RESEARCH CONCERNING THE SOIL WATER BALANCE FOR THE SUGAR BEAT CROP

CERCETĂRI PRIVIND BILANŢUL APEI ÎN SOL LA CULTURA DE SFECLĂ DE ZAHĂR

C. V. POPESCU*, C. BORA, C. A. ROŞCULETE***, C. POPESCU***

**University of Craiova – Faculty of Agriculture, Craiova, Romania*
***S.C.D.A. Şimnic, ***S.C.D.A. Caracal*

Abstract: *In this paper we have studied the soil water balance at the sugar beat crop cultivated in the Research and Development Station ŞIMNIC. The water consumption of the sugar beat crop and the soil moisture dynamics were determined through the soil water balance theory methods.*

Rezumat: *În această lucrare este studiat bilanţul apei în sol la cultura de sfeclă de zahăr cultivată în cadrul Staţiunii de Cercetare Dezvoltare ŞIMNIC. Consumul de apă al culturii de sfeclă de zahăr şi dinamica umidităţii solului au fost determinate prin metoda bilanţului apei în sol.*

Key words: *soil water balance, water consumption, irrigation, soil moisture dynamics*
Cuvinte cheie: *bilanţul apei în sol, consum de apă, irigaţie, dinamica umidităţii solului*

INTRODUCTION

The research was carried out at the sugar beat crop in irrigated and rain fed conditions on the soil from the Research and Development Agricultural Station „SIMNIC". For a period between 1987-2001, there were established at the sugar beat crop the water consumption and the soil moisture dynamics.

MATERIALS AND METHOD

In the experimental plots, the monthly and total sugar beat crop water requirements were determined according to the field water balance theory:

- accurate measurements of the soil moisture at depths of 75 cm and 150 cm – using the gravimetric method at the most important crop stages like crop establishment, harvest, after rainfalls higher than 10 mm and every 10 days;
- measurements of the rainfall,
- accurate management of the irrigation.

The soil moisture dynamics was determined using the same water balance method.

RESULTS AND DISCUSSION

The initial soil water content (Ri), determined as difference to the soil's field capacity (CC) had an average value of 2.515 m^3/ha, inferior with 205 m^3/ha to the field capacity, but superior to the minimum accepted moisture level (Pmin) with 295 m^3/ha. This initial soil moisture reserve, although inferior to the field capacity determined a good start of the crop. The rainfalls (P) were measured and those above 5 mm were used at the soil water balance measurements. The rainfalls average value registered was 2.725 m^3/ha, varying annually between 4.957 m^3/ha in 1999 and 1.230 m^3/ha in 1993.

From table 1 we can observe that rainfalls above 3.500 m^3/ha were registered as well in 2001, 1998, 1991 and 1997. Even then the rainfalls were not enough to cover the crop's demands towards water.

Table 1

Soil water balance (m^3/ha) at sugar beat crop on 0, 75 m soil depth in irrigated regime

Year	No. of days	Ri	P	M	Rf	Consumption	
						Total	Daily
1985	147	2379	2619	3000	2250	5748	39
1986	162	2436	2045	4000	2276	6005	37
1987	163	2470	1350	4500	2130	5990	37
1988	187	2380	1941	3500	2103	5918	32
1989	182	2540	3459	2500	2153	6346	35
1990	175	2375	2002	3500	1870	6007	34
1991	168	2470	3743	2000	2291	5922	35
1992	168	2363	1605	4500	2140	6328	38
1993	170	2418	1230	4500	1907	6241	37
1994	183	2439	3544	2500	2186	5897	32
1995	176	2460	3477	2500	2097	6140	35
1996	155	2677	2525	2500	1677	5876	38
1997	168	2618	3505	2500	1849	5773	33
1998	177	2663	3865	2000	2120	5908	33
1999	177	2654	4957	1000	1946	6265	35
2000	177	2382	2150	4000	1862	5890	33
2001	177	2416	4015	1500	1935	5996	34
Average	171	2515	2725	2716	1996	5960	35

