RESEARCHES CONCERNING THE INFLUENCE OF PRESSURE ON THE DRIP RATE FOR DIFFERENT DRIP WATERING TAPE MODELS

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Abstract

This research shows the influence of the operating pressure on the water flow dispersed through the drip watering tapes. The experiments were organized on a stand in the Laboratory of Horticultural Machinery at the University of Agricultural Sciences "Ion Ionescu de la Brad" in Iasi. In carrying out the experimental researches, there were used 10 types of drip watering tapes and the operating pressure varied from 0.025 to 0,2MPa. Following the experiments, there have been found differences in the flow value of each drainer and each watering line, depending on the working pressure and the type of tape used.

Key words: stand, drip irrigation tape, work pressures

Drip irrigation is made localized and with low water flow, in the plant roots, having continuity in space, but discontinuity in time (Țenu I., 2004).

Irrigation facilities are various in terms of construction, but the most used today are those with drip devices placed on the tubes and ramps located along the plant rows.

Drip watering facilities are made of: water preparation group, which provides connection to the water source, water filtering, devices for the co-administration of fertilizers and irrigation water, systems for regulating and measuring the flow rate and the working pressure; proper watering equipment, consisting of transmission lines, watering pipelines, with provision of water supply to the plant and monitoring system equipment (Biolan I. *et al*, 2010).

An important feature of the drip irrigation system is that it can be used to distribute chemicals (fertilizers and pesticides), by injection into the irrigation system, those being distributed directly to the root zone of the plants (Bevacqua R.F. 2001).

Drip irrigation reduces water's contact with leaves, stems and fruits, creating less favorable conditions for developing a disease (Shock C.C., 2013).

Drainer pipes are parallel with the plant rows and have single or double walls. Watering pipes are subassemblies of the watering facility, which are designed to transport and supply water (Grumeza, Drăgănescu, 1983).

MATERIAL AND METHOD

The experiments were organized on a stand in the Laboratory of Horticultural Machinery at the University of Agricultural Sciences and Veterinary Medicine "Ion Ionescu de la Brad" in Iasi. In carrying out the experimental research, there were used 10 types of drip watering tapes, and the operating pressure varied from 0.25 to 2 bar.

The stand on which the experimental research was conducted (*figure 1*) is made of a supporting metal frame (P), placed on a wooden platform, used for placing the containers that are necessary in measuring the amount of water passing through the drainers, PEHD pipe watering (K) with a diameter of 32 mm and a length of 130 cm, fitted at the ends with plugs (R) and watering tapes.

The watering tapes (M), 10 in number, had a length of 80 cm, each having different characteristics in terms of flow, type and number of drainers, as shown in *table 1*.

The water demand used in the experiment was provided by a tank (D) with a capacity of 300L, connected to the plant watering facility. The filter (I ') was meant to filter the water from the tank, in order to avoid clogging the drainers with debris.

The work pressure was measured with the help of a pressure gauge (C). In order to achieve the pressure, an AIRMASTER (H) air compressor was used.

The watering tapes were numbered from 1 to 10 (A), starting with the main opening valve connected to the water tank. Also, each drainer (N) on each line was numbered according to the number of drainers, starting with the main pipeline.

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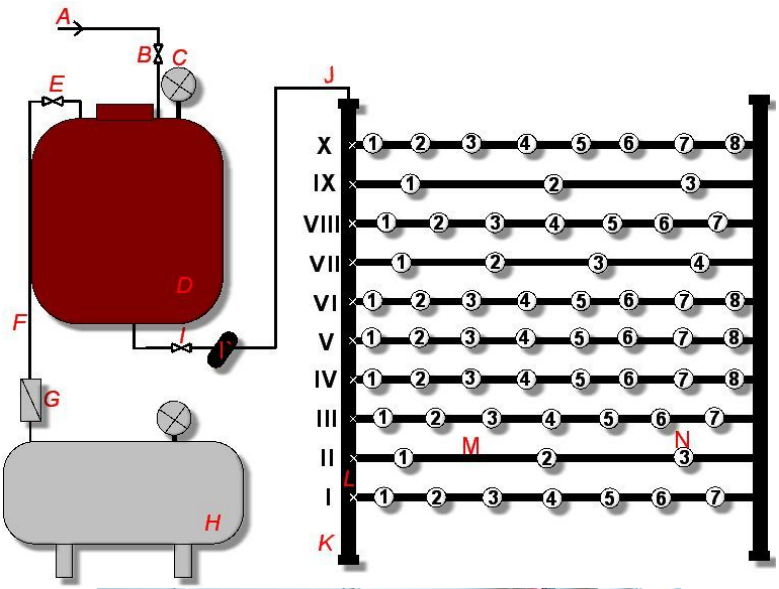

