MAIZE AND WHEAT RESPONSE TO DIFFERENT IRRIGATION LEVELS

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ABSTRACT

By applying different levels of irrigation in different vegetation periods, the yield losses and water consumption were significantly reduced. The purpose of this paper was to study the effects of different levels of water applications and to establish the adequate treatments of maize and wheat crops. Four maize and four wheat cultivars were used in this investigation. The highest corn yield was obtained in the A8 treatment: spring irrigation + irrigation 50% IUA (37 mm in the growth stage and 74 mm in the rest of vegetation). The highest wheat yield was obtained with the same treatment, which proved to be the best in dry years.

Key words: irrigation, water use efficiency (WUE).

INTRODUCTION

Irrigation aims to ensure water to plants for preventing water stress which may cause important yield losses (Haise and Hagan, 1967; Taylor, 1965). Stockle and James (1989), recommended to apply less water when its price increases, the maize yields and returns being higher in this case. Howell et al., 1995, found a good relationship between maize yield and water use efficiency (WUE).

At Fundulea Craciun and Craciun, (1994) established that maize water stress determined evapotranspiration decrease up to 40%, yield reduction up to 92% and a WUE variation between 24.5 and 3.1 kg/mm. Mishra et al. (1995) found the highest WUE of irrigated wheat at root initiation, maximum tillering and milky stages.

Abo-Shetaia and El-Gawad (1995) reported a wheat yield reduction with 37.7% and 29.1%, when the water stress occured in growth and earing stages and a Wue increase when water stress occured in the grain filling stages.

MATERIALS AND METHODS

Wheat and maize experiences were conducted on a cambic chernozem soil at Fundulea, during 1984-1995 period, with different levels of irrigation (Table 1).

The available water content to a depth of 120 cm was measured using the gravimetric method.

The following cultivars were used: maize hybrids Fundulea 420; Fundulea 320, Fundulea 365, Danubiu and wheat varieties Flamura 80, Flamura 85, Fundulea 4, Fundulea 133.

Table 1. Maize and wheat irrigation treatments in 1984-1995 period

Treatments
A_1= Dryland
A_2= Spring irrigation (30 mm)
A_3= Irrigated 50% IUA (74 mm)
A_4= Spring irr. (30mm)+Irr. 50% IUA (74 mm)
A_5= Spring irr. (30mm)+Irr. 50% IUA (37 mm)
A_6= Spring irr. (30mm)+Irr. 70% IUA (44 mm)
A_7= Supply irr. + Irr. 50% IUA (74 mm)
A_8= Spring irr+Irr 50% IUA (37mm in growth stage and 74 mm in the rest of vegetation)
A_9= Spring irr.+Irr 50 %IUA (74mm in growth stage and 37 mm in the rest of vegetation)

RESULTS AND DISCUSSIONS

The rainfalls during the period 1984 – 1995 were under the multiannual average of Fundulea with 56.4 mm, although 825 mm were registered in 1991. The droughtest years were 1985 and 1990 (Figure 1).

In maize vegetation period (April - September), precipitations were under the mean in 7 of 12 years. The worst year for maize production proved to be 1990 when the plants suffered due to water stress in the maximum water consumption period from tasseling to pollination.

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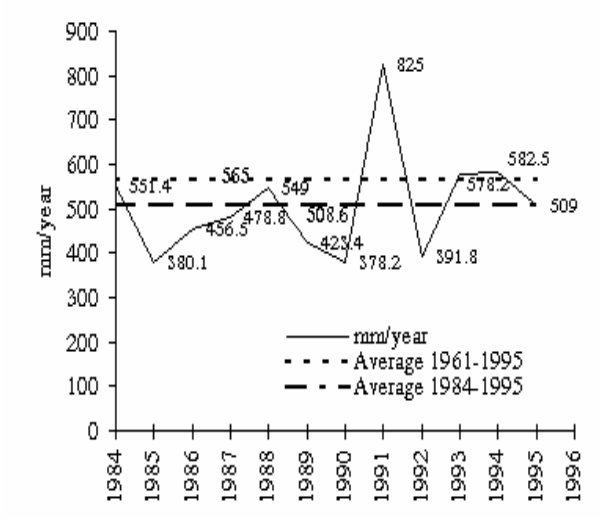

Figure 1. Annual precipitation data Fundulea, 1984-1995

In that period, an accentuated sterility was evident, due to the phenomenon of protandry (Figure 2).

