RESEARCH CONCERNING THE SOIL WATER BALANCE FOR THE ALFALFA CROP

CERCETĂRI PRIVIND BILANȚUL APEI ÎN SOL LA CULTURA DE LUCERNĂ

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 alfalfa crop cultivated in the Research and Development Station ŞIMNIC. The water consumption of the alfalfa crop and the soil moisture dynamics were determined through the soil water balance theory methods.*

Rezumat: *În această lucrare este studiat bilanțul apei în sol la cultura de lucernă cultivată în cadrul Stațiunii de Cercetare Dezvoltare ŞIMNIC. Consumul de apă al culturii de lucernă şi dinamica umidității solului au fost determinate prin metoda bilanțului apei în sol.*

Key words**:** *soil water balance, water consumption, irrigation, soil moisture dynamics*
Cuvinte cheie: *bilanțul apei în sol, consum de apă, irigație, dinamica umidității solului*

INTRODUCTION

The research was carried out at the alfalfa crop in irrigated and rain fed conditions on the soil from the Research and Development Agricultural Station „SIMNIC" between 1987-2001, aiming the establishment of the alfalfa crop water consumption and the soil moisture dynamics.

MATERIALS AND METHOD

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

- accurate measurements of the soil moisture at depths of 75 cm , 100 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 irrigation management.

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 = 2.720 m^3/ha), had an average value of 2.543 m^3/ha, inferior with 177 m^3/ha to the field capacity. This initial soil moisture reserve, although inferior to the field capacity determined a good start of the crop. The rainfalls (P) average value registered was 2.799 m^3/ha, varying annually between 4.957 m^3/ha in 1999 and 1.239 m^3/ha in 1993.

From table 1 we can observe that rainfalls were not enough to cover the crop's demands towards water. There were registered days with cumulative rainfalls and intervals of 20-25 days without any drop of rain, when irrigation was applied. Although alfalfa is resistant to drought, it is using efficiently the irrigation water with important yield increase and superior fodder quality. Irrigation was applied 7-8 days after the alfalfa cuts.

Table 1

Soil water balance (m^3/ha) at alfalfa crop on 1 m soil depth in irrigated regime

Year	No. of days	Ri	P	M	Rf	Consumption	
						Total	Daily
1987	157	2415	2350	4000	2262	6503	41,4
1988	181	2700	1826	4500	2254	6772	37,4
1989	182	2459	3459	2500	1793	6625	36,4
1990	180	2322	2002	4000	1956	6368	35,4
1991	179	2541	3878	2000	2369	6050	33,8
1992	179	2566	1605	4000	2517	5654	31,6
1993	167	2520	1239	4500	2033	5926	35,5
1994	183	2435	3544	2500	2263	6216	34,0
1995	183	2530	3477	1500	2107	5400	29,5
1996	183	2591	2998	2500	1836	6253	34,2
1997	183	2626	3950	1500	1717	6359	34,7
1998	183	2557	3895	2000	1999	6453	35,3
1999	183	2574	4957	1000	1903	6628	36,2
2000	183	2568	2150	3500	2113	6105	33,4
2001	183	2380	4015	2000	2167	6228	34,0
Average	179	2543	2799	2806	2049	6199	34,6

Table 2

Soil water balance (m^3/ha) at alfalfa crop on 1 m soil depth in rain fed conditions

Year	No. of days	Ri	P	M	Rf	Consumption	
						Total	Daily
1987	157	2600	2350	Crop was compromised			
1988	181	2695	1826	Crop was compromised			
1989	182	2450	3459		1731	4178	23,0
1990	121	2322	2002		1756	2568	21,2
1991	179	2540	3878		1526	4892	27,3
1992	179	2561	1605		818	3348	18,7
1993	122	2520	1239		1144	2615	21,4
1994	183	2440	3544		1790	4194	22,9
1995	183	2525	3477		1398	4604	25,2
1996	183	2590	2998		851	4737	25,9
1997	183	2622	3950		1471	5101	27,9
1998	183	2555	3895		1292	5158	28,2
1999	183	2569	4957		1846	5680	31,0
2000	183	2670	2150		1117	3703	20,2
2001	183	2355	4015		1637	4733	25,9
Average	173	2516	2799		1409	4196	24,2