Table 2

Soil water balance (m^3/ha) at sugar beat crop on 0, 75 m soil depth in rain fed conditions

Year	No. of days	Ri	P	Rf	Consumption	
					Total	Daily
1985	147	2355	2619	2156	2818	19
1986	162	2420	2045	1351	3114	19
1987	163	2455	1280	1364	2371	14
1988	187	2375	1941	1385	2931	16
1989	182	2530	3459	1631	4358	38
1990	175	2290	1726	1228	2788	17
1991	168	2462	3743	1866	4339	27
1992	168	2355	1605	1374	2586	15
1993	170	2406	755	1105	2056	17
1994	183	2401	3544	1847	4099	22
1995	176	2435	3477	1906	4006	23
1996	155	2640	2525	1511	3654	24
1997	168	2602	3505	1644	4463	27
1998	177	2635	3865	1854	4646	26
1999	177	2618	4957	2035	5540	31
2000	177	2366	2150	1478	3038	17
2001	177	2402	4015	1767	4650	26
Average	171	2418	2725	1528	3615	21

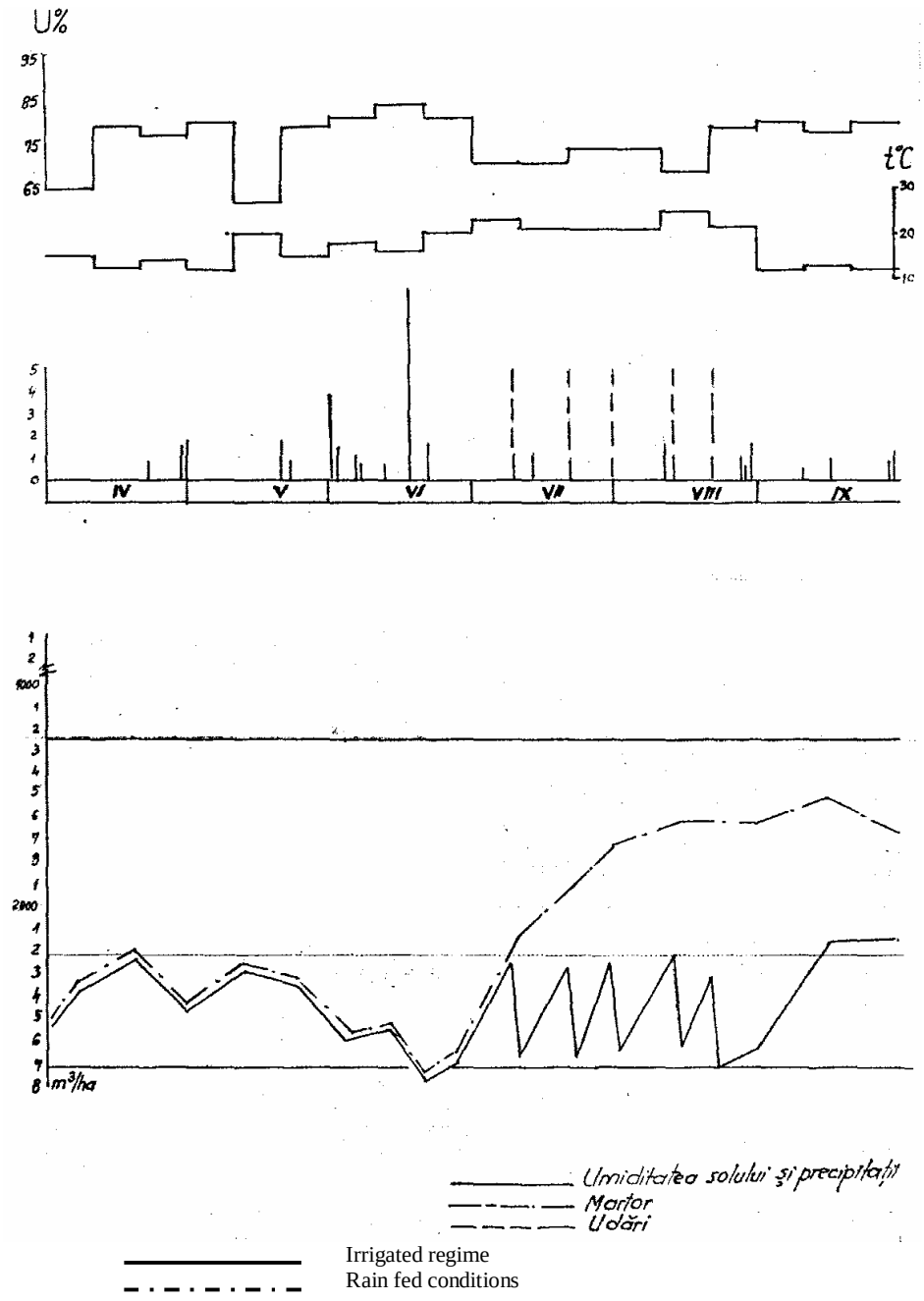


Figure 1. Soil moisture dynamics on 0, 75 m depth at sugar beat crop in 1989

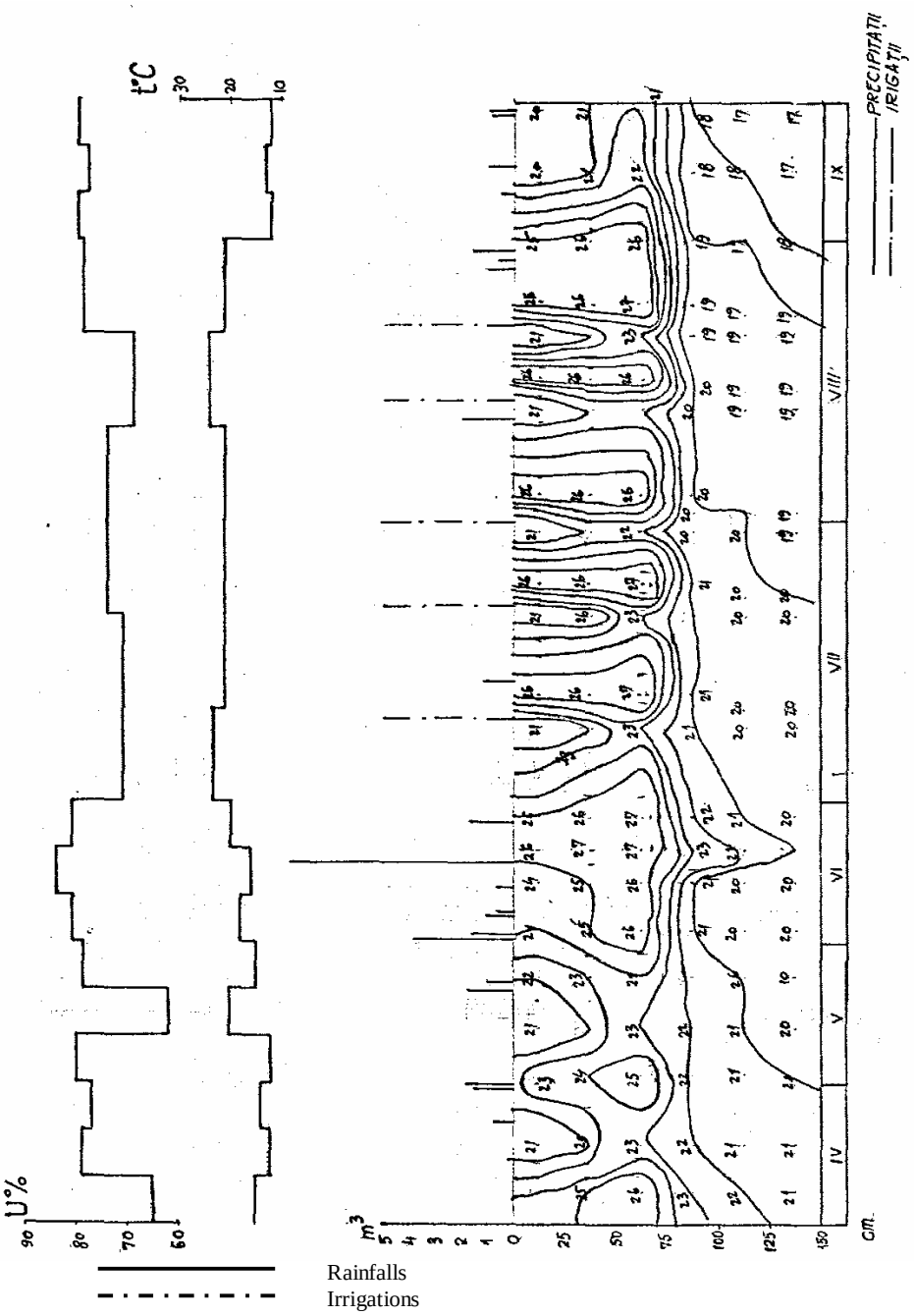
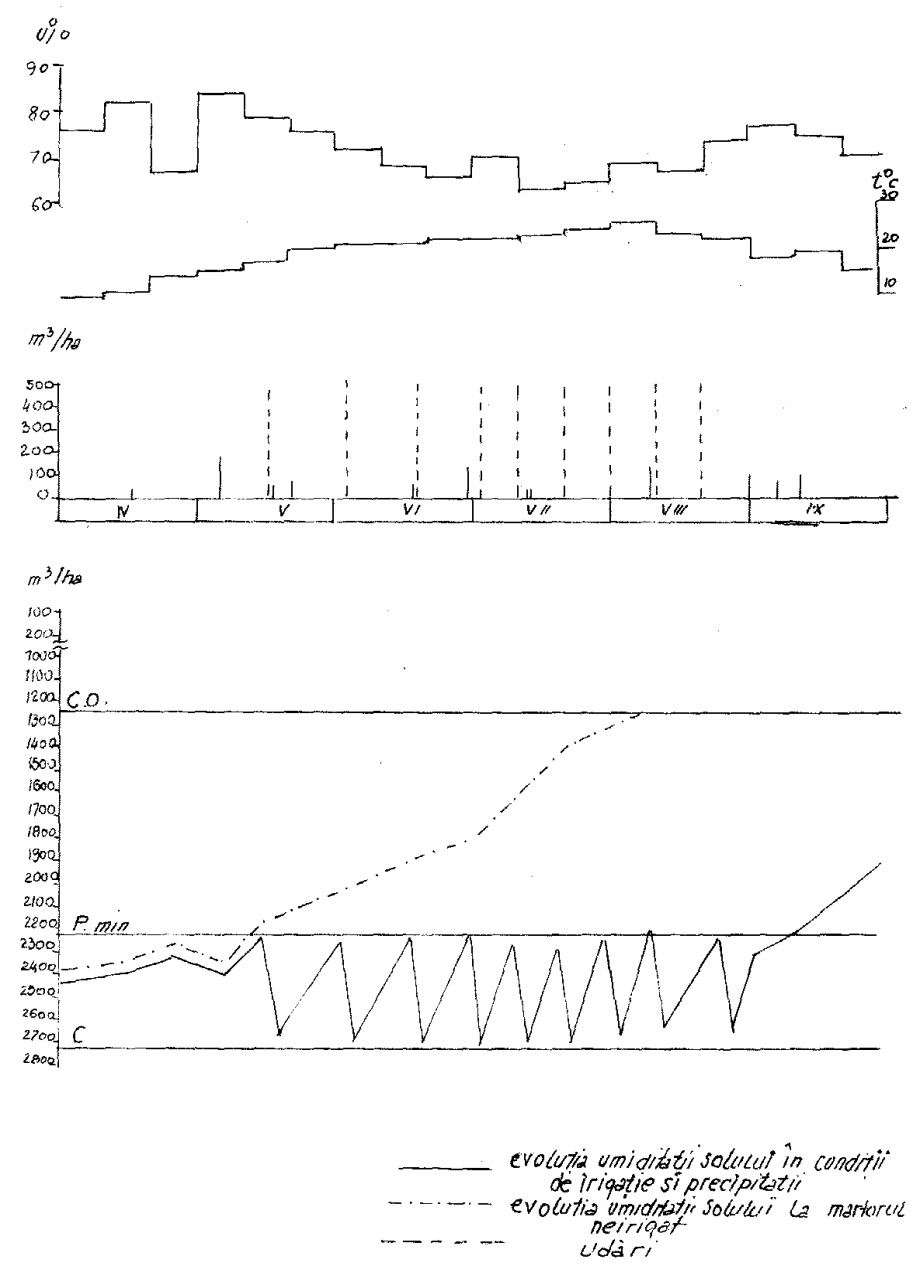