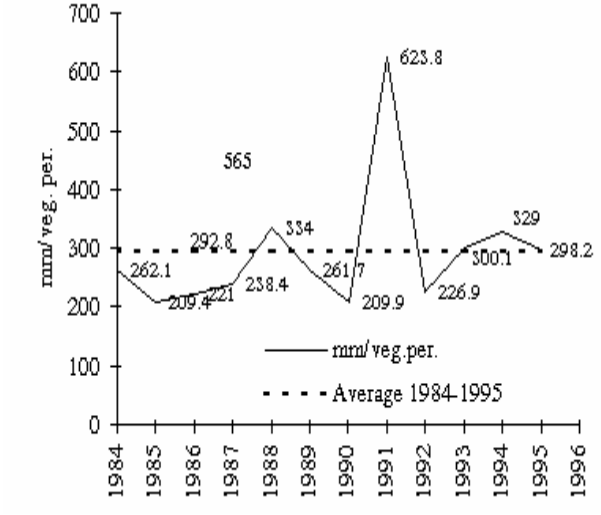

Figure 2. Precipitation data in maize vegetation period Fundulea, 1984-1995

In wheat vegetation period (October-June), 7 years were under the period average and 4 years over this average. The most year for wheat proved to be 1985 (Figure 3).

The results of the twelve experimental years pointed out that irrigation with half water amount in growth stage and with the whole amount in the rest of vegetation (treatment 8) resulted in the highest maize yield of 12957 kg/ha (Table 2).

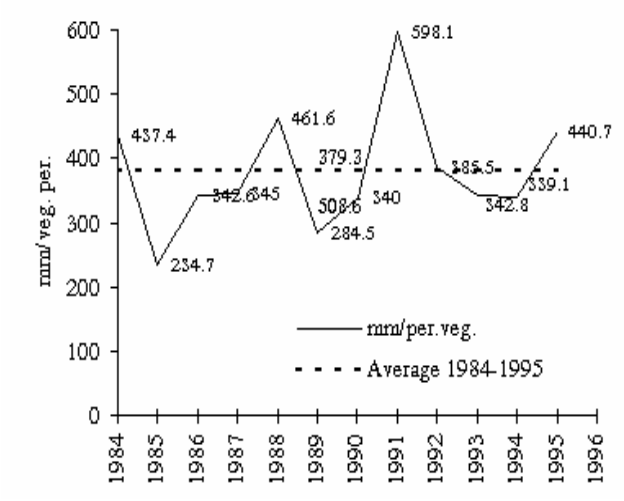

Figure 3. Precipitation data in wheat vegetation period Fundulea, 1984-1995

Table 2. Maize water use efficiency response to different treatments, Fundulea, 1984-1995

Variant	Yield kg/ha	Amount mm	Returns kg/ha	WUE kg/mm
A_1	7252	0	-	-
A_2	8942	39.5	2001	50.6
A_3	11789	165	4847	27.2
A_4	12639	171	5201	31.8
A_5	12029	116	5087	51.5
A_6	12543	140	5601	43.9
A_7	12853	173	5912	32.8
A_8	12957	150	6016	41.3
A_9	11875	144	4933	33.9

DL 5% = 1209.6; DL 1% = 1654.3; DL 0.1% = 2243.1

The highest Wue value of 51.5 kg/mm, was obtained by irrigation with half amount in the whole vegetative period (treatment 5). In the dry year 1990, when the hybrid Fundulea 420 was cultivated, the control dryland treatment registered only 414 kg/ha, while the irrigation treatment A_4 produced the highest yield of 8794 kg/ha (Table 3).

