TECHNOLOGICAL AND ECONOMIC ASPECTS OF DRIP IRRIGATION OF RASPBERRIES

Assoc. Prof. PhD R. Kireva, Prof. PhD M. Mihov
the Institute of Soil Science, Agro-Technology and Plant Protection "Nikola Pushkarov", Sofia, Bulgaria

Abstract: *Drip irrigation provides a fairly even mode of moisture in the soil and, along with this, favorable air, heat, microbiology and nutrition. As a result, there is an increase in yields and an improvement in the quality of production.*

In order to determine the impact of drip irrigation, on the size of the yield and the economic indicators, in the cultivation of raspberries in the soil and meteorological conditions of the area of the village of Chelopechene - Sofia researches of an everbearing variety "Lyulin" were carried out. Various options have been tested - from fully satisfying the daily needs of the culture by water, irrigation with 20% and 40% irrigation norms to non- irrigating conditions.

The results obtained in years with different security of meteorological factors show that the drip irrigation of raspberries has a positive effect on the economic indicators of its cultivation, the costs of creating the raspberry crop, the irrigation system and the cultivation of the crop are redeemed for two or three years.

KEYWORDS: *DRIP IRRIGATION, RASPBERRY CROPS, IRRIGATION REGIME, YIELD, EXPENSES, PAYBACK PERIOD.*

Introduction:

Raspberry is a crop of great economic importance due to excellent technological and taste characteristics and high productivity. These qualities it exerts exclusively in irrigation conditions, which is explained by its biological features.

The micro-irrigation of raspberries is increasingly used, due to the possibility of effective control of the processes in the irrigation system and in the irrigated plantation (Bucks et al.,1982). This method fully meets the requirements for sustainable agriculture and organic production of fruit, incl. ensuring high yields and quality of production, reduction of unwanted side effects (Branson et al.,1981). It has been established from our and world science that from the applied techniques and technologies for irrigation of berry and fruit crops most suitable for their biological requirements is drip irrigation (Drupka,W.,1979, Кирева, Р., В. Петрова, 2014).

Drip irrigation enables irrigation water combined with the necessary fertilizers to be delivered directly into the root system of the plants. This type of irrigation saves considerable water consumption, as well as the operating costs of watering the irrigation system and maintenance of the irrigation system. The drip irrigation system is realized by the installation of irrigation pipes /irrigation wings/. These pipelines are fed by submerged or underground distribution pipelines. Drip irrigators are built along the irrigation line and the water in the irrigation leaves drops into the root system of the plant. Drip irrigation technology is adapted to the type of crop, field features, water source, and planting pattern.

Studies conducted so far on irrigation of raspberries indicate that it is very important to increase the yields of the raspberry before the ripening of the fruit and throughout the harvesting period (Kuiesza, W., 1973, Oosten, A.,1976). According to the same authors, the most negative influence on the yield is the drought two weeks before the harvesting of fruits and during ripening. In maintaining a limited water deficit in the soil, the yield of raspberries increased by over 9.6% and in dry years by 27.6% compared to non-irrigated variants (Mackenrron, 1982).

Full studies of the irrigation regime of raspberries are carried out solely by (Иванов, Ал.,1998,) and some of the drip irrigation parameters for have been established. For the massively inflowing everbearing raspberries, such research is lacking. In view of this, we have directed our study to determine the impact of drip irrigation on the amount of yield and economic performance in growing raspberries "Lyulin".

Materials and method

The field experiments were conducted in the experimental field of the Pushkarov Sofia Institute in the period 1999-2001. The soil is leached cinnamon forest, slightly sandy loam in the plow layer, formed on the base of an old delluvial cone of silt materials. It is poorly stocked with nitrogen, on average with phosphorus and well with potassium. On average, for the layer 0 - 60 cm the soil has the following water-physical properties: Saturation = 22,1%, wilting point – 12,3% on the weight of absolutely dry soil, volume weight at Saturation – 1,47 g/cm^3. For the soil layer 0 - 100 cm the same indicators have values: Saturation – 21,8%, wilting point – 12,3% and volume weight – 1,50 g/cm^3.

Various variations of irrigation have been tested:

- first variant - without irrigation;
- second variant - irrigation with 100% irrigation rate;
- third variant - irrigation with 80% irrigation rate;
- forth variant - irrigation with 60% irrigation rate.

The irrigation rate is calculated using the formula (Frecman and Garzoli, 1980).

To monitor soil moisture dynamics, soil samples are taken under variation 2 (100% irrigation rate) at a depth of 0 - 60 cm over 10 cm, which are processed by the weight-thermostatic method.

The scheme of the drip irrigation installation and the parameters of its main elements are designed to ensure a uniform distribution of the irrigation rate along the rows of raspberries. The installation is made of irrigation wings 20 mm diameter double-walled drip irrigation pipes type "Agrodrip" and water inlet through 30 cm.

Technology and agrotechnics for the creation and cultivation of raspberry crops developed by Experimental plant on berry breeding – Kostinbrod was used for the experiment. The irrigation was carried out by"Drozbah" irrigation system.

Results and discussions

The results from the triennial studies show that the number of irrigation and the irrigation rate are the meteorological conditions (precipitation) in individual years.

Regarding the amount of precipitated rainfall for the period April - September 1999 и 2001 are characterized respectively as a wet and medium-wet year with the provision of rainfall factor in the multi-year series 19,2% and 33,1% respectively, and for 2000 – as very dry with – 98,6%.

