

SUNFLOWER REQUIREMENT FOR WATER IN THE CHERNOZEM ZONE OF YUGOSLAVIA

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Summary

Sunflower requirement for water in the variable semiarid to semihumid climatic conditions of the chernozem zone of Yugoslavia has been defined on the basis of a field trial which included a variant of sprinkler irrigation at the pre-irrigation moisture of 60% of field water capacity (FWC) and a non-irrigated check variant. Water consumption for evapotranspiration of sunflower was determined on the basis of a balance calculated for the rainfall during growing season, the pre-vegetation moisture in the soil layer to 2 meters, and the irrigation requirement.

The average sunflower requirement for water was 450 mm, with the annual variations from 410 to 490 mm, depending on the meteorological conditions of the year of growing. The effect of irrigation on yield was negative because sunflower is an efficient user of reserve soil moisture. It takes up over 200 mm of water from the soil layer to 2 meters, which is about 50% of the total sunflower requirement for water.

Introduction

Water requirements in the variable semiarid to semihumid climatic conditions of the chernozem zone of Yugoslavia have been studied for various field crops: maize by VUČIĆ (1973) and BOŠNJAK ET AL. (1983), soybean by VUČIĆ AND BOŠNJAK (1980), hops by KIŠGECI (1974), sugarbeet by DRAGOVIĆ (1976), alfalfa by BOŠNJAK (1990), and most double crops by VUČIĆ (1981). It is not an easy task to determine sunflower requirement for water in the region investigated, because of a high variability in rainfall level and distribution, the capacity of sunflower plants to take up water from deep soil layers, and the sunflower susceptibility to diseases which, especially if the crop is sprinkle irrigated, imbalances the relationship between water consumption for evapotranspiration and the yield produced.

Water requirement, which depends on local pedoclimatic conditions, defines the water consumption for evapotranspiration which provides the highest yield. Our objective was to determine, on the basis of long-term field trials, the sunflower requirement for water in the chernozem zone of Yugoslavia.

Material and Methods

The field trial was established at the experiment field of the Institute of Field and Vegetable Crops of the Faculty of Agriculture in Novi Sad. The experiment plot was located on the calcareous chernozem of the loess terrace. The trial included two variants: sprinkler irrigation at the technical minimum of soil moisture of 60% FWC and the non-irrigated check variant. The irrigation was scheduled on the basis of soil moisture monitoring at 10-day intervals or more frequently, in soil layers of 10-20 cm to the depth of 60 cm.

In both variants, sunflower evapotranspiration was assessed by balancing the consumption of water from rainfall, reserve water accumulated before the vegetation period, and irrigation requirement. Water consumption from soil reserve was established by measurements of soil moisture in 10-20 cm layers to the depth of 2 meters, conducted at the beginning and the end of the growing season. Soil moisture was determined thermogravimetrically in an oven at 105-110°C.

The experiment included several NS sunflower hybrids in four replications. Cultural practices were conducted at optimum dates. The size of basic plot was 20-36 m². Sunflower yields were presented at the level of the general mean.

Results and Discussion

Water consumption for evapotranspiration (Table 1) remained constant with and without irrigation, because the non-irrigated sunflower used the reserve soil moisture more efficiently.

The sunflowers in the non-irrigated check plot took up 100 mm more reserve soil moisture, on average, than those in the irrigated variants. Depending on the weather conditions of the year of growing, the sunflowers in the non-irrigated check plot took up over 200 mm of water from soil reserve, i.e., about a half of the total amount of water consumed. This was in agreement with an earlier finding of VUČIĆ AND BOŠNJAK (1982) that sunflower grown

on the chernozem soil in the Vojvodina Province take up to 50 % of the total requirement from soil reserve.

It was found that in the chernozem zone of Yugoslavia sunflower yield is negatively affected by irrigation. Positive effects of irrigation were registered only in 1983 and 1984, 32.3% and 19.9%, respectively. The average yield in conditions without irrigation was 9.1% higher than in the irrigated plots, with the annual variation from 1.3 to 43.0%.

High yields of sunflower were obtained in the first three years of the experiment; in the last five years, the yields were generally low because of the outbreak of *Phomopsis* which brought considerable yield reductions.

The irrigation maintained the soil moisture above 60% FWC in the soil layer 0-60 cm, i.e., the layer that contained the largest mass of sunflower roots. This value, which is above the soil water constant for lentocapillary moisture and which is the lower limit of optimum soil moisture for most field crops, brought an indirect negative effect on the yield of sunflower. The negative effect was due to the irrigation technique, i.e., sprinkling, which intensified disease attack. However, the finding that the evapotranspiration was constant with and without irrigation indicated that sunflower, on account of its powerful and deep root system, is an efficient user of hardly available categories of water from both active rhizosphere and deeper soil layers. It was thus concluded that sprinkling irrigation is not recommendable for sunflower growing in the chernozem zone of Yugoslavia.

Water requirement of an agricultural crop is defined as a level of water consumption which brings the highest yield. The water requirements of most crops grown in the chernozem zone of Yugoslavia have been determined in field trials with irrigation variants, which included different pre-irrigation soil moistures, and non-irrigated check plots. In these trials, a positive response to irrigation was registered with all crops. This was not the case with sunflower. In the eight-year trial, the highest yields were obtained in the non-irrigated check plot, with water consumption for evapotranspiration from 409.7 mm to 493.8 mm, or 450 mm on average. These values, which are brought about by the pedoclimatic conditions and the specific characteristics of sunflower, evidently represent the actual sunflower requirement for water in the chernozem zone of Yugoslavia.

Conclusion

Sunflower requirement for water in semiarid to semihumid conditions of the chernozem zone of Yugoslavia was assessed in an eight-year field trial. The requirement was found to be 450 mm on average. The actual requirements varied from 410 mm to 490 mm, i.e., $\pm 10\%$ from the average. This was a normal variation which corresponded to the weather conditions of the year of growing.

Sunflower was an efficient user of reserve soil moisture accumulated in the winter period preceding the growing season since it took over 200 mm of water from the soil layer to 2 meters. This amount of water makes about 50% of the total sunflower requirement for water.

Tab. 1 - Evapotranspiration (mm) and yield (t ha^{-1}) of irrigated and non-irrigated sunflower

Year	Variant	Evapotranspiration (mm)				Yield (t ha^{-1})
		Rainfall	Soil reserve	Irrigation rate	Total	
1977	Irr.	264.6	110.6	60	435.2	2.551
	Non-irr.	264.6	165.2	-	429.8	3.232
1978	Irr.	319.8	67.6	120	507.7	3.423
	Non-irr.	319.8	139.0	-	458.8	3.630
1979	Irr.	265.3	29.4	110	404.9	2.212
	Non-irr.	265.3	213.6	-	478.9	2.943
1980	Irr.	311.2	138.6	60	509.8	1.471
	Non-irr.	311.2	182.6	-	439.8	2.103
1981	Irr.	304.3	28.5	140	472.8	2.003
	Non-irr.	304.3	177.8	-	482.1	2.101
1982	Irr.	217.5	90.0	120	427.5	1.424
	Non-irr.	217.5	192.2	-	409.7	1.443
1983	Irr.	295.6	50.5	80	425.5	2.123
	Non-irr.	295.6	151.5	-	447.1	1.605
1984	Irr.	343.0	58.4	60	461.4	1.912
	Non-irr.	343.0	124.0	-	467.0	1.607
Average	Irr.	290.2	71.7	94	455.9	2.140
	Non-irr.	290.2	170.7	-	458.4	2.333

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