DETERMINATION OF WATER CONSUMPTION IN DIFFERENT CROPS FOR IMPROVEMENT OF THE IRRIGATION TECHNOLOGIES AND PERIODS IN DIFFERENT PARTS OF ROMANIA

Nistor Andrei*, Brejea Radu**

*Sole proprietorship – Nistor Andrei Nicolae, 10 Doina St., Oradea, Romania,
e-mail: nistor_andrei_nicolae@yahoo.com
**University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048,
Oradea, Romania, e-mail: rbrejea@yahoo.com

Abstract

Research programme "Exploitation of the Irrigation and Drainage" of the Research Institute for irrigation and Drainage Băneasa – Giurgiu had research fields (30) in the all the areas of Romania. Crop coefficients "Kc" are used in the irrigation scheduling and it is obtained like report between water consumption and pan evaporation determined daily at 8^{00} o'clock. In the 12 location (Oradea, Suceava, Podu Iloaiei, Tecuci, Braila, Valul lui Traian, Dor Marunt, Baneasa – Giurgiu, Caracal, Siminic, Malu Mare and Maglovit) were placed the research fields and the research results obtained in winter wheat, maize, sunflower, soybean, sugar beet, and alfalfa are presented. The daily water consumption of crops differs depending on the month and the locality. Whereas Romania, in all the areas of interest for irrigation, has an impressive database for irrigation scheduling using the pan class A, is recommended to improve the current situation by using the variable depths for irrigation, depending on the growth rate of the root canal system and not of a fixed depths as at present.

Key words: crop coefficient, irrigation scheduling, research field, water consumption, evaporation

INTRODUCTION

Irrigation scheduling is of all the measures which have as main objective the provision of the moment the application of irrigating and compilation and transmission of documents and the necessary data for the information of the beneficiaries (Domuța et al., 2012; Ionescu-Șișești, 1982).

The problem to the establishment of the correct application of the moment of irrigation applied has constituted an important preoccupation of specialists in the field. This fact depends on to the greatest extent possible to obtain the expected yields and the prevention of negative phenomena in the evolution of the soil and groundwater (Groza et al., 2004; Ionescu-Șișești, 1986; Luca, Nagy, 1999).

The methods and processes used over time in the irrigation scheduling have been designed specifically for this purpose or were taken from other areas, some adaptations. Methods for the irrigation scheduling shall take into account the relations in the soil-system-water-plant-climate (Domuța, Domuța, 2010; Domuța, 2010; Domuța, 2011; Domuța, 2012; Domuța,

2014). When selecting the method for the irrigation scheduling the view is and the type of arrangement used in the irrigation, the mode of application of the irrigation (in Romania is used irrigation by rotation), the structure of crops, the characteristics of the organizational and technical (the size of the system and of the sectors of irrigation, the dimensions of the soil of the occupied with the crops, the beneficiaries etc.) considerations of efficiency and last but not least, economy ones (Muntean et al., 2001; Muntean et al., 2008; Petrescu, 1999).

Grumeza (1989) classifies the methods of irrigation scheduling into the following groups: the method of extrapolation of data on the reserve of water from the plots of the control; methods based on the relationship between the water consumption of plants and reference evaporation of reference determined using evaporimeter, climate formula, lysimeters etc. and methods based on the use of physiological indicators.

Domuța (2000) considers that the methods of irrigation scheduling can be grouped as follows:

a) direct methods - based on the control of soil moisture by: the gravimetric method; the tensiometer method; neutron method; and methods based on the physiological indicators of plants;

b) indirect methods - based on the connection between the water consumption of the reference evapotranspiration (ET0). These method involves the use of the coefficients Kc for processing ETo in the optimal use of water. These coefficients have settled in Romania after a specific methodology carried out by Grumeza (1987, 2005).