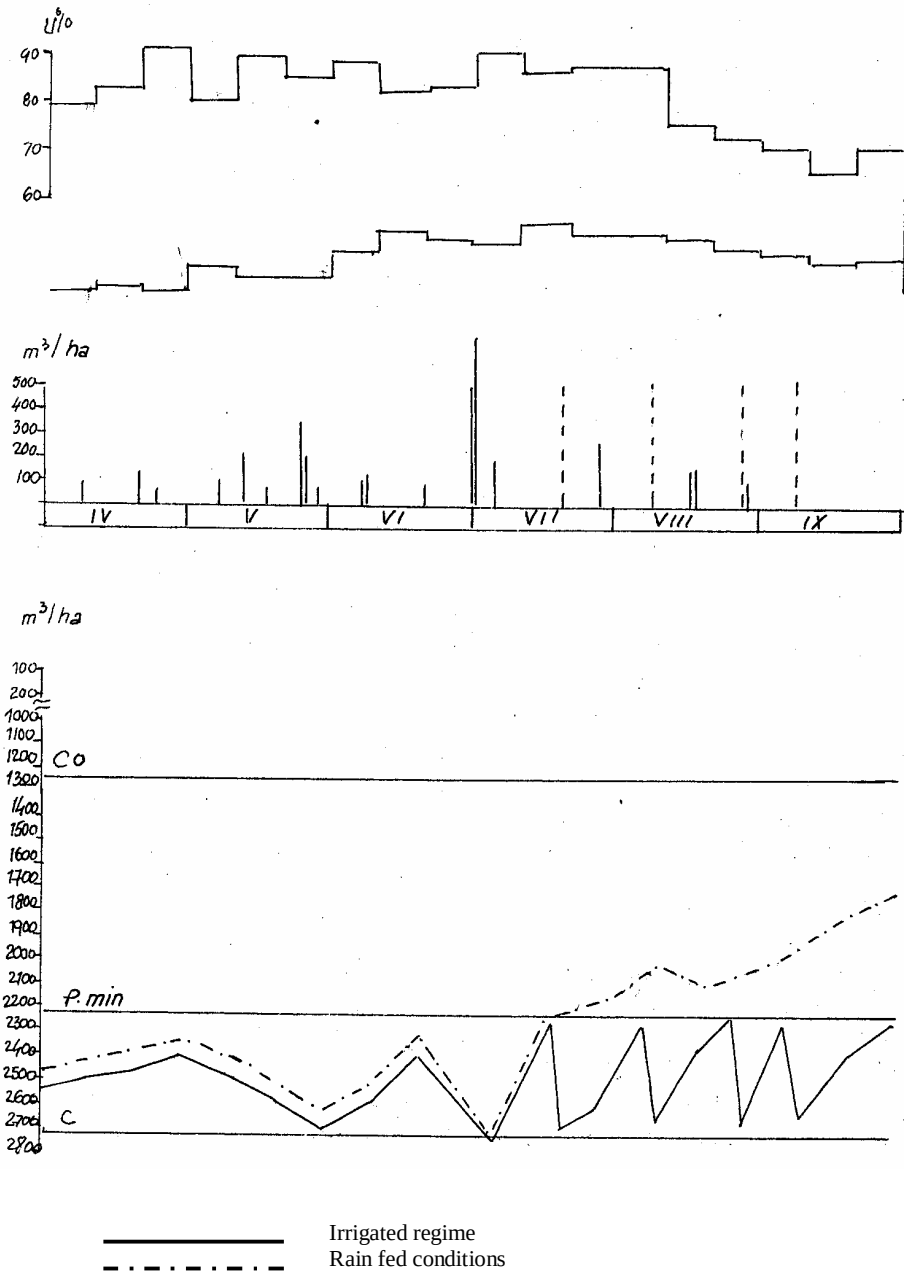

Figure 1. Soil moisture dynamics on 0, 75 m depth at alfalfa crop in 1991

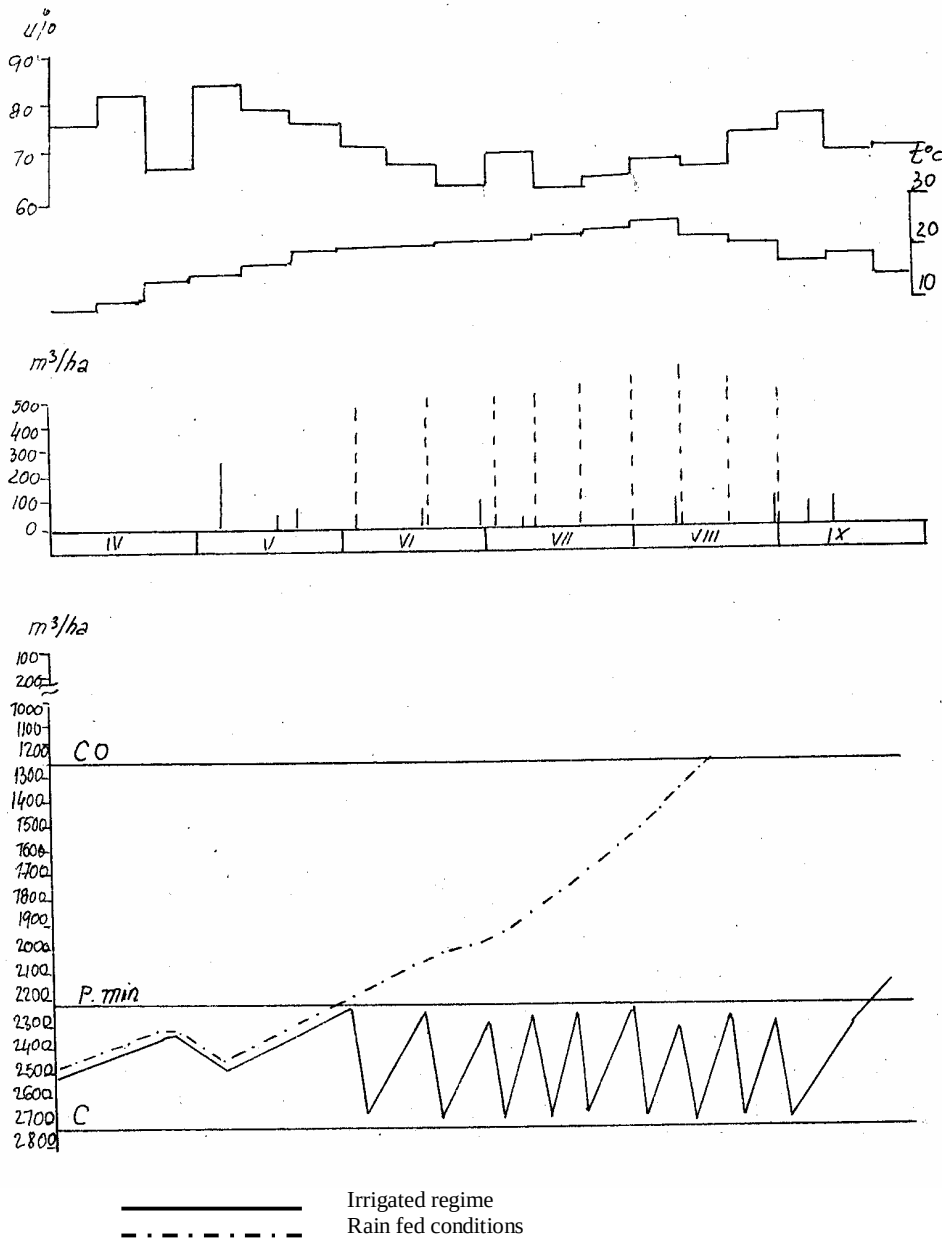

Figure 2. Soil moisture dynamics on 0, 75 m depth at alfalfa crop in 1993

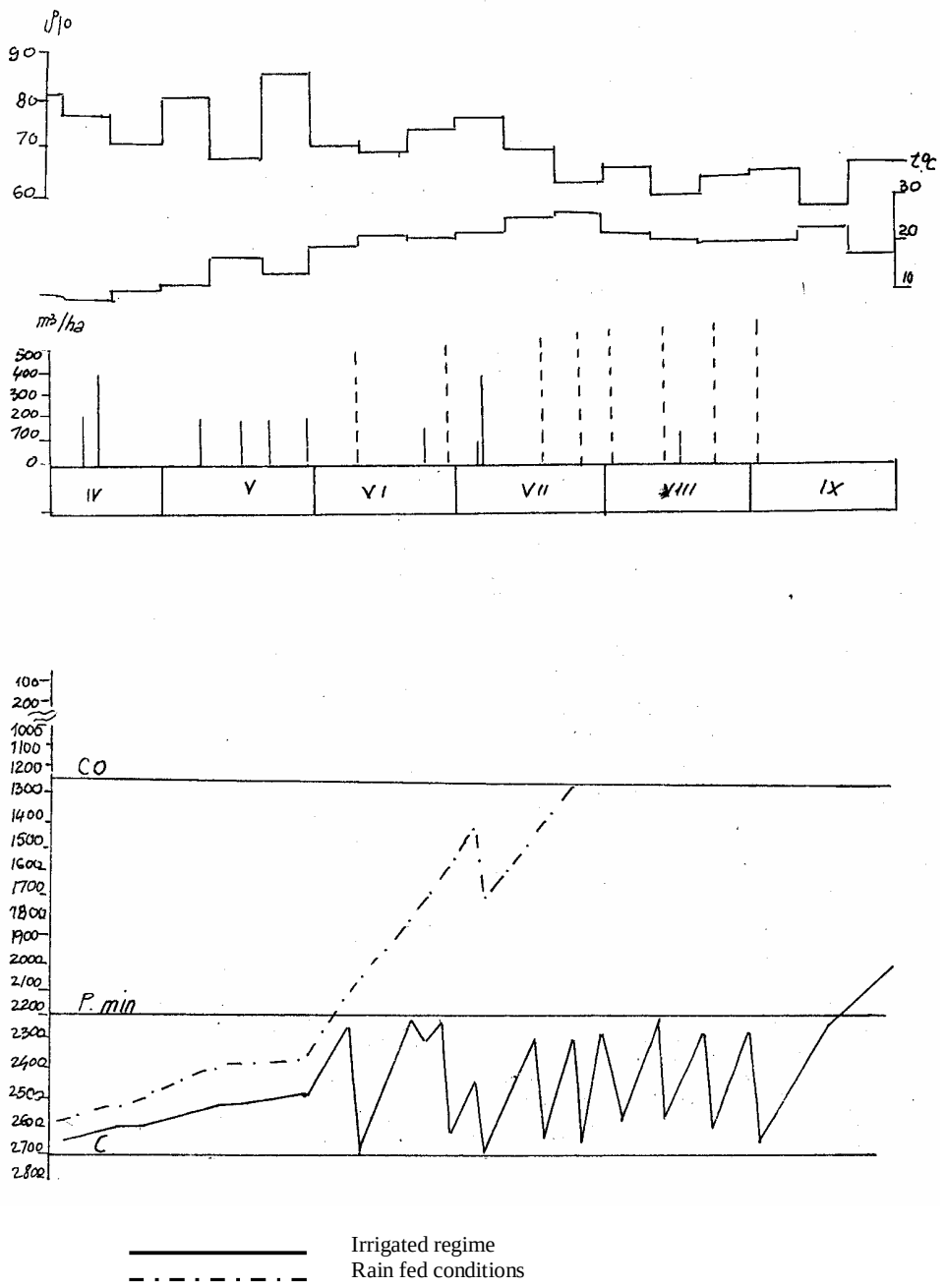

Figure 3. Soil moisture dynamics on 0, 75 m depth at alfalfa crop in 1987

There were applied between 2 and 9 irrigations, with an average of 2.806 m^3/ha. In 6 years, the irrigation rate (M) was over 3.000 m^3/ha, and in rain fed conditions, in 1987 and 1988, due to low moisture and rainfall rates, alfalfa crop wasn't established at all.

The final soil moisture content (Rf) determined and related to the permanent wilting point (CO = 1.240 m^3/ha) and minimum accepted moisture level (Pmin = 2.220 m^3/ha) was in average 2.049 m^3/ha, inferior with 171 m^3/ha to minimum accepted moisture level and superior with 809 m^3/ha to the wilting point.

