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COTTON IRRIGATION REGIME UNDER CONDITIONS OF REGULATED WATER DEFICIT

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Abstract

Field trial on cotton (Perla cultivar) was carried out during the 2001-2006 period on leached vertisols under irrigation regime of sprinkling – 75 % of the field moisture capacity (FMC) for the soil layer of 0-40 cm. The trial included the following variants: 1. Two irrigations of 400 mm per hectare – the first one at the bud formation stage and the second – at the blooming stage; 2. Two irrigations of 400 mm – the first one at the blooming stage and the second – at the boll formation stage; 3. Single irrigation of 500 mm at the blooming stage; 4. Single irrigation of 600 mm at the blooming – boll formations period; 5. Non-irrigated variant– standard. It was established that the best results were obtained at the variant with second time irrigation of 400 mm at the bud formation stage and at the blooming period. This irrigation provided 36.0 % (747 kg/ha) higher yield as compared to non-irrigated cotton. This irrigation regime realizes higher productivity per 1000 m^3 per hectare irrigating water producing 934 kg/ha more seed cotton than the non-irrigated variant.

Key words: *cotton, irrigation, irrigation rate, cotton yield*

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младоплодење (формирање чушки); 3) едно наводнување со 500 mm/ha во фенофаза масовно цутење на памукот; 4) едно наводнување со 600 mm/ha во меѓуфазен периодот цутење – формирање чушка; 5) варијанта без наводнување – стандард.

Најдобри резултати беа добиени од првата варијантата со две наводнувања со 400 mm/ha – првото во фенофаза бутонизација на памукот, а второто во фенофаза масовно цутење. Споредено со стандардот, приносот во првата варијанта е повисок за 36,0% (747 kg/ha) и продуктивноста е највисока од 1.000 m^3/ha вода, т.е. апсолутно за 934 kg/ha повеќе суров памук.

Клучни зборови: *памук, наводнување, норма на наводнување, принос на памук*

1. Introduction

Bulgarian cotton has been defined by the optimal and rational irrigation regimes, pre irrigation soil humidity, and the soil depth humidity as well as by the period of watering. It was found out a single irrigation quantity and irrigation rate during the years with different rainfall provision for the main soil type – leached vertisols.

During the last 20 years the deficit of irrigation water and its value have been increased. Therefore it has become necessary for this situation those steps to be taken in order to reduce cotton irrigation depth, with a reason to receive a high effect from unit of irrigated water and unit of area. The studies to this effect were carried out in USA (McMichael Hesketh 1982; Garrot, Punymeier, Husman, 1988; Gerik et all 1996); Gruce (Danalotos et al 1998; Paschalidis Stavrikos, 2006); Uzbekistan (Bezborodov, 1995), Bulgaria (Nikolov, 1994) and other authors (Spenser, 1998).

Herewith the research the task of ascertaining of rational irrigation regime under conditions of regulated water deficit for cotton is given.

2.Material and methods

During the period between 2001-2006 a field trial was set by the standard method in 4 replications with size of the plots - 20 m^2. The following variants were tested: 1. Two irrigations of 40 mm at 75 % FMC in soil layer 0-40 cm. The first was realized at the bud formation stage, and the second – at the flowering stage. 2. Two irrigations of 40 mm at 75 % FMC in soil layer 0-40 cm. The first was realized at the blooming stage, and the second at the boll formation stage. 3. Single irrigation at 75 % FMC in layer 0-40 cm at irrigation rate of 50 mm at the blooming stage. 4. Single irrigation at 75 % FMC for layer 0-40 cm at irrigation rate of 60 mm at the blooming stage. As for a control we used a non-irrigated variant. The tests were conducted at an irrigation regime of sprinkling on variety Perla-267, in two crop rotation (durum wheat - cotton), at fertilization rate of N_{120} and crops density of 160 000 plants per 1 ha.

The soil type was leached vertisols with humus horizon – 70-115 cm, with humus content of 1.8 – 3.5 % and clay minerals 60 %, wilting moisture 18-20 %. FMC for layer 0-50 cm was 34.2 %, 51-100 cm was 31.6 % and 101-200 cm – 28.7 %. The productive moisture for layer 0-60 cm was 96 mm, for 0-100 cm was 181 mm and 101-200 cm – 99 mm.

In terms of temperature (Table 1) the climate in 2001 and 2003 was warm, 2002 and 2006 – moderate, and 2004-2005 – cool. The rainfall sum for the period May–August characterized 2001 and 2006 as with a dry climate, 2002 and 2003 as moderate, and 2004 and 2005 – moderately humid.

3. Results and discussion

September yield which was determined with a cotton earliness for the irrigated variants during the dry climate years (2001 and 2006) was significantly higher than the non irrigated control – with 13.5-34.9 % (Table 2). For the moderately humid years (2002 and 2003) the yields of the irrigated variants were 6.1 – 23.8 % higher than the non-irrigated cotton. During the humid years (2004-2005) the average results showed that the non-irrigated variant exceeded the irrigated variants with 11.0 to 234 kg/ha.

