IRRIGATION INFLUENCE ON WATER CONSUMPTION AND YIELD IN SUNFLOWER CROP IN THE CRISURILOR PLAIN AND IN DIFFERENT REGIONS OF ROMANIA

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Abstract

The results of research in the field of soil water balance placed on preluvosoil from Agricultural Research and Development Station Oradea are compared with results obtained from Podu Iloaiei (Northern Moldova), Braila and Mărculeşti (Baragan Plain), Valu lui Traian and Caracal (Oltenia Plain). On the irrigation depth of the sunflower crop (Grumeza N., 1989) has been taken to maintain the water supply between easily available water content and field capacity. For this purpose soil samples were taken from 10 to 10 days being irrigated whenever the water reserve reached the minimum level. In Oradea, in the period 1976-2014 average of total water consumption at irrigated sunflower was 48.1% higher than the value registered in unirrigation conditions, the differences registered over the years ranging between 15 and 122%. For coverage the optimum water consumption irrigation was needed each year to cover its share of total water consumption is between 6 and 63% . Irrigation determined more stable yields obtained, value of standard deviation of the yields obtained under irrigation condition in Oradea, in the period 1976-2014 is less than 8.6% under unirrigation conditions.

Key words: irrigation, sunflower, daily water consumption, yield

INTRODUCTION

Sunflower is one of the most important oilseed crops grown worldwide (13% of world production of oil) and the most important oilseed crops for Romania. The oil from sunflower achenes is significant and is characterized by color, taste and smell pleasant, high in vitamins (A, D, E, K) and aromatics; in addition, sunflower oil is very well preserved for long periods (Domuta, 2010, Muntean 2008, 2011).

Sunflower oil is one of the most well balanced in terms of fatty acids it contains. It is used both "cold" and cooking and is rich in linoleum acid - essential fatty acid for human consumption (Borza, Stanciu, 2010).

In 1999 (after the Annual Statistical Report, 2000) in the world were cultivated sunflowers about 21.800. ha, resulting an global average yield of 1190 kg grains / ha and global yield of 25 840 tones overall.

Big countries cultivators of sunflower are: USA (1413 thousand ha and an average yield of 1690 kg seeds / ha), Argentina (3.750 thousand ha 1810 kg / ha), India (2.200 thousand ha, 550 kg / ha), China (720 thousand hectares, 1290 kg / ha), Turkey (520 000 ha 1250 kg / ha), France (895 000 ha 2090 kg / ha), Hungary (428 000 ha 1650 kg / ha), Spain 990 000 ha

1110 kg / ha), the former Soviet Union (6912 thousand hectares, of which 4,100 thousand hectares in the Russian Federation and 2,400 thousand hectares in Ukraine 800 kg / ha).

In Romania, sunflower was introduced for oil production in the mid sec. XIX in Moldova; the main plant producing cooking oil, sunflower open unprecedented development (Muntean et al., 2003). Growing on larger surfaces debuted in sec. XX, with 672 ha in 1910, leading to 200,000 ha in 1938; After second war areas increased to 416 000 ha in 1948, 496,500 ha and 526,700 ha in 1950 between 1971 - 1975. In recent years, the areas with sunflower crops have been fluctuating, knowing some setback in 1990 (395 thousand hectares) and reached 700 thousand ha since 1995 due to interest in sunflower oil on the domestic market and export. It should be emphasized that areas of over 850 thousand hectares planted with sunflowers in the last 5 years (over 1 thousand. ha in 1999), justified undoubteLSDy the high profitability of the crop, presents a real danger because one can no longer meet minimum interval break of 6 years to return on the same field of culture imposed by phytosanitary rules. Big counties which grow sunflower crops are: Constanta, Teleorman, Calarasi, Dolj, Braila, Ialomita, Olt Timis (over 50,000 ha each). (Muntean, 2011)

Worldwide, it is estimated that in the next period areas with sunflowers will continue to grow, in a slower way, the overall trend is stabilizing surfaces; it is imposed on the one hand, technological constraints (share in the crop structure), and on the other the productive and qualitative performance of the new hybrids (Borcean, 2006).

Sunflower consumes plenty of water (650 mm or more) throughout the vegetation period. To satisfy water needs, sunflowers can use intensive water reserves accumulated in the soil in winter, thanks to the development of its root system. Incidentally, under steppe conditions (Bărăgan, Dobrogea, southeastern Moldova), sunflower production is correlated with rainfall in winter. It becomes therefore imperative to take steps to have water reserves in the soil in the spring, at level of field capacity. (Berbecel et al., 1970, Jude, 2012)

The specific consumption registered in different crop conditions in the world is variable (360 to 765), but higher yields are obtained especially at the values of 400 - 450, which means that sunflower request for moisture it's medium. Supports drought better than other crops, which is explained by the active and deep root system, reducing perspiration by a rapid return to the state of turgidity of the wilted leaves, but yield decreases in function of intensity and duration of droughts (Domuta, 2000, 2009, 2012).