Table 1: *Rainfall during raspberry vegetation period (1999 – 2001)*

Periods	Total rainfall (mm)			Rainfall factor security (%)		
	1999 г.	2000 г.	2001 г.	1999 г.	2000 г.	2001 г.
Month IV - IX	398	182	358	19,2	98,6	33,1
Average multi-annual	365	363	362	-	-	-
Month VII - VIII	152	28	75	7,3	96,6	70,8
Average multi-annual	108	107	017	-	-	-

The sum of precipitations during the growing season of the crops for 1999. is 33 mm higher than the average multi-year values, and for the July-August period by 44 mm. In 2001, which is characterized as moderately humid, rainfall in April - September is almost the same as in the mid-year series - 358 mm and in July - August it is 75 mm (Table 1).

In the very dry year (2000) the sum of rainfall for the period April - September is 182 mm, which is 50% lower than the average multiannual values. Particularly dry during this year are the months of July and August, with the sum of rainfall being 28 mm, much lower than the average multiannual values for the same period of 107 mm. These rainfall was extremely inadequate for the development of raspberries, which predetermined a large number of waterings.

The results of triennial studies show that the number of irrigation and irrigation rates is determined by the weather conditions (precipitation) in individual years. The number of irrigation varies from 12 to 17 and the irrigation rate from 2160 to 4500 m^3/ha.

On average, during the rape season, 18 irrigations are made with average irrigation rate 180 m^3/ha and irrigation rate 3240 m^3/ha, with the highest number of pollutions being realized during the many dry years (2000), where the number of irrigations reaches 25, and the size of the irrigation rate reaches 4500 m^3/ha.

The results obtained for the raspberry yield during the different humid years show the impact of drip irrigation on its size. The greatest increase in yield was obtained in 2000, when it was about three times higher than the non-irrigated variant (Table 3). The least increase with 2470 kg/ha was obtained during the wet year 1999, with an average increase of the yield in the three years of 6000 kg/ha.

The irrigated regimes during the years also affected the yields obtained. Highest yields were obtained for variant with 100% irrigation rate - 10 760 kg/ha, and lowest for non-irrigated variants - 4 470 kg/ha. Lowering the irrigation rate by 20 and 40% has led to a reduction in yields of 11 and 22%. The reduction in yield is not drastic and such irrigation regimes can be used in the event of a water shortage.

Table 2: *Yield of the raspberry on variants end years*

Variant	1999		2000		2001		Average for the period 1999-2001г.	
	kg/da	%	kg/da	%	kg/da	%	kg/da	%
No irrigation	7 120	100	3 840	100	2 480	100	4 470	100
100% M	9 590	135	13 930	365	8 710	351	10 760	241
80% M	8 950	126	12 250	319	7 690	310	9 630	215
60% M	8 350	117	9 830	256	6 890	278	8 350	187

For the normal development of raspberry, given its biological water needs, it is necessary to ensure that the soil is wetted on a continuous strip along the rows, requiring overlapping of wetted areas from the individual water inlets in the pipeline. The research has shown that the use of an Agrodip type installation with irrigation wings and 30cm water inlets, supplying a water quantity of 2,7 l/h, the requirements of the field conditions of the Test field are met and the installation is suitable for supplying the required amount of water cultivated crop. The cost of creating one dka of raspberry plantation amounts to 3600 Lv/ha (on an experimental field). The analysis of the economic indicators shows that the investments made for the establishment of the plantation and the construction of the drip irrigation installation are redeemed in the third year (Table 3). In case a loan is obtained for the creation and cultivation, for example, the size of its area multiplied by the cost of its creation and the construction of the irrigation installation, area (ha) in 10000 Lv/ha, at 10% annual interest rate and one year grace period, there is the possibility to pay the loan for three, five or seven years, which will allow for the first year to make a profit.

Conclusions:

1. On average, for the duration of the experiment, the highest yield of 10760 kg/ha was obtained with the optimal irrigation variant and the lowest in the non-irrigated variant - 4470 kg/ha

2. The greatest increase in yield was obtained in 2000, when it is about three times larger than the non-irrigated option, the least increase of 2470 kg/ha was obtained during the moist 1999, as an average for the three studied years the increase of the yield is with 6000 kg/ha.

3. The investments made to create a raspberry crops and for the construction of the drip irrigation system under the terms of the survey shall be redeemed for three years.

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Table 3: *Economic indicators of the production of raspberry "Lyulin"variety*

Year	1998		1999		2000		2001		Average Irrigation 1998-2001	Average Non-irrigation 1998-2001
Indicator	Irrigation	Non-irrigation	Irrigation	Non-irrigation	Irrigation	Non-irrigation	Irrigation	Non-irrigation	Irrigation	Non-irrigation
1. Costs for setting up the plantation, lv/ha	3600	3600	-	-	-	-	-	-	-	
2. Costs for construction of a drip irrigation installation, lv/ha	6200									
3. Production costs, lv/ha	3520	2900	6160	4750	8970	3150	5590	2020	6910	4470
4.Yield, kg/ha	1200	1200	9590	7120	13930	3860	8710	2480	10760	3640
5. Average purchase price, lv/kg	1,2	1,2	1,2	1,2	1,6	1,6	1,7	1,7	1,5	1,5
6. Income, lv/ha	1440	1440	11500	8540	22280	180	14800	4210	16140	6700
7. Profit, lv/ha	-11880	-5960	5340	3790	13310	3030	9210	2190	9230	2230