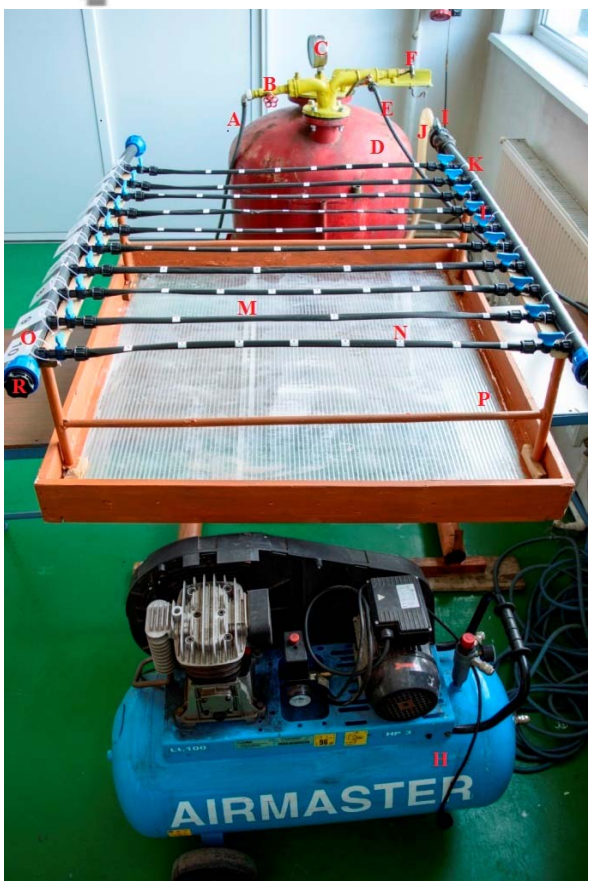

Figure 1 **Experimental stand for testing various drip tubes**

A – water supply hose; **B, E, I, L** – valve; **C** – manometer; **D** – water tank; **F** – compressor cable; **G** – backflow; **H** – compressor; **I' –** filter; **J** – supply connection; **K** – main pipeline; **M** – watering tape; **N** – drainer; **P-** ironwork platform; **R –** plugs for the main pipeline; **I...X** – watering tape lines numbering; **1...8** – watering tape drainers numbering.

Table 1

Features of the watering tapes used provided by the manufacturer					
Watering line	**Hole type**	**Tape wall thickness (mil.)**	**Distance between drainers (cm)**	**Flow L/h**	**Manufacturing company**
1	slot	6	10	1,5	Toro (Aqua-Traxx)
2	pill	6	20	2,1	Plastic Puglia (Aqua Tape)
3	slot	6	10	1,5	Plastic Puglia
4	slot	6	10	1,5	-
5	slot	8	10	1,5	Plastic Puglia
6	slot	6	10	1	Hidro Tape
7	pill	6	20	2	Hidro Dryp
8	slot	6	10	1,5	Irri Tape
9	pill	6	20	1,2	Green Tape
10	slot	6	10	1,2	Silver Drip

*** 1 mil = 1/1000th of an inch**

In order to store the water supplied from the drainers, there were used plastic containers (*figure 2*), located under each drainer. To measure the amount of water in each container corresponding to each drainer, a 1000 ml graduated cylinder was used (*figure 2*).

The experimental research has sought to reproduce, in the laboratory, a drip watering cycle, during 2 hours, using eight working pressures, from 0.025 MPa to 0.2 MPa.

The aim of the experimental research was to monitor throughout the whole process of watering, the watering tapes resistance and the flow on each line, while increasing the pressure. For every pressure used, there were made 3 attempts.

The average amount of water accumulated per line was carried out by calculating the amount of the water supplied after three attempts, corresponding to each of the eight pressures.

Thus, for each attempt, the watering system was opened, adjusting and keeping the pressure constant over two hours. In this time, there were monitored and measured the volumes of water resulted in each container from each line and in each drainer in the line (*figure 2*).

As the drainer related to a container was filled, it was hollowed into a cylinder (*figure 2*), it was measured and its value was recorded, along with the time when the replacement of the filled container with an empty one was made.

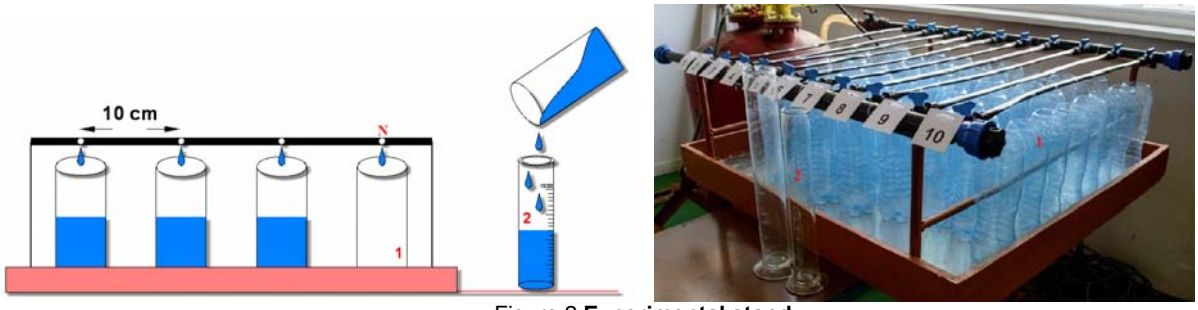

Figure 2 **Experimental stand**
1 – plastic container; **2** – cylinder; **N** – drainer

RESULTS AND DISCUSSIONS

The evolution of the water flow on each line, in all the 8 used pressures (0.025 ... 0,2 MPa) and the resistance of the watering tapes can both be seen in *figure 3*.

