EVAPOTRANSPIRATION OF LONG-DAY ONION, IRRIGATED BY MICROSPRINKLERS

ЕВАПОТРАНСПИРАЦИЯ НА ЛУК НА ДЪЛГИЯ ДЕН, НАПОЯВАН ЧРЕЗ МИКРОДЪЖДУВАНЕ

MERANZOVA R., BABRIKOV T.

РЕЗЮМЕ

Представени са изследванията, направени върху поливния режим и евапотранспирацията на лук на дългия ден, сорт Santana, отглеждан чрез директна сеитба. Полските експерименти са проведени през периода 1996-97 год., при климатичните условия на гр. Пловдив, при алувиално-ливаден тип почва. Напояването е извършено чрез система за микродъждуване при поддържане на влажност 80-100% от тази при ППВ за оптималния вариант и два варианта с редуциране на поливните норми, съответно 75 и 50 %.

Определени са големините на напоителните норми, ходът на реалната евапотранспирация, нейната продуктивност и връзката относителен добив-относителна евапотранспирация. Прилагането на система за микродъждуване за напояване на лук, отглеждан чрез директна сеитба е предотвратило образуването на почвена кора и е улеснило поникването на семената.

ABSTRACT

Investigations were made on the seasonal water requirements of annual onion cv. Santana grown under optimal schedule of irrigation and water stress. Three variants with different irrigation rates (1.00 IR, 0.75 IR and 0.50 IR) were studied. A system for microsprinkler irrigation was used, the time of irrigation being determined by estimating soil moisture. The first irrigation was done after sowing and the last - at the lodging of onion leaves.

The actual evapotranspiration for the three irrigated variants was established. Its total value in the optimal variant over the irrigation season was 337,84 mm. The evapotranspiration productivity varied in the range of 8,58 - 14,55 kg/mm. The „relative yield - relative evapotranspiration" relationship was determined.

KEY WORDS: evapotranspiration, long-day onion, sprinkler irrigation

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DETAILED ABSTRACT

The objective of the investigation was to establish the watering regime and the fitness of the microsprinkler irrigation system in several long-day onion cultivars. Cultivar Santana, possessing very good adaptive and productive characters, was used for the study.

A field experiment was conducted with a long-day onion cv. SANTANA during the years 1996-97 in the region of Plovdiv. The experiment was set up in four variants with three replications per variant. The variants differed by the irrigation rates - 1.0 IR, 0.75 IR, 0,50 and 0,0 IR.

The number of irrigation rates applied was 9 during the first experimental year and 8 during the second. The quantity of average total water supplied for optimal variant was 213 mm, 162 and 110 mm consequently for the two variants with reduced irrigation rates.

The total evapotranspiration for the whole vegetation period of the first variant (1,0 IR) is 337,84 mm, and the daily mean value - 2,832 mm. By ten-day periods, the average 24-h evapotranspiration varies from 0,53 to 5,4 mm, the highest values being registered on the first ten days of July. For the studied period, evapotranspiration productivity varies in the range of 8,58 to 14,55 kg/mm. The relationship between relative evapotranspiration and relative yield was established.

The use of a microsprinkler system for irrigation of annual onion prevents the formation of soil crust and facilitates the emergence of seeds.

INTRODUCTION

The new trend in onion production on a European scale is the implanting of annual cultivars with a view to shorten the period of vegetation and intensify the market supply of onions. For the Bulgarian climatic conditions - low precipitation and extreme temperatures during the period of vegetation, irrigation is the main prerequisite for the growing of annual onion cultivars (4). The relationships established even though for the conditions of the experiment can be used to optimize the irrigation schedule and forecast the yield particularly under conditions of water stress (1, 3). The objective of the investigation was to establish the watering regime and the fitness of the microsprinkler irrigation system in several long-day onion cultivars. Cultivar Santana, possessing very good adaptive and productive characters, was used for the study.

MATERIAL AND METHODS

A field experiment was conducted with a long-day onion cv. SANTANA during the period 1996-97 in the region of Plovdiv. The experiment was set up in four variants with three replications per variant. The variants differed by the irrigation rates - 1.0 IR, 0.75 IR, 0,50 and 0,0 IR.

