Irrigation regime of pepper grown in unheated greenhouses with drip irrigation

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Abstract: *In order to establish the irrigation regime of pepper variety "Gold Medal", grown in plastic unheated greenhouses in the Chelopechene experimental field, Sofia district, irrigation options were tested from fully satisfying the water needs of the crop /100% irrigation rate/ to irrigation with 20% and with a 30% increase in irrigation rates. A water-saving irrigation technology is used. The highest yield of 4879 kg/dka was obtained when using 130% irrigation rate, followed by the variant with 120% irrigation rate – 4460 kg/dka on average for the research period. The yield in the variant irrigated by class "A" evaporation pan, approaches the yield obtained in the variant with 100% implementation of the irrigation rate.*

Introduction

To obtain high and quality yields from vegetable crops, it is necessary for the plants to be supplied with water throughout the growing season, which is achieved by conducting a proper irrigation regime.

To ensure higher efficiency of the irrigation of these crops in conditions of water deficit, it is also necessary to apply water-saving and environmentally friendly irrigation techniques.

For their normal development and fruiting, the soil humidity must be above 85% of the field capacity (Dulov Sl., 1976; Matev T., 1969; (Kireva R., 1987), as the best results regarding the use of water from plants is produced by drip irrigation. This method fully meets the requirements for sustainable agriculture and ecological fruit production, including ensuring high yields and quality of production, and reducing unwanted side effects (Bucks et al., 1982).

The purpose of the development is to establish the irrigation regime of the "Gold Medal" pepper variety, with drip irrigation in greenhouse conditions.

Materials and methods

The studies to establish the irrigation regime of the pepper variety "Gold Medal" grown in plastic unheated greenhouses were carried out in the period 2003-2004 in the experimental field of ISSAPP "N. Pushkarov" in the village of Chelopechene, Sofia.

The following irrigation options were tested:

Pre-irrigation humidity – 90% of field capacity

- 130% realization of the irrigation rate /variant 1/;
- 120% realization of the irrigation rate /variant 2/;
- 100% realization of the irrigation rate /variant 3/;
- 100% implementation of the irrigation rate established for the "A" class evaporation pan. (Evaporation) /variant 4/.

The irrigation rate for class "A" evaporation pan is calculated according to the formula

m= E0 .Ki.K, (1),

where: m is the size of the irrigation rate, mm;

E0 - evaporation from a free water surface according to class "A" evaporation pan, mm;

Ki – biological coefficient of culture;

K- coefficient for reducing the irrigation rate, taking into account the area occupied by the plants in one decare. In the experiment, K =0.67 t.s., 67% of the area is irrigated.

Irrigation rates for the other variants are calculated according to the formula:

$$m = [10.H\alpha.(FC - \delta_T)].K,$$

where: m is the size of the irrigation rate in mm;

α – the volume density of the soil in gr/cm3;

H – depth of the active soil layer in m (in the experiment H = 0.5 m);

FC – marginal field moisture content in % relative to the absolute dry weight of the soil;

$\delta t\ pr.vl$ – pre-irrigation soil moisture in % relative to the absolute dry weight of the soil;

K – the coefficient of reduction of the irrigation rate, taking into account the area occupied by the plants in 1 dka. In the experiment, K = 0.67 i.e. 67% of the area is irrigated.

With drip irrigation, the amount of the entire irrigation rate is not given, as with other irrigation methods. A reduction is applied at the expense of the non-irrigated area. For this purpose, the formula of [Ferckman, Grazoliq 1980] was used, taking into account the planting scheme. After calculating the irrigation rate for option 3, the rates of the other options are determined based on their size.

Results and discussions

The reports of the implemented irrigations show that for the conditions of the Sofia field, on average, during the period of the study, 26 irrigations were implemented for the growing season of the pepper.

In option 3, in which the calculated irrigation rate is submitted, it was found that the pre-irrigation humidity was maintained at an average of 85-90% of the PPV. The rest of the irrigation rates are derived from option 3, except option 4, which was irrigated using a class "A" evaporation pan. Irrigation rates in this variant were calculated based on the readings of class "A" evaporation pan and the culture coefficient K obtained as a ratio of ET (evapotranspiration) and E0 (evaporation from a free water surface)

The size of the irrigation rates for the individual variants varied from 16.5 to 21.5 mm, and the irrigation rates from 430 to 559 mm on average during the research period. The irrigation rate calculated according to evaporator class "A" for the entire growing season, on average for the experimental years, is 431 mm, (Table 1).

Maximum irrigation rates in individual years in the period of greatest water consumption can be applied in 3-4 days to satisfy the needs of the plants. At a pressure of 1.5 atmospheres, they are realized in 2-3 hours.

The established values of the irrigation rates can be used to size the irrigation network, and the irrigation rates when compiling the general water balance in the greenhouse complexes.

The implemented irrigation regimes had a different impact on the formation of pepper yields. The highest yield of pepper grown under the soil and meteorological conditions for the Sofia field was formed in the variant with 130% implementation of the irrigation rate - 4879 kg/dka irrigated with an irrigation rate of 21.5 mm and an irrigation rate of 559 mm.

The yield in the variant irrigated by evaporator class "A" approaches the yields obtained in the variant with 100% implementation of the irrigation rate.

The increase in the irrigation rate by 20 and 30% leads to an increase in yield by 5-14.5%, which is insignificant compared to the amount of supplied water (Table 2).

In the conditions of water deficit and the high price of irrigation water, the obtained information shows that the increase of the irrigation rates of the researched crop grown in a plastic greenhouse is not justified.

Table 1. *Number of watering events, watering rate (mm), and total irrigation rate (mm) of pepper for the growing season in Chelopechene, Sofia. All data are average values for the period of 2003-2004*

Watering norm (share,%)	**2003**			**2004**			**Average 2003-2004**		
	Watering number	Watering norm (mm)	Irrigation norm (mm)	Watering number	Watering norm (mm)	Irrigation norm (mm)	Watering number	Watering norm (mm)	Irrigation norm (mm)
130	25	22.2	555	27	20.9	564	26	21.5	559
120	25	20.5	522	27	19.3	521	26	19.9	517
100	25	17.1	428	27	16.1	435	26	16.5	430
100 % measured by evaporator of class A (average for 1993-1994)	25	17.2	430	27	16.2	437	26	16.6	431

Table 2. *Yield (Y, kg/da) and relative yield (R, %) of pepper obtained for different regims drip irrigation in Chelopechene, Sofia*

Watering norm (share, %)	2003		2004		Average for 2003-2004	
	Y	R	Y	R	Y	R
130	4358	114	5400	115	4879	114.5
120	3939	103	4980	106	4460	105.0
100	3812	100	4680	100	4246	100
100 % measured by evaporator of class A (average for 2003-2004)	3800	99	4480	95,7	4140	97,5

Conclusions

To keep soil moisture in the range of 85–90% of field capacity when growing pepper in plastic unheated greenhouses, 26 waterings with an average irrigation rate of 16.5 mm are required. They are implemented at different intervals, depending on the development of plants and the stress of meteorological factors at an irrigation rate of 430 mm.

Of the realized irrigation rates, the highest yield of pepper grown under the soil and meteorological conditions for the Sofia field is formed in the variant with 130% realization of the irrigation rate - 4879 kg/dka, followed by the variant with 120% irrigation rate - 4460 kg/dka on average for the period of research. The yield in the variant irrigated by class "A" evaporation pan approaches the yield obtained in the variant with 100% implementation of the irrigation rate.

Literature

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