Table 3. Maize water use efficiency response to different treatments in dry year. Fundulea, 1990

Variant	Yield kg/ha	Amount mm	Returns kg/ha	WUE kg/mm
A_1	414	0	-	-
A_2	1144	30	730	24.3
A_3	8133	148	7719	52.1
A_4	8794	148	8380	56.6
A_5	6787	74	6373	86.1
A_6	8575	176	8161	46.4
A_7	8212	148	7798	52.7
A_8	7053	111	6639	59.8
A_9	6450	111	6036	54.4

DL 5% = 1292; DL 1% = 1757; DL 0.1% = 2353

Concerning wheat crop, the maximum yield was obtained in A8 treatment, with yield returns of 2020 kg/ha. The spring irrigation (A_2) was efficient, bringing an yield increase of about 1000 kg/ha. The highest WUE value was 22.6 kg/mm, registered in A_5 treatment (Table 4).

Table 4. Wheat water use efficiency response to different treatments. Fundulea, 1984-1995

Variant	Yield kg/ha	Amount mm	Returns kg/ha	WUE kg/mm
A_1	3953	0	-	-
A_2	4932	34.7	979	28.2
A_3	5807	131.6	1854	14.1
A_4	5865	141.5	1932	13.6
A_5	5899	86	1946	22.6
A_6	5893	121.6	1940	15.9
A_7	5767	138	1814	13.1
A_8	5973	118.8	2020	17.0
A_9	5722	111.3	1769	16.0

DL 5% = 527.2; DL 1% = 968.0; DL 0.1% = 975.0

In the dry year 1985, wheat yield in dryland treatment (A_1) was only 1849 kg/ha.

The highest yield of 7808 kg/ha was obtained in A8 treatment (Table 5).

Table 5. Wheat water use efficiency response to different treatments in dry year. Fundulea, 1988

Variant	Yield kg/ha	Amount mm	Returns kg/ha	WUE kg/mm
A_1	1849	0	-	-
A_2	4162	74	2313	31.3
A_3	6360	206	4511	21.9
A_4	6009	185	4160	22.5
A_5	5800	148	3951	26.7
A_6	6870	185	5021	27.1
A_7	6661	155	4812	31.0
A_8	7808	276	5959	21.6
A_9	6185	185	4336	23.4

DL 5% = 467.8; DL 1% = 635.8; DL 0.1% = 851.5

The spring irrigation (A_2) registered a very good WUE (31.3 kg/mm). The yield returns obtained by irrigation were very significant in all treatments.

The maize WUE coefficients (l/kg grain) were almost 400 l/kg in irrigated treatments A_3 and A_6, compared to dryland treatment of 535 l/kg grain (Table 6).

Table 6. Maize water use efficiency coefficients in different treatments. Fundulea, 1984-1995

Variant	Yield kg/ha	Consumption mm	WUE coeff. l/kg grain
A_1	7252	387.8	535
A_3	12639	495.2	392
A_6	12543	487.9	389
1990			
A_1	414	555.7	13423
A_3	8794	625.7	711
A_6	8575	620.3	723

In the dry year 1990, the maize WUE coefficients rose over 700 l/kg grains in irrigated treatments A_3 and A_6 and exceeded 13000 l/kg grain under dryland conditions.

The wheat WUE coefficients exceeded 800 l/kg under irrigated conditions and reached on an average of 12 years 1019 l/kg in dryland treatment (A_1) and 1929 l/kg in the dry year 1985 (Table 7).

Table 7. Wheat water use efficiency coefficients in different treatments, Fundulea 1984-1995

Variant	Yield kg/ha	Consumption mm	WUE coeff. l/kg grain
A_1	3953	402.7	1019
A_3	5863	511.4	872
A_6	5893	503.5	854
1985			
A_1	1849	356.7	1929
A_3	6009	497.0	827
A_6	6870	497.0	723

CONCLUSSIONS

Maize irrigation brought yield returns up to 6016 kg/ha on the average of 12 years, with WUE ranging from 27.2 to 51.5 kg/mm. In dry years, such as 1990, the maximum maize yield return was 8380 kg/ha, with a WUE of 56.6 kg/mm.

Wheat irrigation brought average yield returns of 2020 kg/ha, with a WUE of 22.6 kg/mm.

In dry years such as 1985, the maximum wheat yield return reached 5959 kg/ha in the treatment with half water amount in the growth stage and whole amount in the rest of vegetation period.

Maize WUE coefficients ranged from 389-392 l/kg grains under irrigated conditions, while at wheat ranged from 854 to 872 l/kg grains. The highest values of WUE coefficients were registered in dryland treatments.

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