# Hydraulic evaluation of drip irrigation system and the automation process based on soil moisture sensors

**Научный руководитель – Ziganshin Bulat**

***Abdelfattah Ahmed Hassan***
*PhD*
Казанский государственный аграрный университет, Kazan, Russia
*E-mail: ahmed-fa@yandex.com*

Irrigated agriculture uses the highest portion of the world's water resources. The agricultural sector accounts for 80 % of the total water withdrawn from both surface water and groundwater resources. As population grows, competition for water resources increases for domestic and industrial use. There is therefore a recognized need for research on effective methods for the use of limited water resources. Drip irrigation is considered the most efficient irrigation system. Unlike other pressurized irrigation systems such as sprinkler, in which water spreads over the entire soil surface, with drip irrigation water is supplied directly to small areas near plant roots at low flow rates (usually 0.5 ... 20 L/h) using drippers (Reinders 2006, Koech et al. 2015).

The objective of this research are to: (1) Characterize the change pattern of drippers discharge with respect to change in pressure and to recommend the best working pressure for every kind of drippers (the pressure under which the highest uniformity of water application is achieved). And (2) the inclusion of the highest performance drippers in a smart control drip irrigation based on soil moisture sensors.

To achieve the above mentioned objectives, an experimental test rig was developed to evaluate the water distribution uniformity and coefficient of variation of drippers discharge. Five different types of drippers were selected for the experiment (A, B, C, D, and E). The drippers were manufactured by Rivulis Eurodrip irrigation incorporation; (A, B, C) types are classified as pressure compensating. Drippers were tested at three pressure levels: 0.05, 0.2 and 0.35 MPa. To calibrate the soil moisture sensors, a scale of the volumetric water content was made, starting from air dry soil (15% moisture content) to saturation (100% moisture content) (with a step increase of 5%), and the corresponding sensor readings were recorded.

The results showed that for all types of drippers the discharge increased with increasing pressure. With increasing pressure from 0.05 to 0.35 MPa, the flow rate increased from (7.4 to 8.4), (from 3.6 to 4.9), (from 2.1 to 2.4), (from 3.1 to 8.2) and (from 5.7 to 15.2) L/ h for drippers A, B, C, D and E, respectively. The coefficient of variation of non-pressure compensating drippers was higher than 10% at all pressure levels, and hence they were classified as low-quality drippers according to ISO 9261-2004. For drippers of type A and C, the highest uniformity of water consumption and the smallest deviations from the specified nominal flow rate were achieved at an operating pressure of 0.2 MPa. The coefficient of variation of type A drippers was 0.10, 0.05 and 0.06 under pressure levels of 0.05, 0.2 and 0.35 MPa respectively. The coefficient of variation of type C drippers was 0.05, 0.03 and 0.11 under pressure levels of 0.05, 0.2 and 0.35 MPa respectively.

The intelligent irrigation system was designed so that it continuously monitors the soil water content and determines if irrigation is required based on the information obtained from sensors (when moisture content reaches the set point). At soil moisture contents of 20 and 25% (field capacity), the corresponding sensor readings were 81 and 53 ohms respectively.

## References

1) F.B.Reinders, Micro-irrigation: world view on technology and utilization, in: Proceedings of the 7th International Micro-Irrigation Congressin Kuala Lumpur, Malaysia, 2006.
2) R.K. Koech, A. Camargo, B. Molle, E. Saretta, J. Frizzone, G. Benhu, D. Pezzaniti, Intercomparison drippe rtesting within the INITL, Flow. Meas. Instrum.46 (2015)1–11.