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Значение системы фертигационно-инъекционного орошения в экономии оросительной воды

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Аннотация. Отмечается, что в водном балансе Азербайджанской Республики возникла серьезная напряженность из-за аридизации климата. Согласно расчетам, при сохранении тренда на аридизацию климата имеющиеся водные ресурсы Азербайджана могут сократиться более чем на 40 % до 2050 года, а к 2100 году ожидается сокращение существующих водных ресурсов в Азербайджане до 9,5...11,5 млрд м^3. При этом сегодня в Азербайджанской Республики около 70 % все потребляемой воды направляется на нужны сельского хозяйства, из который около 30…40 % теряется при транспортировке на инфильтрацию и испарение. Поэтому актуальными являются исследования по разработке и внедрению водосберегающих технологий орошения. Цель данной работы заключалась в описании технологии фертигационно-инъекционного орошения для экономии оросительной воды и ее эффективному использованию в сельском хозяйстве при орошении. В статье рассматриваются результаты опытных испытаний системы фертигационно-инъекционного орошения на серо-коричневых (каштановых) почвах в условиях Гянджа-Газахского района Азербайджанской Республики. Приводится схема усовершенствованных устройств фертигационно-инъекционного орошения. Отмечаются важные преимущества разработанной технологии. Отпадает необходимость в использовании фильтра, а затраты на строительство и эксплуатацию системы снижаются. Нет необходимости в дополнительном резервуаре для смешивания удобрений и в устройстве для подачи раствора удобрений в систему.

Ключевые слова. Фертигация, капельное орошение, каштановые почвы, почва, орошение, мелиорация, водные ресурсы, водосберегающие технологии, аридизация, климат, инъектор, сельское хозяйство, Азербайджан.

The importance of fertigation-injection irrigation system in saving irrigation water

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Abstract. It is noted that serious tensions arose in the water balance of the Republic of Azerbaijan due to the aridization of the climate. According to calculations, while maintaining the trend for climate aridization, the available water resources of Azerbaijan may decrease by more than 40 % until 2050, and by 2100 it is expected to reduce the existing water resources in Azerbaijan to 9.5...11.5 billion m^3. At the same time, today in the Republic of Azerbaijan, about 70 % of all water consumed is sent to agriculture, from which about 30...40% is lost during transportation for infiltration and evaporation. Therefore, research on the development and implementation of water-saving irrigation technologies is relevant. The purpose of this work was to describe the technology of fertigation-injection irrigation to save irrigation water and its effective use in agriculture in irrigation. The article discusses the results of experimental tests of the fertigation-injection irrigation system on gray-brown (chestnut) soils in the Ganja-Gazakh region of the Republic of Azerbaijan. A diagram of improved devices for fertigation-injection irrigation is provided. Important advantages of the developed technology are noted. There is no need to use a filter, and the cost of building and operating the system is reduced. There is no need for an additional fertilizer mixing tank and a device for feeding fertilizer solution into the system.

Keywords. Fertigation, drip irrigation, chestnut soils, soil, irrigation, reclamation, water resources, water-saving technologies, aridization, climate, injector, agriculture, Azerbaijan.

Introduction. According to the information of the world hydrometry service centers the global climate changes in the earth has become intensive. A serious tension was created in Azerbaijan water balance. According to the calculations if the

climate changes will develop at this rate, then the available water resources of Azerbaijan can be reduced more than 40 % till 2050 [1, 2, 3]. According to the account of the World Bank about aridity in the Central Asia and Caucasus countries , reduction of the existence water resources in Azerbaijan is expected: 9.5...11.5 billion m^3 till 2100 [4].

Approximately 70 % of the water taken from the water sources is directed to need of the agriculture, it is mainly used in irrigation. 30...40 % of the water used in irrigation is spent on loss during their transportation and field use. Irrigation is fulfilled with the traditional methods. That's why an amount of the leakage and evaporation losses strongly rises. According to the collected information the water resources in our country is very scanty [3] and the progressive irrigation and fertilization technologies are applied in very few areas, more precisely, 1.42 billion of irrigated soils is applied on only 74 thousand hectares.

