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IRRIGATION REGIME OF GRAIN MAIZE

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Abstract

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Experimental survey was performed during 2003 – 2006 on the experimental field of Agricultural institute, Stara Zagora on soil type leached smolnitza. Influence of irrigation through one and two furrows on the maize grain yield was investigated in the next variants: Irrigation by 800g.kg^{-1} FWC for the layer 0 – 100 cm; Irrigation through one furrow at M=500g.kg^{-1}. Irrigation through one furrow at M=1000g.kg^{-1}; Irrigation through two furrow at M=500g.kg^{-1}; Irrigation through two furrow at M=1000g.kg^{-1}. Results from the survey demonstrated that for the condition on soil type leached smolnitza optimal irrigation of maize for grain, realized by supporting of before irrigation moisture 800g.kg^{-1} FWC supply 7883kg.ha^{-1} grain. Irrigation of maize in the groove and two furrows, with the same water as in the optimal variant leads to reduction in yield compared to the optimum, by 42g.kg^{-1} and 139g.kg^{-1}, and to reduce irrigation by 500g.kg^{-1} rate the reduction in yield was 101g.kg^{-1} and 187g.kg^{-1}. Upon submission of irrigation water through a groove with the size of the irrigated rate 60 mm, decrease the yield of 20g.kg^{-1} to 60g.kg^{-1} compared with variations in each irrigation furrow irrigation at the same rate. The reduction in yield when irrigation with furrow irrigation in normal 30mm versus irrigation in each furrow irrigation with normal 60mm was from 40g.kg^{-1} to 80g.kg^{-1}. Two irrigation furrows with 60mm irrigation rate resulted in significant reduction of the resulting yield and ranged from 130g.kg^{-1} to 160 g.kg^{-1}.

Key words: irrigation, irrigation norm (M), water deficit, yield

Introduction

Production of maize is traditional for our country and further information on irrigation regime is essential for the efficiency of cultivation of grain maize. The proper combination of complex agricultural activities leads to obtaining higher yields with lower costs. Important role in this complex occupies irrigation. Grain maize is particularly sensitive to moisture deficit during appearance small broom, and darkening of silk, fertilization and initiation of milk maturity. Water stress in leaf-make phase can reduce the surface of the leaves, and if the shortage of readily available water appearance small broom and coincide with the formation of the cob, it even does not appear silk.

Multi-mode studies of irrigation for maize showed that water deficit in the soil at the end of vegetation directly depends on the quantity and distribution of rainfall and the amount of irrigation rate (Lazarov and Mehandjiev, 1982; Eneva, 1991; Petrov, 1994; Rafailov, 1998; David, 1998; Moteva, 2005; Popova, 2006). Increasing of yields due to irrigation varies from 2 to 4 times in different groups of hybrids FAO (Zivkov and Mehandjiev, 2006).

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The objective of present investigation was to analyze the impact of water deficit developed through irrigation during a two furrow on yield of maize grain.

Materials and Methods

Field studies were conducted in the experimental field of Agricultural Institute, Stara Zagora in the period 2003-2006. Soil type is leached smolnitza. The content of clay is 640 g.kg^{-1} - 670 g.kg^{-1}, and humus content is 30 g.kg $^{-1}$ in the 0-40 cm layer and 22 g.kg^{-1} for the layers 40-80 cm. Soil profile is 120cm by 80cm humus horizon. The level of groundwater in wet years is from 2.5 to 3.0 m and from 6.0 to 8.0 m. in dry years. Soil type is characterized by significant lateral filtration 1.0 – 1.5 m. Soil can accumulate large stock water, much of which is unimproved. These store water is distributed evenly in the soil horizon. For layers 0-100 mm is 452 mm, and the value of a 10cm move between 43 and 46 mm. The study includes the next variants: 1. without irrigation (Standard); 2.Irrigation by 800 g.kg^{-1} FWC; 3. Irrigation through one furrow at M=500 g.kg^{-1}; 4. Irrigation through one furrow at M=1000 g.kg-1; 5. Irrigation through two furrows at M=500 g.kg-1; 6. Irrigation through two furrows at M=1000 g.kg^{-1}

Field experiment was conducted with moderate-early matured corn hybrid. The magnitude of variations in the experimental plots without irrigation, with optimum irrigation and furrow irrigation was 56 m^2. In the 4th and 5th variants area of 84 m^2 was increased to cover a representative number of irrigated furrows in one parcel and the size of the harvest area in all variants is 24 m^2. Both options are watered with a decrease in soil moisture in the second variant to 800 g.kg $^{-1}$ FWC. During the period are tested variants of irrigation with different amounts of irrigation norm. Irrigation is accomplished through seasonal-stationary system of irrigation pipes (u-100). Water is distributed in irrigated furrows through perforated pipes installed them sealing rings, nipple and hoses (length - 1m) in order to direct the streams in the respective irrigated furrows. Furrows in the experimental plots are short (10 m) and closed. Water must be submitted through the variable current or impulse to achieve even distribution of the necessary irrigation norm.