The experimental plots were irrigated with RONDO XL microsprinklers, produce of PLASTRO Co, Israel. The reason of using microsprinkler irrigation installation was to prevent a soil crust formation and help the germination and emergence of seeds.

The soil of the experiment is alluvial-meadow solonetz light. According to its mechanical composition it is clayey with almost neutral reaction, bulk density of 1.2 t/m^3 and moisture at FC - 30%. The change in the soil moisture was followed with soil moisture samples method and irrigation was applied when water moisture dropped to 80% of the FC. The irrigation rates were calculated for an active soil layer H = 0,30 m. Irrigation was stopped by the beginning of leaf lodging. To determine the real evapotranspiration, the balance method, considered sufficiently precise, was used.

DISCUSSION

The first year of the field experiment was considered moderate in terms of precipitation amount (40% security), but the precipitation distribution by months was very irregular - from an extremely dry July - with no rainfalls, to a very moist May with 5% security of appearance and medium dry April and August. The second (1997) year was characterized medium humid with 23% security of appearance, but the rainfalls were relatively regular distributed by months excepting very humid August (1% sec. of appearance).

The number of irrigation rates applied, the amounts of the total irrigation rates in the irrigated variants are given in Table 1. The quantity of water supplied during the irrigation period for the optimal variant is 213 mm, 162 and 110 mm consequently for the two variants with reduced irrigation rates.

Table 1: Number and amounts of total irrigation rates (mm)

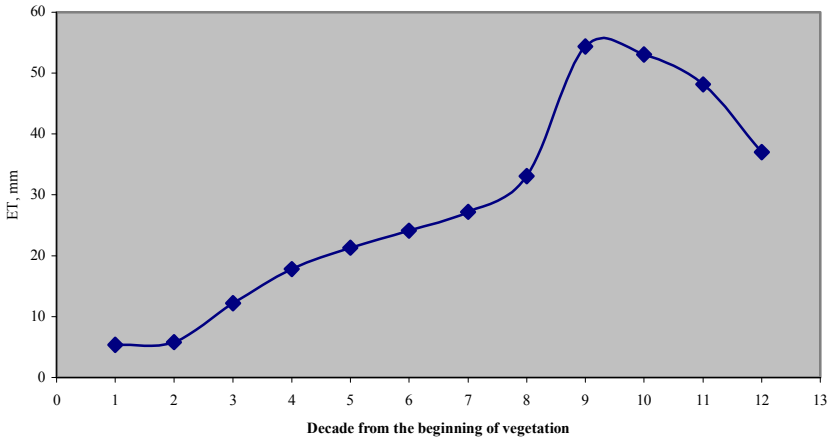
Variant	Number of IR	Mean irrigation rate IR	Total irrigation rate
		1996	
1.0 IR	9	25	225
0.75 IR	9	19	171
0.50 IR	9	13	117
		1997	
1.0 IR	8	25	200
0.75 IR	8	19	152
0.50 IR	8	13	104

The values of actual ten-day evapotranspiration for the variant with maximum irrigation rates applied are show in Table 2. The total evapotranspiration for the whole vegetation period of the first variant (1,0 IR) is 337,84 mm, and the daily mean value - 2,832 mm. By ten-day periods, the average 24-h evapotranspiration varies from 0,53 to 5,4 mm, the highest values being registered on the first ten days of July. For 1996 year the total evapotranspiration is 339,97 mm for the first variant and the daily mean value 2,725 mm. Maximum value is observed during the first decade of July. During the whole irrigation season of 1997 year the total evapotranspiration is 335,71 mm with maximum values of the last ten days of July and the first ten days of August. The change of decade value of average real evapotranspiration is shown in Figure1.

Table 2: Real evapotranspiration by decade in mm

Month	April			May			June			July			Total
Decade	I	II	III	I	II	III	I	II	III	I	II	III	
						1996							
1,00 IR	4,69	6,05	13,46	18,24	18,79	25,52	27,95	29,97	59,45	52,56	46,35	36,94	339,97
						1997							
1,00 IR	5.94	5.46	10.99	17.3	20.81	22.69	26.37	36.11	49.30	53.56	50.02	37.16	335.71
						mean							
1,00 IR	5.32	5.76	12.22	17.77	21.31	24.10	27.16	33.04	54.38	53.06	48.18	37.05	337.84

Figure1: Change of the real decade evapotranspiration



The detailed analysis on the experimental results obtained shows, that under irrigation 58,83% of the onion evapotranspiration is formed at the expense of the irrigated water applied, 38,67% at the expense of rainfalls during the period of vegetation and only 2,5% at the expense of the soil water supplies in the variant with a maximum irrigation rate.