MATERIAL AND METHOD

In the international scientific literature 'Kc' (crop coefficient) represents the coefficient of culture medium used for the conversion of reference evapotranspiation (ET0) in the optimal water consumption of the crop. As a result, the calculation formula of it, is the following:

$$Kc = \frac{Optimum\ daily\ consumption}{Daily\ reference\ evapotranspiration}$$

In the immediate vicinity of each research field for soil water balance into the soil operates a station for irrigation scheduling. Here is determined the daily evaporated water with evaporimeter Bac pan class A. The existence of a complex, meteorological machine (meteorological stations, automatic transmission, etc.) which allows air temperature determination, the sun brilliance duration, air humidity, wind speed, creates the premises for determination of other types of evapotranspiration reference (Thornthwaite Penman, etc.) in addition to the evaporation. Through the

reporting of data for optimal daily water consumption, calculated on months or on phenophase at values of the evapotranspiration reference are obtained Kc values (Domuța et al., 2001; Domuța et al., 2009).

RESULTS AND DISCUSSION

The irrigation influence on the water consumption of winter wheat

The use of irrigating while maintaining the reserve of water on the depth of wetting between the easily available water content and field capacity determines a substantial improvement of the daily water consumption of water of winter wheat. Thus, in the conditions of the area moderately sub-humid of the Crisurilor Plain in the period 1976-2014 the average values of the water consumption have been higher than in conditions of non-irrigated with 19% - 56 %, noticing that the maximum difference was recorded in the last month of vegetation, plant leaves while the work in an extended period of time.

Table 1

The daily average water consumption (m^3/ha/day) of winter wheat in different areas of Romania

Zone	Location	Variant	Month			
			April	May	June	July
Crisurilor Plain	Oradea (1976-2014)	Unirrigated	26	33	17	
		Irrigated	31	45	20	
North Moldavia	Podu Iloaiei	Irrigated	27	43	-	
Baraganului Plain	Braila	Irrigated	23	42	-	
Dobrogea	Valu lui Traian	Irrigated	30	48	-	
Baraganului lain	Marculesti	Irrigated	28	44	-	
Burnasului Plain	Băneasa Giurgiu	Irrigated	38	41	-	
Olteniei Plain	Caracal	Irrigated	29	41	-	
Central of Part Transilvania	Cluj Napoca	Irrigated	-	-	-	

In the month of April the largest daily water consumption of winter wheat were registered in Burnasului Plain, at Baneasa Giurgiu, 38 m^3/ha and the smallest in Braila in Baragan Plain, 23 m^3/ha/day. During the month of May the largest water consumption has been registered at the Valu Traian in

Dobrogea and the lowest daily consumption has been registered in Podu Iloaiei. In the June, the highest value optimal consumption of water has been registered in Oradea, and the lowest in Podul Iloaiei; in the localities of Oradea, Braila, Baneasa-Giurgiu and Caracal were recorded the maximum values of the daily consumption of water of winter wheat.

The irrigation influence on the maize water consumption

Ensuring the maintenance of the reserve of water between the easily available water content and the field ability on the watering depth using the irrigation is carried out conditions for the increase in value of the daily consumption, the highest relative difference (77%) was recorded in the month of August.

The values for the optimum daily water content of maize differ. In the April the largest optimum water consumption of the maize has been registered at the Băneasa-Giurgiu (22 m^3/ha/day), in May in Oradea (30 m^3/ha/day), in June in Marculesti (43 m^3/ha/day), in July in Marculesti and Oradea (61 m^3/ha/day), in August in Marculesti (54 m^3/ha/day) and in September in Marculesti and Braila (28 m^3/ha/day).

Table 2

The daily water consumption (m^3/ha/day) of maize in different areas in Romania

Zone	**Location**	**Variant**	**Month**					
			April	**May**	**June**	**July**	**Aug**	**Sept**
Crisurilor Plain	Oradea (1976-2014)	Unirrigated	15	26	36	40	27	16
		Irrigated	18	30	42	61	48	27
North Moldavia	Podu Iloaiei	Irrigated	15	25	39	51	38	19
Baraganului Plain	Braila	Irrigated	16	19	41	58	51	28
Dobrogea	Valu Traian	Irrigated	13	21	34	58	49	21
Baraganului Plain	Marculesti	Irrigated	14	22	40	61	54	28
Burnasului Plain	Băneasa Giurgiu	Irrigated	22	28	43	58	43	27
Olteniei Plain	Caracal	Irrigated	18	26	39	59	42	24
Central Part of Transilvania	Cluj Napoca	Irrigated	17	26	34	39	31	22