In rain fed conditions, the soil moisture at the end of the vegetation period was lower than the minimum level with 825 m^3/ha and slightly superior to the wilting point.

The water consumption of the plants was determined monthly and for the whole vegetation period. Its average value was 6.199 m^3/ha, with annual variations between 6.772 m^3/ha in 1988 and 5.400 m^3/ha in 1995.

In rain fed conditions, from table 2 we observe that the average value of the water consumption was 4.196 m^3/ha, inferior with 2.003 m^3/ha to the consumption in irrigated regime. Lowest water consumption was registered in 1990 – 2.568 m^3/ha and the highest in 1999 – 5.680 m^3/ha.

Regarding the soil moisture dynamics, there were years when there were applied 8 – 9 irrigations in 1987 and 1993 and 4 irrigations in 1991. In figures 1 and 2 there are presented the results regarding the soil moisture dynamics in two representative years – 1993 and 1991.

In rain fed conditions, the soil moisture (figure 3) was lower than the minimum accepted level starting with the end of the month of May in 1987 and 1993 and the second decade of the month of July in 1991 – due to rainfalls that occurred at the end of the month of June that year.

It can be anticipated that in the dry years, soil moisture will reach the minimum acceptable level earlier with obvious yield differences and even crop's total destruction.

CONCLUSIONS

Experimental research showed the following:

- the average water consumption of the alfalfa crop for a period of 16 years was 6.199 m^3/ha, with annual variations between 6.772 m^3/ha in 1988 and 5.400 m^3/ha in 1995 for the irrigated crop;

- the average water consumption of the alfalfa crop for a period of 16 years was 4.196 m^3/ha in rain fed conditions with variations between 5.680 m^3/ha in 1999 and 2.568 m^3/ha in 1990;

- the average daily water consumption of the alfalfa crop was 34, 6 m^3/ha for the irrigated crop and 24, 2 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 and even crop's total destruction.

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