The average volume of the water flow during 2 hours varied according to the pressure. At a pressure of 0.025 MPa, the water quantity ranged from a minimum of 3,419 L obtained in the 10th line, to a maximum of 14,042 L obtained in the 4th line, the maximum difference obtained with this pressure being of 10,623L.

Increasing the pressure to 0.05 MPa, the amount of water was minimal in the 10th line, with a value of 5,397 L, while in the 4th line a maximum of 20,490 L was obtained. The maximum difference obtained with this pressure was of 15,093 L.

Reaching a 0,1 MPa pressure, the minimum amount of water recorded was of 8,098L in the 10th line, the maximum being yield in the 4th line, with

a value of 28,827L, resulting in a maximum difference of 20,729L.

The amount of accumulated water at a pressure of 0,125 MPa ranged from 9,542 L in the 10th line to 32,263 L in the 4th line, the difference obtained being of 22,721 L.

The minimum amount of water recorded at a pressure of 0.15 MPa was achieved in the 9th line, with a value of 10,108L, and the maximum, in the 4th line, of 35,201L, resulting in a maximum difference of 25,093L.

At a pressure of 0,175 MPa, the tapes belonging to the 2nd, 4th and 9th lines have failed, being turned off, the amount of water being recorded only for the remaining lines in operation. Thus, the amount of water in the 1st,3rd,5th,6th,7th,8th and 10th lines ranged from a minimum of 11,619 L in the 10th line, to a maximum of 33,343L in the 5th line, and the recorded difference was of 21,724 L.

At the maximum working pressure under study, of 0.2 MPa, the amount of water ranged from 12,157 L in the 10th line, to 34,438L in the 5th line. The difference obtained was of 22,281 L.

The differences observed in the lines that have resisted all the three attempts, up to the maximum pressure under study, of 0.2 MPa, concerning the amount of the accumulated water with increasing the pressure, were attributed to losses.

At a pressure of 0.075 MPa it was obtained an accumulated amount of water, which ranged from a minimum of 6,787 L in the 10th line, to a maximum of 23,713 L, obtained in the 4th line, the maximum difference recorded being of 16,926 L

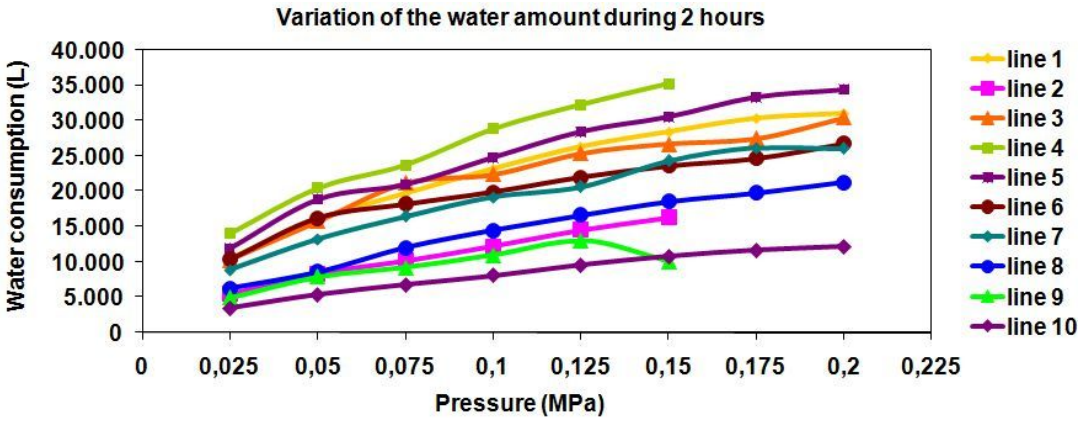

Figure 3 **Variation of the water amount in all the working lines during 2 hours**

CONCLUSIONS

Following the experimental research, the analysis and the interpretation of the results, conclusions concerning the influence of the pressure on the flow rate and the resistance of the used watering tapes can be shaped as it follows:

With the increase of pressure, the water flow in all the lines tested for two hours increases as well.

The minimum amount of water recorded was of 3,419 L, at a pressure of 0,025 MPa, in the 10th line, and the maximum amount of water was of 35,201 L, at a pressure of 4 0,15 Mpa, in the 4th line.

Out of the 10 lines tested in the experiment, 7 resisted to the maximum pressure of 0,2 MPa bar and 3 lines have succumbed to a pressure greater than 0,15 MPa.

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