The irrigation influence on the sunflower water consumption

Daily values of the daily water consumption grow in conditions of irrigation use. In the April the highest value daily water consumption in

sunflower has been registered at Băneasa-Giurgiu (23 m^3/ha/day), in May at Caracal (35 m^3/ha/day), in June at Marculesti (61 m^3/ha/day), in July at Marculesti (66 m^3/ha/day), and in August at Baneasa - Giurgiu (48 m^3/ha/day).

Table 3

The daily average water consumption (m^3/ha/day) of sunflower in different areas in Romania

Zone	Location	Variant	Month				
			IV	V	VI	VII	VIII
Crisurilor Plain	Oradea (1976-2014)	Unirrigated	9	27	40	38	20
		Irrigated	21	31	54	60	38
North Moldavia	Podu Iloaiei	Irrigated	20	27	44	54	38
Baraganului Plain	Braila	Irrigated	14	26	50	58	32
Dobrogea	Valu lui Traian	Irrigated	17	24	54	62	30
Baraganului Plain	Marculesti	Irrigated	15	24	61	66	29
Burnasului Plain	Băneasa Giurgiu	Irrigated	23	32	53	52	48
Olteniei Plain	Caracal	Irrigated	16	35	56	58	26

The irrigation influence on the sugar beet water consumption

The ensurance of soil water reserve between easily available water content and field capacity, the water accessibility and the conditions of microclimate. It determine the increase of the daily consumption of water in sugar beet.

Monthly, the highest values of the optimal consumption of sugar beet were recorded in Oradea in April (24 m^3/ha/day), and May (30 m^3/ha/day), at Valu Traian in June (53 m^3/ha/day), at Marculesti in July (62 m^3/ha/day), at Baneasa Giurgiu in august (51 m^3/ha/day) and in Oradea in September (30 m^3/ha/day).

Table 4

The daily average water consumption (m^3/ha/day) of sugarbeat in different areas in Romania

Zone	Location	Variant						
			IV	**V**	**VI**	**VII**	**VIII**	**IX**
Crisurilor Plain	Oradea (1976-2014)	Unirrigated	20	28	37	36	25	18
		Irrigated	24	33	49	57	47	30
North Moldavia	Podu Iloaiei	Irrigated	19	25	45	51	38	29
Baraganului Plain	Braila	Irrigated	15	23	46	57	49	29
Dobrogea	Valu lui Traian	Irrigated	16	24	53	56	47	29
Baraganului Plain	Marculesti	Irrigated	14	25	48	62	50	29
Burnasului Plain	Băneasa Giurgiu	Irrigated	20	28	49	56	51	25
Olteniei Plain	Caracal	Irrigated	18	28	49	55	44	28
Central Part of Transilvania	Cluj-Napoca	Irrigated	17	25	35	43	31	19

CONCLUSIONS

The paper is based on the research field for soil water balance study placed by Research Institute for Irrigation and Drainage Băneasa-Giurgiu, in the Cri□urilor Plain (Oradea), North Moldavia (Podu Iloaiei), Dobrogea (Valu lui Traian), Bărăgan (Brăila, Mărcule□ti), Burna□ului Plain (Băneasa-Giurgiu), Olteniei Plain (Caracal) and Central Part of Transilvania.

In June, the highest value of winter wheat water consumption has been registered in Oradea, and the lowest in Podul Iloaiei. The values for the

optimum daily water content for maize differ: in April at the Băneasa-Giurgiu (22 m^3/ha/day), in May in Oradea (30 m^3/ha/day), in June in Marculesti (43 m ^{3}/ha/day), in July in Marculesti and Oradea (61 m^3/ha/day), during the month of August in Marculesti (54 m^3/ha/day) and in the month of September in Marculesti and Braila (28 m^3/ha/day).