Sunflower has a sensitivity phase to drought lasting swear 40 days before and after blooming. Consequences of hydric stress on seed production and the oil content depends on the phenological stage in which

the plant is surprised: the period of maximum sensitivity for seed mass is located in stage 3 cm floral button until the end of flowering; period of maximum sensitivity during the oil content ranging from full flowering stage and early grain maturity. (Domuta, 2010)

Currently, it is considered that, regardless of the period with hydric stress, total numbers of achene format output size m^2 affecting more the yield than MMB values. (Bîlteanu, 2003)

In terms of Romania in irrigated crops, the fewer rainfall in the second half of July and August (very common) leads to lower yields and inefficient use of fertilizers.

MATERIAL AND METHOD

The researches were carried out in field soil water balance, long term trial designed by N. Grumeza to ICITID Baneasa-Giurgiu. Irrigation regime was specific to each area. (Grumeza et al., 1989, Grumeza, Kleps, 2005)

The results of research in the field of soil water balance placed on preluvosoil from Agricultural Research and Development Station Oradea are compared with results obtained from Podu Iloaiei (Northern Moldova), Braila and Mărculeşti (Baragan Plain), Valu lui Traian and Caracal (Oltenia Plain).

On the irrigation depth of the sunflower crop has been taken to maintain the water supply between easily available water content and field capacity. For this purpose soil samples were taken from 10 to 10 days being irrigated whenever the water reserve reached the minimum level. (Grumeza et al., 1989, Borza et. al, 2012)

Sunflower water consumption was established using the known formula. (Botzan, 1966)

The yield results were calculated by variance analysis method. (Săulescu, 1967)

RESULTS AND DISCUSSION

The influence of irrigation on water consumption at sunflower crop

Daily values of daily water consumption increase under irrigation conditions.

In April the highest value of daily water consumption at sunflower was registered in Baneasa-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 Marculesti (66 m^3 / ha / day) and in August at Baneasa - Giurgiu (48 m^3 / ha / day) (table 1).

Table 1.

Daily water consumption (m^3/ha/day) at sunflower crop in different areas from Romania

Area	Location	Variant	Month				
			IV	V	VI	VII	VIII
Crisurilor Plain	Oradea	Unirrigated	9	27	40	38	20
		Irrigated	21	31	54	60	38
Moldova de nord	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 Plai	Băneasa Giurgiu	Irrigated	23	32	53	52	48
Campia Olteniei	Caracal	Irrigated	16	35	56	58	26

In Oradea, in the period 1976-2014 average of total water consumption at irrigated sunflower was 48.1% higher than the value registered in unirrigation conditions, the differences registered over the years ranging between 15 and 122%. For coverage the optimum water consumption irrigation was needed each year to cover its share of total water consumption is between 6 and 63% (Table 2).

Table 2.

Total water consumption at irrigated and unirrigated sunflower crop and sources of couverege Oradea 1976 – 2014

Variant	Σ (e + t),		Source of coverege					
	m^3/ha	Interval of variation %	Soil reserve (Ri-Rf) m^3/ha	P		Σm		
				m^3/ha	Int.of var. %	m^3/ha	Interval of variation	
							%	%
1.Unirrigated	3994	100	1173	2819	47-108	-	-	-
2. Irrigated	5917	105-222	954	2819	24-72	2153	36,3	6-63

Σ (e + t) = water consumption;

R_i-R_f = soil water reserve (initial reserve – final reserve)

P = precipitations in the vegetation season;

Σm = irrigation rate

After irrigated sunflower remain in soil big quantity of water reserve ensuring better conditions for the execution of plowing better quality compared to unirrigated variant.

The link between water consumption and yield of sunflower is straightforward and mathematical expressions with different forms depending on climate zone (Grumeza et al., 1989). This reflects the importance of irrigation to increase yield of sunflower, when irrigation is the main means of improving water consumption. In terms of Oradea for the period 1987-2014, this link is of power type (Fig. 1).