There is a good climate condition and fruitful soils for development of the viticulture in the Ganja-Dashkasan economic region of Azerbaijan. It is very difficult to achieve rationality without conduction of irrigation for getting high productivity from these soils. Therefore, today efficient and economical use of the available water resources, prevention of water losses, increase of soil productivity and its adaptation to the global climate changes are important problems for science and practice. Very rational and progressive irrigation and fertilization technique and technologies have been worked out by us in order to achieve a solution of these problems.

The known irrigation methods and irrigation techniques can't be applied in everywhere and in watering of all the agricultural plants. On the basis of the researches efficiency of the drip irrigation method and application areas were perfectly studied. But the investigations show that there are some shortage characters of the drip irrigation method and the system (technique) that implements it and there is a serious need for improvement of this technique. A main shortage feature of the drip irrigation method is pouring water directly onto the soil. At this time enough evaporation from the soil surface happens. That's why author give the following information about the offered fertigation-injection irrigation (FII) watering system [5, 6, 7, 8].

Along with it, the experiments and tests with injection irrigation method weren't performed later. There were some reasons and they are the followings:

injection irrigation technique, mainly incompleteness of the injector constructions that are main elements (worker organ) of the injection irrigation system;

at that time the simplicity of the drip element, organization of the mass production and absence of enough experiments with injection irrigation method in the irrigation area;

absence or incompleteness of the theoretical bases, especially hydraulic account method of the injection irrigation method.

The purpose of this work was to describe the technology of FII to save irrigation water and its effective use in agriculture in irrigation.

Materials and methods. The experiment was selected in the zone of the Production Unity «Amin» of the Samuchk region where the technical and table grape sorts are grown. The grape plantation was established in the grey-brown (chestnut) soils that are characteristic for Ganja-Gazakh district and it was provided with the irrigation system.

The research method. A proven methodology for the nature of each issue was used in order to resolve the raised issues. Generally, the systematic approach method was applied. The studied issues were solved by conducting laboratorial and field experiments. The information was attracted to the scientific analysis and the relevant conclusions were drawn. Construction, work principles, their advantages and disadvantages of the existence irrigation method and watering techniques were studied collection of the information and their scientific analysis. The hydraulic account and projecting methods of the offered FII technique and technologies were prepared on the basis of the study and analysis of the calculation methods in the scientific opinion and reference sources. We achieved the following aims:

improvement of the soil injection irrigation system which has not been studied in detail, establishment of the new and regulated injector, preparation of the method in order to perform a hydraulic account of the FII system and to project it;

analysis of the fertilization technique and technology and preparation of the management principles of FII system and use of the device and technology for application of the fertilization in the root system of plants with FII system.

definition of the effect of FII technologies on development and productivity of the grape plant;

definition of the economical rationality of FII system.

Theoretical and practical importance of the research. The hydraulic calculation and projecting methods prepared for FII system can be used in calculation and projecting of the analogical systems. Conducting methods of the described laboratorial and field experiments and the obtained consequences in the work can be used as a methodical means in the scientific-research works by the researchers. The research conclusions, especially the prepared FII system give an opportunity to economize irrigation water and fertilizers for 2...4 times, to prevent the water and fertilizer losses , to increase productivity of the grape and fruit gardens, at last to prevent the water deficiency. Generalization and information about the irrigation methods and watering techniques can be used as methodic aids in the high education institutions and other training schools.

The known irrigation methods and watering techniques can't be applied everywhere and in watering of all the agricultural plants. On the basis of the researches an efficiency and application areas of the drip watering method were thoroughly studied. But the investigations show that there are some shortage features of the drip irrigation method and the system that realizes it and there is a serious need for improvement for this technique [9, 10, 11].

Along with it, later the experiments and tests were performed with the injection irrigation method. There were some reasons and they consist of the followings:

injection irrigation technique, especially incompleteness of the injector constructions that are basic elements (work organ) of the injection irrigation system;

at that time simplicity of the drip element, organization of the mass production and absence of the experiments with the injection irrigation method in the watering area;

absence or incompleteness of the theoretic bases of the injection irrigation method, especially hydraulic account method.

