IRRIGATION AN IMPORTANT COMPONENT OF THE ALFALFA TECHNOLOGY IN CRISURILOR PLAIN

Domuța Cristian*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea; Romania, e-mail: cristian_domuta@yahoo.com

Abstract

The researches were carried out in the field of soil water balance from Agricultural Research and Development Station Oradea, leading soil moisture regime between easily available water content and field capacity on the depth 0-75 cm at alfalfa I and 0-100 cm at alfalfa second year. Irrigation determined the increase of quantity of water in the soil, improving its accessibility for plants and reduces aeration porosity, realizing a water/air regime more favorable for crop. Optimal water supply of alfalfa crop determined the increase of the total water consumption by 43.0% at alfalfa I year and 54.0% alfalfa II year, in its coverage irrigation with a share of 38.1% (interval of variation 9.1 = 64.7%) in alfalfa first year and a share of 39.2% (variation interval about 14.3 to 61.2%) in alfalfa second year. Irrigation determined the improve of yield stability, value of standard deviation decreasing in comparison with the unirrigated alfalfa crop with 11.4% Ist year and 14.7% II nd year.

Key words*:* irrigation, alfalfa, water consumption, yield, easily available water content

INTRODUCTION

A sustainable culture technology should ensure obtaining high yields, stable, good quality in terms of environmental protection. (Budoi, Penescu, 1996, Domuța, 2012, Guș, 1998, Lăzureanu, 1993, Jitereanu, 1995, Ștefanic, Săndoi, 1993, Toncea, Alecu, 1999)

Alfalfa crop is characterized by a high resistance to drought thanks to properties to obtain water from deeper soil layers. The roots have a strong force of water absorption and prolonged droughts in the plant slow down growth and water consumption is reduced. In the first year of alfalfa roots are weak and, therefore, the necessity for water needs to have higher soil moisture in the surface layers. Alfalfa crop does not support high soil temperatures; sometimes they cause even plant death. Although it is very resistant to drought, alfalfa only gives high yields in regions where annual rainfall quantity is higher than 500 mm and rainfall evenly distributed. In regions with less precipitation alfalfa gives high yields only on low relief forms, in meadows, or under irrigation. Alfalfa not supports moisture excess; sown on land too wet and in regions where rainfall exceeding 1000 mm per year does not lead to good results (Domuța, 2003, 2005, 2009).

MATERIAL AND METHOD

In 1969 the Research Institute of Irrigation and Drainage Baneasa-Giurgiu within the research program "Exploitation of the irrigation and drainage works" effectuated long trial experiments called fields of soil water balance. The experiments were designed by Grumeza and were located in all areas of interest for irrigation in Romania. Variants studied:

V1 – Unirrigated

V2 – Irigated with maintaining of soil water reserve between easily available content and field capacity on irrigation depth. Irrigation depth is specific for every area and crop (Grumeza et al., 1989). For this purpose, soil samples were taken from 10 to 10 days. Fields of soil water balance had a number of 8-10 crops depending on the suitability of area. (Domuta 1993, 1997, 2000, 2012, 2014)

Next to the field of soil water balance placed a station for irrigation schedule feature with Bac evaporimetre class A and meteorological equipment. Results regarding to daily water consumption of the plants obtained in field soil water balance and daily Bac evaporation allowed to establish crop coefficient "Kc" used in irrigation scheduling.

The soil from research field is a luvosol with the following profile: Ap = 0-24 cm, El = 24-34 cm; BT_1 = 34-54 cm; Bt_2 = 54-78 cm; Bt/c = 78-95 cm, C = 95-145 cm. It is noted that migration of colloidal clay causes the apparition of horizon El with 31.6% colloidal clay and two horizons of colloidal clay accumulation with Bt_1 and Bt_2 with 39.8% and 39.3% colloidal clay. (Colobas, 2000)

Easily available water content (Wea) was established in function of texture: Wea = WP + 2/3 (FC – WP).

A drill is the water source for irrigation and their quality for irrigation is very good: pH = 7.2; Na^+ = 12.9%; mineral residue = 0.5 g/l; CSR = -1.7; SAR = 0.52.

Both in alfalfa I^{st} year and alfalfa II^{nd} year the soil moisture of 0 – 75 cm depth was determined ten to ten days. In the variant without irrigation suspending the moment of the irrigation use was when the soil water reserve on 0 – 75 cm depth decreased to easily available water content in alfalfa 1^{st} year and on 0-100 cm in alfalfa II^{nd} year.