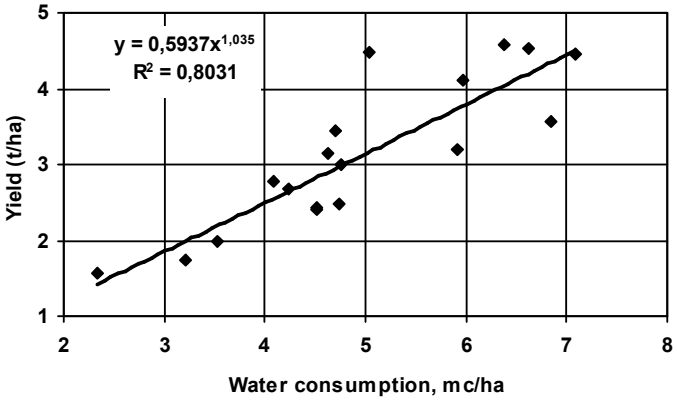

Fig. 1. Correlation between water consumption and yield in sunflower, Oradea 1987-2014

The influence of irrigation on sunflower yield

As analyzed above optimal use of irrigation had the effect of increasing the quantity of soil water available to plants and creating microclimate conditions more favorable. As a result, water consumption of crops has improved substantially causing determining the obtaining of significant yield gain

Research conducted during 1976-2014 in Oradea highlights that by maintaining water reserve between easily available water content and the field capacity of 0-75 cm depth using irrigation was obtained an yield gain of 48.9%, the interval of variation of differences registered in the 39 years being from 6 to 110% (table 3).

Table 3

Irrigation influence on level and stability of the yield in sunflower crop, Oradea 1976-2014

Variant	Yield				Standard deviation	
	Average		Interval of variation			
	kg/ha	%	kg/ha	%	kg/ha	%
Unirrigated	2330	100	1350-3140	100	580	100
Irrigated	3470	148,9	1757-4580	106-210	530	91,4
LSD 5% 210; LSD 1% 380; LSD 0,1% 720						

Irrigation determined more stable yields obtained, value of standard deviation of the yields obtained under irrigation condition in Oradea, in the period 1976-2014 is less than 8.6% under unirrigated conditions.

In descending order of relative differences between yield of sunflower optimal irrigation and yield of unirrigated sunflower were

obtained at Baneasa - Giurgiu 68%, followed by Valu lui Traian (60%), Braila (55%), Caracal (37%), Mărculeşti (25%) and Podu Iloaiei (18%) (table 4).

Table 4

Irrigation influence on yield in sunflower crop in different area of Romania

Area	Location	Variant	Yield		Difference	
			Kg/ha	%	Kg/ha	%
Moldova de nord	Podu Iloaiei	Unirrigated	2200	100	-	-
		Irrigated	2600	118	400	18
Dobrogea	Valu lui Traian	Unirrigated	2300	100	-	-
		Irrigated	3700	161	1400	61
Baraganului Plain	Braila	Unirrigated	2200	100	-	-
		Irrigated	3400	155	1200	55
Baraganului Plain	Marculesti	Unirrigated	2400	100	-	-
		Irrigated	3000	125	600	25
Burnasului Plain	Băneasa Giurgiu	Unirrigated	2500	100	-	-
		Irrigated	4200	168	1700	68
Olteniei Plain	Caracal	Unirrigated	2700	100	-	-
		Irrigated	3700	137	100	37

From all crops for grains sunflower crops had the lowest response to half the irrigation ratio respecting the optimal number of watering, yield decreasing compared with irrigated variant with 1/1 m with only 20.3%, but the difference was statistically as very significant. However, such a measure is not justified by the costs of irrigation. So, to the sunflower too, it is recommended to apply the irrigation ratio through warning bulletin of irrigations (Domuta, 1995).

CONCLUSIONS

Research conducted in the fields of soil water balance representative for sunflower crop irrigation determined the following conclusions:

- In April the highest value of daily water consumption at sunflower was registered in Baneasa-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 Marculesti (66 m^3 /ha/day) and in August at Baneasa - Giurgiu (48 m^3/ ha /day).
- In Oradea, in the period 1976-2014 average of total water consumption in irrigated sunflower was of 48.1% higher than the value registered in unirrigated conditions. The differences registered over the years ranging between 15 and 122%. For coverage the optimum water consumption, the irrigation was needed every. The irrigation participation in the total water consumption is between 6 and 63%

- The link between water consumption and yield of sunflower is straightforward and mathematical expressions with different forms depending on climate zone. This reflects the importance of irrigation to increase yield of sunflower, when irrigation is the main means of improving water consumption. In terms of Oradea for the period 1987-2014, this link is of power type.
- Research conducted during 1976-2014 in Oradea highlights that by maintaining water reserve between easily available water content and the field capacity of 0-75 cm depth using irrigation was obtained an yield gain of 48.9%. The interval of variation of differences registered in the 39 years being from 6 to 110%.
- Irrigation determined more stable yields obtained, value of standard deviation of the yields obtained under irrigation condition in Oradea, in the period 1976-2014 is less than 8.6% under unirrigation conditions.
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