In April the highest value of daily water consumption for sunflowers has been registered at the Băneasa-Giurgiu (23 m^3/ha/day), and in the month of May at Caracal (35 m^3/ha/day), in June at Marculesti (61 m ^{3}/ha/day), in July at Marculesti (66 m^3/ha/day), and in August at Baneasa - Giurgiu (48 m^3/ha/day).

The highest values of the water consumption for sugar beet were recorded in Oradea in April (24 m^3/ha/day), in Oradea in May (30 m^3/ha/day), at Valu lui Traian in June (53 m^3/ha/day), at Marculesti in July (62 m^3/ha/day), at Baneasa Giurgiu in august (51 m^3/ha/day) and in Oradea in September (30 m^3/ha/day).

REFERENCES

1. Domuța C. et al., 2001, Researches regarding the water requirement in the main crop from Western Romania (1976-2000). Proceedings of "19th European Regional Conference, Sustainable use of land and water" 4 – 8 June Brno and Prague
2. Domuța C. et al., 2006, Irrigation influence on sunflower in the conditions of the moderate wet area from Western Romania. "1st Symposium on Sunflower Industrial Uses", September 11-14, Udine, Italy http://www.sunflower symposium.org
3. Domuța C., (coordonator), 2009, Irigațiile în Câmpia Crișurilor 1967 - 2008. Ed. Universității din Oradea, Oradea
4. Domuța C. et al., 2012, Irigarea culturilor în Câmpia Crișurilor. Ed. Universității din Oradea, Oradea
5. Domuța Cr., 2010, Cercetări privind influența irigației asupra culturilor de porumb, soia și sfeclă de zahăr în condițiile Câmpiei Crișurilor. Teză de doctorat. USAMV Cluj Napoca
6. Domuța Cr., 2011, Subasigurarea cu apă a porumbului, soiei și sfeclei de zahar din Câmpia Crisurilor. Ed. Universității din Oradea
7. Domuța Cr., 2012, Cercetările privind irigarea soiei în Câmpia Crișurilor. Ed. Universității din Oradea
8. Domuța Cr., 2014, Research regarding the impact of the correctly irrigation scheduling on soybean from Crisurilor Plain. Analele Universității Oradea Fascicula Protecția Mediului, Vol XXIII, Anul 19, pp.43-51
9. Domuța Cr., Domuța C., 2010, Irigarea Porumbului în Câmpia Crișurilor. Ed. Universității din Oradea
10. Groza N., Petrescu E., Vatamanu V., 2004, Irigarea culturilor. Ed. Sitech Craiova, Craiova
11. Grumeza N. et al., 1987, Corelația consum de apă-producție și prognoza irigației în condițiile pedoclimatice ale Câmpiei de Vest. Cereale și plante tehnice, nr.**7**
12. Grumeza N. et al., 1989, Prognoza și programarea aplicării udărilor în sistemele de irigații. Ed. Ceres, București

13. Grumeza N., Kleps Cr., 2005, Amenajările de irigații din România. Ed. Ceres, București
14. Ionescu Șișești Vl., 1982, Consumul de apă și regimul de apă al culturilor. Ed. Ceres, București
15. Ionescu Șițețti Vl., 1986, Irigarea culturilor. Ed. Ceres, București
16. Luca E., Nagy Z., 1999, Irigarea culturilor. Ed. Genesis Tipo, Cluj-Napoca
17. Muntean L.S., Borcean I., Axinte M., Roman Gh.V., 2001, Fitotehnie. Ed. Ion Ionescu de la Brad
18. Muntean L.S. et al., 2008, Fitotehnie. Ed. Academic Press Cluj-Napoca
19. Petrescu E., 1999, Cercetări privind reducerea consumului de apă la cultura de sfeclă de zahăr irigată în condițiile pedoclimatice ale Câmpiei Caracalului. Teză de doctorat. ASAS "Gheorghe Ionescu Șișești", București