In alfalfa seed requires moderate moisture during strains growing and higher humidity during fruiting. This moisture is ensured, usually by irrigation during flowering. Irrigation during the flowering plants is not indicated because lay down the plants and prevents a certain extent pollinating flowers. At the plants with good supply of water, the color of

leaves is pale green and at plants insufficiently supplied with water color of leaves are dark green. (Domuta, 2010)

The water consumption of alfalfa (and other crops) was determined by soil water balance, depth balance is 0-150. (Grumeza et al., 1989, Grumeza, Kleps, 2005)

Yields results were obtained in accordance with the rigors of experimental technique.(Săulescu, 1967)

RESULTS AND DISCUSSION

In the field of soil water balance from Oradea, leading soil moisture regime between easily available water content and field capacity on irrigation depth at alfalfa first year on depth of 0-75 cm and 0-100 cm at alfalfa second year, in the period 1976-2014 was obtained following irrigation regime (Table 1).

Table1

Variation interval of irrigation regime at alfalfa I year and II year, Oradea 1976-2014

Variation	Irigation ratio (m^3/ha)		Number of applications	
	Alfalfa I year	Alfalfa II year	Alfalfa I year	Alfalfa II year
Minimum value	1000	1200	1	1
Maximum value	4680	5760	10	10
Average value	2595	3050	6	7

Schemes application in the field of research of water balance in the soil from Oradea during 1976-2014 have the following configurations:

	IV	V	VI	VII	VIII	IX
Alfalfa I year	0	½	1	2	2	½
Alfalfa II year	½	1	1	2	2	½

Influence of irrigation on water from soil

Irrigation increases the quantity of water available in the soil, improving its accessibility for plants and reduces aeration porosity, making regime water / air more favorable for crop (Figure 1).

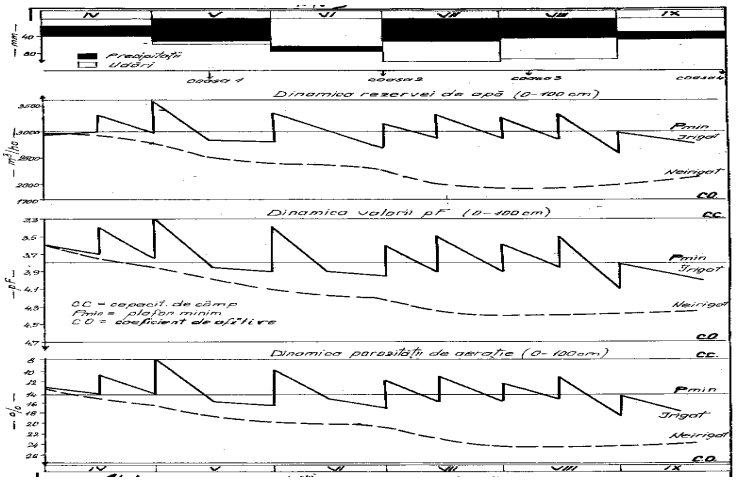

Fig. 1. The influence of irrigation on the water supply, its accessibility and aeration porosity on irrigation depth at alfalfa second year, Oradea 1988 - 2014

The influence of irrigation on water consumption of alfalfa crop

Daily water consumption of alfalfa crop is improve after using irrigation. In terms of Oradea it reached to a value nearly double than variant irrigated in August; in this month registered and the higher absolute difference compared to unirrigated alfalfa second year and in July at alfalfa first year (table 2.).

In the alfalfa 1st year the biggest values of the daily water consumption were registered in July, 33.4 m^3/ha/zi in unirrigated variant. In irrigated variant, the biggest value were registered in the same month, 34.1 m^3/ha/zi in unirrigated variant and 55.3 m^3/ha/zi in irrigated variant. (table 2.).

Table 2.

Irrigation influence on daily water consumption at alfalfa crop, Oradea, 1976-2014

Variant	Specification	IV	V	VI	VII	VIII	IX
ALFALFA I[st] year							
Unirrigated	Average	18.7	28.2	32.5	33.4	25.2	20.5
	Int. of variation	6-33	17-45	18-63	14-44	3-44	8-31
Irrigated	Average	20.7	32.8	47.1	53.6	41.2	31.1
	Int. of variation	7-34	18-42	27-69	36-79	27-64	18-56
ALFALFA II[nd] year							
Unirrigated	Average	28.2	32.6	31.9	34.1	25.6	21.8
	Int. of variation	14-36	17-49	15-47	13-51	4-46	3-45
Irrigated	Average	30.3	40.2	47.2	55.3	50.0	32.1
	Int. of variation	15-36	26-62	28-66	38-83	37-71	21-52

Optimal water supply of alfalfa crop determined the increase of the total water consumption by 43.0% at alfalfa I year and 54.0% alfalfa II year, in its coverage irrigation with a share of 38.1% (interval of variation 9.1 = 64.7%) in alfalfa first year and a share of 39.2% (variation interval about 14.3 to 61.2%) in alfalfa second year (table 3).

Table 3.