Results and Discussion

Years of study in terms of amount of rainfall, fell in the vegetation period of maize grain for the 76-years period as established: 2003 and 2006 - Dry (with 849g.kg^{-1} and 901g.kg^{-1}), and 2004 and 2005 - Wet (with the 74g.kg^{-1} and 22g.kg^{-1}). The amount of rainfall in different years is unevenly distributed monthly (Figure 1). According to providing rainfall in July-August 2003 and 2006 averaged dry (with security and 682g.kg^{-1} respectively 603g.kg $^{-1}$), and 2004 and

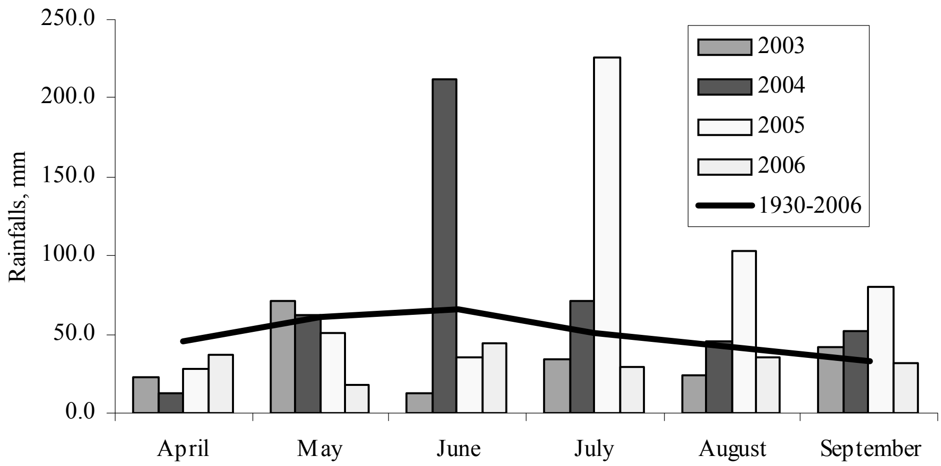

Fig. 1. Quantity and distribution of rainfalls for the region of Stara Zagora, mm

2005 can be described as moist, with 229g.kg^{-1}, and 9g.kg^{-1} (Table 1). Values of average dailies temperatures during the years of field experiment are similar to values for long period Quantity and distribution of rainfall during the vegetation of the predetermine the culture and the need for additional moisture-security. During the years of the study were made from 2 to 3 irrigations during the vegetation period of maize grain. With applications 3 irrigations need is met by readily available moisture during the critical phases of development of culture.

The yield is formed under the joint impact of all vegetation factors. Deviations from optimal conditions contributing to the decline in yields. Highest yield average for the period of study is derived from options with optimum irrigation 7883g.kg^{-1} (Table 2). Yields in natural moisture-security of culture vary widely. Favorable conditions led to high climatology results in 2005 and 2006. The resulting products, on average for four-year period in the amount of 5623g.kg^{-1} lower yield in 2003 due to prolonged drought in the air during the flowering and insemination stage of development. In 2004 yields of all the options are very low, due to the fallen during the period of vegetation of maize grain hail.

In irrigation reduced irrigation rate in one and two furrows yield is average for the period 7085 kg.ha^{-1} and 6405 kg.ha^{-1}. A good soaking of the soil horizon was observed in distribution of water in the groove, which satisfy the greater needs of the plants of water, which affects the yields obtained. The results are driven by a filtration properties of the soil type - leached smolnitza, if not prevent major losses in depth and on the other -waterings were made during appearance small broom of maize grain in the next phases of development, when the culture has highly developed root

Table 1

Quantity and security of rainfalls in the region of Stara Zagora

Year	Sum, mm	P	Sum, mm	P	Sum, mm	P
	VII-VIII	g.kg $^{-1}$	IV-IX	g.kg $^{-1}$	I-XII	g.kg $^{-1}$
2003	58.4	682	207.3	849	423.1	823
2004	116.7	229	455.4	74	623.3	293
2005	329.8	9	523.8	22	823.6	61
2006	65.5	603	195.7	901	408.3	862
Average 2003-2006	142.6		345.6		571.8	
1930-2006	43.2		298.7		556.5	