During the dry years the earliness of the irrigated variants was set between 79.3 – 84.9 % of the total yield amount. For moderate years this percentage was set as 72.7 – 82.7 %, and for humid – 50-59.1 %. For the non-irrigated controls this ratio was respectively 91.2 %, 85.1 % and 74.7 %. The average for the period 2001-2006 the earliness of the irrigated variants was set between 72.6 – 74 % and 83.7 % for non-irrigated control. The highest September yield

The average for the period (2001-2006) the total seed-cotton yield
single irrigation was in 21 % higher than the standard. With two irrigations t
yield increase was 29.7-36.9 % or 601-747 kg/ha higher - Table 4.

In dry and moderately humid climate years, as well as in years of avera
temperature the irrigation effect on cotton for all irrigation regimes w
statistically significant. In the humid and cool climate in 2004 it was significa
only for the variant with irrigation regime of two irrigations during the tw
stages – bud formation and flowering.

The effect of 1000 m^3 irrigation water per 1 ha, expressed in addition
yield of kilograms of cotton, obtained with additional yield of kilograms
cotton obtained as a result of the irrigation depends on the year rainfall an
temperature. This effect was greatest for the dry and warm years and varie
from 586 to 1163 kg/ha. The average for the period the highest values wer
obtained by the variant with two irrigations of 400 mm done in the bu
formation and flowering stages

4. Conclusion

Under conditions of regulated water deficit, the highest effect wa
provided by irrigation regime of 75 % FMC in soil layer 0-40 cm, which wa
realized in two irrigations with irrigation rate of 400 mm in the phases of bu
formation and blooming. Average for 6 years with this irrigation regime th
total cotton yield increased with 747 kg/ha or with 36.0 %, including increas
of 51.2 % in dry years.

This irrigation regime was characterized with the highest effect of 100
m^3 irrigation water – average with 934 kg/ha.

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2003	298	585	685	739	772	539	387	2781	3707
2004	381	470	599	714	686	560	433	2469	3462
2005	364	552	587	690	684	545	357	2513	3415
2006	362	512	600	688	751	555	433	2551	3539
1928-07	357	524	624	722	694	561	425	2564	3550
Precipitations, mm Врнежи, mm									
2001	72	60	31	24	7	70	3	122	195
2002	67	29	17	176	35	50	53	257	360
2003	55	73	33	106	10	28	82	222	332
2004	18	93	136	30	73	40	19	332	391
2005	18	50	73	158	52	92	45	333	470
2006	67	19	33	67	49	40	17	168	225
1928-07	45	62	66	54	42	34	38	224	296

Table 2. Seed cotton yield of September gathering by years (kg/ha)
Табела 2.Принос на суров памук во септември по години

Variants Варијанти		Years – Години						Average Просек	
		2001	2002	2003	2004	2005	2006	kg/ha	%
V1		2010	2944	2742	546	1946	2062	2042	120.8
V2		2209	3110	2320	329	1716	1893	1930	114.1
V3		1787	2930	2374	521	1654	1662	1821	107.7
V4		1848	2604	2268	707	1577	1692	1783	105.4
St		1317	2641	1951	1135	1378	1722	1691	100.0
GD	5.0 %	167	243	189	78	160	104	104	6.2
	1.0 %	234	381	264	110	196	146	146	8.6
	0.1 %	331	648	374	155	275	206	206	12.2

Table 3. Seed cotton yield by years (kg/ha)
Табела 3. Принос на суров памук по години (kg/ha)

Variants Варијанти		Years – Години						Average Просек	
		2001	2002	2003	2004	2005	2006	kg/ha	%
V1		2192	4034	3224	2035	2268	2846	2767	136.9
V2		2412	3744	2825	1970	2059	2717	2621	129.8
V3		1887	3748	2997	1768	1901	2460	2460	121.8
V4		1960	3829	2872	2005	1858	2210	2456	121.6
St		1369	3199	2198	1805	1561	1985	2020	100.0
GD	5.0 %	107	57	343	193	136	128	65	3.2
	1.0 %	149	90	481	230	190	179	105	5.2
	0.1 %	211	152	679	284	286	253	129	6.7

	kg/ ha	%	Effect of 1000 ha ефект на 1(	kg/ ha	%	ffect of 1000 m2 ефект на 1000 п	kg/ ha	%	Effect of 1 water –	kg/ ha	%	ffect of 1000 m3 ефект на 1000 m
V1	2519	151.2	1065	3629	134.5	1163	2152	127.9	586	2767	136.9	934
V2	2565	153.9	1123	3285	121.7	733	2015	119.7	415	2621	129.7	751
V3	2174	130.4	1014	3373	125.0	1348	1835	109.0	304	2460	121.8	880
V4	2085	125.1	697	3351	124.2	1087	1931	114.7	413	2456	121.6	727
St	1667	100.0	-	2699	100.0	-	1683	100.0	-	2020	100.0	-