Figure 2. Soil moisture dynamics on 0.75 m depth at sugar beat crop in 1989



Irrigated regime

Rain fed conditions

Figure 3. Soil moisture dynamics on 0, 75 m depth at sugar beat crop in 1993

During the research period there were applied different numbers of irrigations, with an average of 2.716 m^3/ha with annual variations between 4.500 m^3/ha in 1992 - 1993 and 1.000 m^3/ha in 1999. In all these years, there were applied minimum 2 irrigations.

The final soil moisture content (Rf) determined and related to the permanent wilting point (CO) and minimum accepted moisture level (Pmin) was in average 1.996 m^3/ha, inferior with 224 m^3/ha to minimum accepted moisture level and superior with 756 m^3/ha to the wilting point. In rain fed conditions as observed in table 2, the average value of the soil moisture at the end of the vegetation period was 1.528 m^3/ha, lower than the value obtained in irrigated conditions with 468 m^3/ha.

The water consumption of the plants was determined monthly and for the whole vegetation period. Its average value was 5.960 m^3/ha, with annual variations between 6.328 m^3/ha in 1992 and 5.748 m^3/ha in 1985. In rain fed conditions, from table 2 we observe that the average value of the water consumption was 3.615 m^3/ha, inferior with 2.345 m^3/ha to the consumption in irrigated regime. Lowest water consumption was registered in 1987 – 2.371 m^3/ha and the highest in 1999 – 5.540 m^3/ha.

Regarding the soil moisture dynamics, there were years when the first irrigation was applied at the end of the month of June or beginning of July. In some years irrigation had to be started with one month in advance. In 2002 seeding was not possible without a supplementary irrigation.

In natural conditions, soil moisture level reached its minimum accepted level even at the end of the month of May. There were registered situations when the soil moisture was at the permanent wilting point (CO). In figures 1 and 2 it is presented the soil moisture dynamics for year 1989 – considered as an average year regarding rainfalls and in figure 3 the soil moisture dynamics for 1993 – an excessive dry year, when 9 irrigations were applied.

CONCLUSIONS

Experimental research showed the following:

- the average water consumption of the sugar beat crop for a period of 16 years was 5.960 m^3/ha, with annual variations between 6.328 m^3/ha in 1992 and 5.748 m^3/ha in 1985 for the irrigated crop;
- the average water consumption of the sugar beat crop 16 years was 3.615 m^3/ha, inferior with 2.345 m^3/ha to the consumption in irrigated regime. Lowest consumption was registered in 1987 – 2.371 m^3/ha and the highest in 1999 – 5.540 m^3/ha;
- the average daily water consumption of the sugar beat crop was 35 m^3/ha for the irrigated crop and 21 m^3/ha for a crop in rain fed conditions.

It can be anticipated that in dry years, the soil moisture will reach the minimum accepted level (Pmin) earlier, with obvious yield differences.

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