in ^{0}C, O_2, NH_3 (N), PO_4, NO_3 (N), Fe in mg / l; fortress in ^{0}dH, that according Regulation for classification of water (1999) in R. of Macedonia. Research was done monthly during 2009 years, to prove the quality of water from accumulation Strezevo used for irrigation. The results showed a variable value which depends the process of eutrophication. Categorization of the investigated parameters in 2009 is done on the basis of the Regulation on Classification of lead and water courses of the Republic Macedonia (Official Gazette of the R. Macedonia No.18 of 31.03.1999 year).

All results measuring during 2009 confirmed in the incident reviewed of parameters during 2011year.

Table 1. Parameters measured during 2009 year in accumulating water Strezevo

Parameters 2009year	T^0(C)	O_2 (mg/l)	CO_2 (mg/l)	NH_3 (N) (mg/l)	PO_4 (mg/l)	NO_3(N) (mg/l)	Fortress ^{0}dH	pH	Fe (mg/l)
January	5.67	10.33	3.52	0.13	0.04	0.28	1.45	7.49	0.13
February	6.04	11.70	2.82	0.12	0.04	0.64	1.76	7.69	0.17
March	5.40	11.91	3.88	0.06	0.09	0.47	-	7.58	0.15
April	6.00	11.76	2.50	0.00	0.02	0.29	-	7.45	0.00
May	10.00	10.93	2.90	0.02	0.01	0.52	-	7.72	0.01
June	16.16	-	7.36	0.08	0.06	-	-	7.58	0.11
July	18.00	9.14	10.62	-	0.00	0.28	-	7.46	0.15
August	16.00	10.43	11.75	-	0.02	0.37	-	7.45	0.14
September	14.75	7.89	9.17	-	-	-	-	7.26	0.15
October	14.00	9.39	5.35	0.00	0.00	0.21	1.76	7.40	0.08
November	9.76	11.02	3.84	0.08	0.00	0.42	1.72	7.52	0.07
December	7.50	10.73	4.85	0.07	0.00	0.40	1.76	7.46	0.07
Average	10,77	10,43	5,71	0,062222	0,03	0,39	1,69	7,51	0,10
St.Deviation	4,7477136	1,233655	3,224157	0,047639	0,029449	0,130707	0,130707	0,125517	0,056589

Average and standard deviation of monthly main parameter concentrations in water from reservoir Strezevo during 2009 year: (T in ^{0}C, O_2, NH_3 (N), PO_4, NO_3 (N), Fe in mg / l; fortress in ^{0}dH) showing in Figure 3.

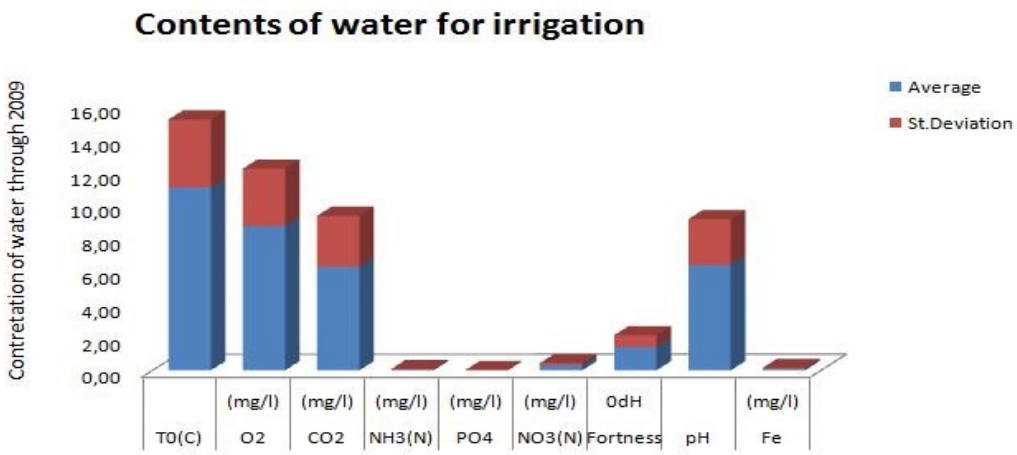

Figure 3. Concentration of parameters in water during 2009 years, in reservoir Strezevo