As regards the irrigation water deficiency and the most effective use of water resources available, the results obtained for the evapotranspiration and water applied by irrigation productivity, are of a special scientific and practical interest (2,3).

For the studied period, evapotranspiration productivity varies in the range of 8,58 to 14,55 kg/mm. On the basis of the data in Table 3, the relationship and the correlation coefficient of the relative yield - relative evapotranspiration function were developed.

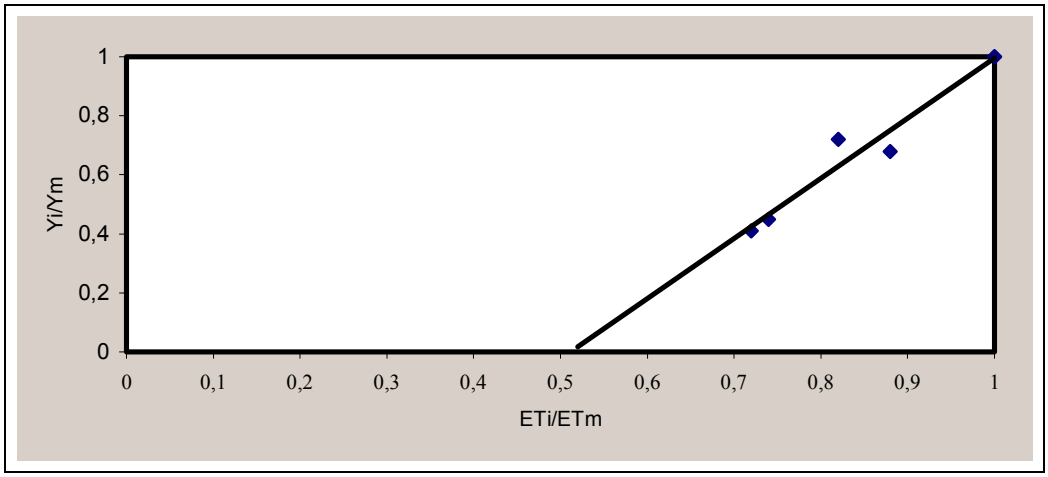
Table 3: Water Use Efficiency

M_i	ET_i	Y_i	ET_i/ET_m	Y_i/Y_m	Y_i/M_i	Y_i/ET_i
mm	mm	kg/dka			kg/mm	kg/mm
213	337.84	4917	1	1	23.08	14.55
162	290.54	3450	0.86	0.70	22.30	11.87
110	246.62	2115	0.73	0.43	19.22	8.58

$Y_i / Y_m = 2.077 \cdot (ET_i / ET_m) - 1.086$, $R^2 = 0{,}958$

where Yi, and ET_i are yield and evapotranspiration in variant i, respectively, Y_m and ET_m are maximum yield and maximum evapotranspiration, respectively.

Figure2: Relationship between relative evapotranspiration and relative yield



The slope of the line in Figure 2 shows that the yield can fall by 2,04 % at a 1% reduction in the seasonal evapotranspiration.

CONCLUSIONS

1. The use of a microsprinkler system for irrigation of annual onion prevents the formation of soil crust and facilitates the emergence of seeds.
2. The real evapotranspiration of long day onion for the condition of the experiment in a variant receiving maximum irrigation rate was 337.84 mm for the whole irrigation season, the highest values being recorded in the first ten days of July.
3. Evapotranspiration productivity varies in the range of 8,58 for the variant, received half of the maximal irrigation rate to 14,55 kg/mm for optimal variant.

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Meranzova Rossitza,
Department of Land Reclamation, Agricultural University, Plovdiv, Bulgaria,
Tel: +359 32 6126/265,
Babrikov Todor
Department of Horticulture, Agricultural University, Plovdiv, Bulgaria,
Tel: +359 32 6126/218