Total water consumption at alfalfa crop and source of covering in the condition from Oradea 1976-2014

Variant	Total water consumption			Source of covering					
					P		$\sum_m$		
	m^3/ha	%	Interval of variation %	Ri-Rf m^3/ha	m^3/ ha	%	m^3/ha	%	Interval of variation %
ALFALFA Ist year									
Unirrigated	4765	100	100	1149	3616	-	-	-	-
Irrigated	6809	143	-	598	3616	-	2593	38,1	9,1-64,7
ALFALFA IInd year									
Unirrigated	5137	100	100	1314	3823	-	-	-	-
Irrigated	7930	154	-	992	3823	-	3113	39,2	14,3-61,2

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

P = precipitations in the vegetation season;

Σm = irrigation rate

Between water consumption and yield of alfalfa exist a direct link with different mathematical expressions depending on the pedoclimatic conditions (Grumeza et al., 1989). This correlation highlights the opportunity of irrigation, which is the main agrotechnic measure that can determine significantly increasing water consumption of alfalfa crop, as in fact and other crops in the conditions from Oradea were highlighted such highly significant statistics correlations (Domuta, 2003).

Influence of irrigation on yields at alfalfa crop

In the condition of application of optimal irrigation with maintaining of the soil water reserve between easily available water content and field capability in the alfalfa first year, the average of green mass during 1976-2014 was 68844 kg/ha, with 25171 kg/ha (57.6 more than in unirrigated conditions, interval of variation of relative differences being between 13 and 304%. In alfalfa IInd year, the average for the mentioned period, 97889 kg / ha, it was higher in comparison with unirrigated conditions with 51.9% (33441 kg / ha), interval of variation of the relative differences being between 19-195% (table 4).

Table 4.

Influence of irrigation on level and stability of the yield at alfalfa crop, Oradea 1976-2014

Variant	Average yield		Interval of variation		Standard deviation	
	kg/ha	%	kg/ha	%	kg/ha	%
ALFALFA Ist year						
Unirrigated	43673	100	18500-89800	100	37950	100
Irrigated	68844	157,6	30500-120850	113-404	33630	88,6
ALFALFA IInd year						
Unirrigated	64448	100	29500-118590	100	30160	100
Irrigated	97889	151,9	57000-145240	119-295	25720	85,3
LSD 5% 720; LSD 1% 1260; LSD 0,1% 1960						

Irrigation determined the improve of yield stability, value of standard deviation decreasing in comparrison with the unirrigated alfalfa crop with 11.4% in alfalfa Ist year and 14.7% in the alfalfa II nd year.

The green mass obtained under irrigation conditions decreases the percentage of dry substance, instead by increasing of yield gain increases the quantity of dry substance per hectare. Therefore, irrigated alfalfa crop presents more difficulty in the process of hay drying.

CONCLUSIONS

Research efectuated during 1976-2014 in the field of soil water balance on the preluvosoil at Agricultural Research and Development Station Oradea determined the following conclusions:

- In alfalfa Ist years to maintain water reserve between easily available water content and field capacity on the 0-75 cm depth using was need an irrigation rate of 2595 m^3/ha, variation interval 500-4680 m^3/ha. At alfalfa IInd year irrigation rate had an average of 3050 m^3/ha, variation interval 1200-5760 m^3/ha;
- Irrigation increases the quantity of water available in the soil, improving its accessibility for plants and reduces aeration porosity, making regime water / air more favorable for alfalfa crop;
- Daily water consumption of alfalfa crop is improve after using irrigation. In terms of Oradea it reached to a value nearly double than variant irrigated in August. In this month registered and the higher absolute difference compared to unirrigated alfalfa second year and in July at alfalfa first year;

- Optimal water supply of alfalfa crop determined the increase of the total water consumption by 43.0% in alfalfa I year and 54.0% in alfalfa II year. Irrigation participation were of 38.1% (interval of variation 9.1 = 64.7%) in alfalfa first year and of 39.2% (variation interval about 14.3 to 61.2%) in alfalfa second year

- In the condition of application of optimal irrigation with maintaining of water reserve between easily available water content and the field capacity in alfalfa first year, the average of green mass during 1976-2014 was of 68844 kg / ha, with 25171 kg/ha (57.6 more than in unirrigated conditions, interval of variation of relative differences being between 13 and 304%. At alfalfa IInd year, the average for the mentioned period, 97889 kg / ha, it was higher compared with unirrigated conditions with 51.9% (33441 kg / ha), interval of variation of the relative differences being between 19-195%

Irrigation determined the improve of yield stability, value of standard deviation decreasing against the unirrigated alfalfa crop with 11.4% Ist year and 14.7% II nd year.

The research sustain the need of the irrigation in alfalfa from Crisurilor Plain.

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