The chart of Fig.3 show pH annual average value was about 7, which indicates that an indicator of alkaline water. Oxygen indicator mode, CO_2 and O_2 say that the accumulated water is first class of water for irrigation. In terms of maximum permissible concentrations that are indicators of eutrophication, the annual average concentrations of nitrate nitrogen, and ammonia nitrogen belong to group III, and according to concentrations of total phosphorus belongs to group IV of accumulated water.

The contents of trace elements and heavy metals in the water were below the MDK, the content of total soluble salts, and can't talk about the process of salting of irrigated areas, but inadequate quality was applied water demands are constantly monitoring the status of soil salinity in irrigation systems (Ljiljana Nesic M., et all., 2003)

The temperature has an influence on the water quality in the way it is increased when the temperature is increasing due to chemical and biochemical reactions, and also the development of certain microorganisms depended on a certain temperature.

Some toxic substances decrease the pH value of the water and therefore pH values have the largest influence the industrial pollution. The value of the pH shall define standards, according to ISO 10523.

The water quality is assessed according to the quantity of depleted potassium permanganate. Methods by which shall define the consumption of potassium permanganate e ISO 8467. Chloride, the determination will their very important, because it can be the origin of the mineral, but also, can be, and an indicator of fecal pollution. The method which was determined is ISO 9297. Rule book for the safety of the water on R. Macedonia, nitrite be able maximum were to appear in a concentration of 0.1 mg / l as calculated using nitrogen and determine by the HACH METHOD 8507.

The increased concentration of nitrates into the water is not always maintained an indicator of water pollution and its quality is confirmed and with other chemical and microbiological methods. Nitrates are determined by the HACH METHOD 8039.

Iron in the water main becoming of the country which is not further influenced by the carbonic acid, sulfur acid or other organic crossing the acid into the water. Iron in the water appears on surface water with double valence, and further on in the presence of oxygen in crossing the trivalent (Alan Beeby, 2008).

Conclusion

The United States Agency for International Development, Regional Services Center (RSC), Budapest, intends to issue a Request for Proposal (RFP) on behalf of its client Mission, USAID Macedonia, in anticipation of the procurement of a cost plus fixed fee completion contract that will implement a four year project entitled the Regional Small Business Development (RSBD) Project to be implemented in Macedonia (FBO,USAID program, 2011-20014).

Of great importance to the holding of the good situation of accumulation Streževo is successful eutrophication. In that sense, it is best to undertake measures to eliminate the reasons that, brings to his outburst, as for example:

- A restriction on the influx of nutrients at the entrance to accumulate, especially at the entrance to nitrogen and phosphor, due to the fact that these two elements enter into the composition of the material on organic alga. This can be realized with the extension of the inbound water of suspended substances, so as to control the phosphorus concentration is on, and in that way ensure the oligotrophic situation of accumulation. Also can be done and precipitation of the phosphate on the depth lake.
- Revisions of of incoming water in the accumulation of heavy metals
- At eutrophication may react with physical cleaning with the lake of aquatic plants, which directly reduces the excess of organic substances.
- Aeration and accumulation following the introduction of the dry air, so they are brought in alga deeply impoverished, where it slows his development.
- Applied on biological methods for the reduction of the phytoplankton alga.

The results of the analysis have been done in the most objective current situation in water and ecosystems in the region, on measures of reaching the "good condition" of the water bodies. In that direction, a legal various studies for the protection of the living environment, and also, in the near future is planned and concrete steps for implementation.

This paper aims at reviewing our knowledge on the efficient use of water for food production and identifying opportunities and determining what additional studies may need to be carried out to ascertain the conditions under which “more food with less water” is possible. With this paper we try to contribute to the debate that it is possible to identify increasing crop productivity of maize silage in addition to the system of drip irrigation, but using the water quality, ensuring food security and securing livelihoods farmers.

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