Table 2

Yield of maize for grain at water deficit, kg.ha $^{-1}$

Variants of irrigation	Yield of maize for grain				
	2003	2004	2005	2006	Average
1.Without irrigation	3740	3360	7560	7830	5623 st.
2.Irrigation by 800g.kg^{-1} FWC	7050	4570	9570	10 340	7883 +++
3.Irrigation through one furrow at M=500g.kg $^{-1}$	6330	4080	8610	9320	7085 ac +++
4.Irrigation through one furrow at M=1000g.kg $^{-1}$	6610	4290	9220	10 090	7553 a +++
5.Irrigation through two furrow at M=500g.kg $^{-1}$	5170	3780	8030	8640	6405 b ++
6.Irrigation through two furrow at M=1000g.kg $^{-1}$	6080	3840	8320	8920	6790 bc ++
LSD,	P<0.05=553.3	P<0.01=766.4	P<0.001=1057.4		
*Differences among variants are statistically significant at P<0.05 if have not equal letters					

system. In the distribution of irrigation water in the groove is not implemented in the loss of water depth, water is utilized by the root system of plants and if there are losses, they are offset by reduced evaporator surface of the soil. Upon submission of water two furrows of the water penetrates into the deep part of the soil profile and remains unused. The area around the root system of plants is part of the uneven moist as a result of poor filtration in the arable horizon and creating conditions of water deficit, which makes obtaining lower yields.

The analysis of the results shows the favorable impact of optimal moisture-security. In this way the distribution of the water layer is inhabit root moisturizes most evenly, a plant is placed under the same conditions of growth and development.

Irrigation of crops in the irrigated water is distributed not only in depth, vertical filtering through the soil, but also the lateral infiltration, which depends on the nature of the soil type. To establish the impact of this infiltration on moistening the area of sowing experiments were conducted for irrigation, where irrigation is carried out in a furrow and two respectively in 1.40m and 2.10 m.

The reduction in yield for different types of irrigation during a two furrows and irrigation at a reduced rate are systematized and given in Table 3. The table shows that in the irrigation line in a decrease in yield from 0.94 to 0.98, respectively, from 20g.kg^{-1} to 60g.kg^{-1}, to variations in irrigation in each furrow and 60mm irrigation norm. The reduction in yield is insignificant and could be recommended in the irrigation of heavy soils, such as leached smolnitza.

The reduction in yield when irrigation with furrow irrigation during normal 30 mm to irrigation in each furrow irrigation with normal 60 mm from 0.92 to 0.96, respectively, from 40 g.kg^{-1} to 80 g.kg^{-1}. Experimental results show that when water scarcity may be a reduced water rate in furrow irrigation.

In two furrows irrigation, with irrigation rate 60 mm, the reduction of yield to irrigation in each furrow and with the same irrigation rate is 130g.kg^{-1} to 160g.kg^{-1}. Since the reduction is significant, it should be applied in case of shortage of water. In the reduced irrigation rate as for irrigation in one and two in furrows irrigation, the yield is reduced slightly.

Yields obtained for the investigation period were statistically significant. Better soaking of the soil horizon was observed in distribution of water in each groove in a groove, which satisfies the greater needs of plants that show and made a statistical processing of data on yield variations. Established is $P < 0.001$ compared to maize grain grown without irrigation. Proven ($P < 0.01$) are the differences between the production and obtained from standard options irrigated by filing of irrigation water in two furrows.

Table 3
Reduction yield of maize for grain, irrigated through furrows

Variants	Years				
	2003	2004	2005	2006	Average
Irrigation by 80% FWC - norm 60mm (M=100 g.kg $^{-1}$)	7050	4570	9570	10340	7883
Irrigation through one furrow at M=1000g.kg $^{-1}$	6610	4290	9220	10090	7553
Diminution compared to in every M=1000g.kg $^{-1}$	0.94	0.94	0.96	0.98	0.95
Irrigation through two furrow at M=1000g.kg $^{-1}$	6080	3840	8320	8920	6790
Diminution coparated to in every M=1000g.kg $^{-1}$	0.86	0.84	0.87	0.86	0.86
Irrigation through one furrow at M=500g.kg $^{-1}$	6330	4080	8610	9320	7085
Diminution compared to through one furrow at =1000g.kg $^{-1}$	0.96	0.95	0.93	0.92	0.94
Irrigation through two furrow at M=500g.kg $^{-1}$	5170	3780	8030	8640	6405
Diminution compared to through two furrow at M=1000g.kg $^{-1}$	0.85	0.98	0.97	0.97	0.94

Conclusion

Irrigation of maize in the groove and two furrows, with the same water as in the optimal variant leads to reduction in yield compared to the optimum, by 42 $g.kg^{-1}$ and 139 $g.kg^{-1}$, and to reduce irrigation by 500$g.kg^{-1}$ rate the reduction in yield was 101$g.kg^{-1}$ and 187$g.kg^{-1}$.

Upon submission of irrigation water through a groove with the size of the irrigated rate 60mm, decrease the yield of 20$g.kg^{-1}$ to 6$g.kg^{-1}$ compared to variations in each irrigation furrow irrigation at the same rate.

The reduction in yield when irrigation with furrow irrigation in normal 30 mm versus irrigation in each furrow irrigation with normal 60mm is from 40$g.kg^{-1}$ to 80$g.kg^{-1}$. Two irrigation furrows with 60mm irrigation rate resulted in significant reduction of the resulting yield and ranged from 130$g.kg^{-1}$ to 160$g.kg^{-1}$.

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