Results and discussion. A main worker element of the injection irrigation system is considered a worker organ which gives an irrigation water to the root system of the plant (figure 1). The known injection connector (figure 2) consists of shtuser (barrel) with a diameter of 6mm, the injection tube with a diameter of 25...309 mm and a length of 80...90 cm. A bottom of the injection tube is closed with a wooden plug or bitumen. 20...24 holes with a diameter of 1.5 mm are opened in the ground part of the injection tube.

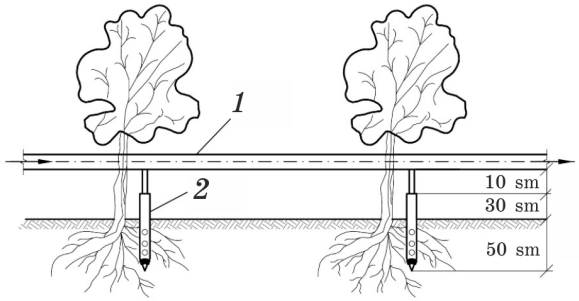

Figure 1 – **Location scheme of the injector in root system of the plant:** *1* – irrigation pipeline; *2* – injector

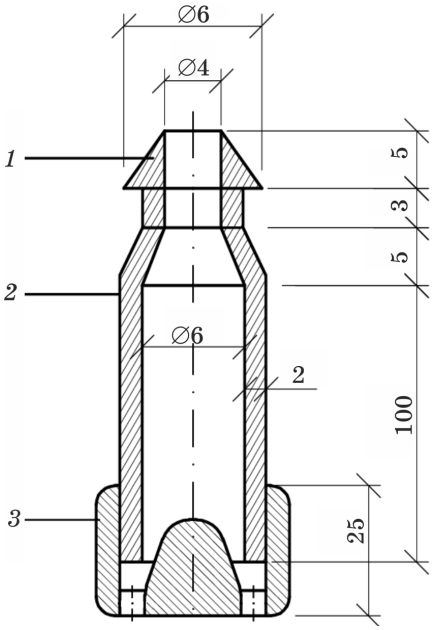

Figure 2 – **Shtuser together with drossel:** *1* – elastic conical helmet; *2* – shtuser; *3* – drossel

The shortage features of the known injector consist of these: connecting of the injectors with irrigation pipeline is rather unreliable; its blunt bottom prevents manual burying; since there is no cover at the

connector of the shtuser with the injection pipe, there is an open space between the shtuser and the pipe; it becomes easier for strange objects to fall into the injection tube; the holes that are opened on the injection tube are very small and therefore they are plastered and closed with silt and the injector stops working.

Both the system and the injector element have been improved in order to prevent one or the other deficiency of the known injection system [5]. The injector connector consists of element (shtuser), drossel, injection tube and cover.

In order to ensure reliable connection of the injector to the irrigation pipeline, the helmet of the shtuser is made in the form of an elastic and conical shape, and the part connecting with the injection pipe is made in the form of a drossel to regulate the consumption.

Conclusions

The offered FII system has a number of advantages compared to other systems and the following results were obtained. There is no need to use a filter and the construction and exploitation expenses of the system are reduced. There is no need for an additional barrel in order to mix fertilizer and an injector device in order to give fertilizer solution to the system. Closing the injector with silt and other sediments does not occur, compared to drippers. An amount of evaporation decreases over and again compared to the other irrigation method and techniques because the irrigative water does not fall on the soil surface, only the water is spent on plants transpiration. Conduction of irrigation by the turbid water with rich nutrients is possible and this gives an opportunity for decrease of the fertilizer number. Quick moistening of soils in the zone with the root system of plants is provided compared to dripping method, and this gives a chance to perform irrigation interruptedly, to economize irrigation water and to reduce exploitation expenses. It is possible to water the tomato, cucumber and other plants which were planted in rows by the injection irrigation system. At this time the injectors can play a support role for the same plants. Compared to drip irrigation system, there is no need for regulation of the water consumption that is given to every plant in the injection irrigation system. There is no need for establishment of the avancamera, diluents or filter in the injection irrigation system, if the irrigative water is taken from underground water sources.

Автор заявляет об отсутствии конфликтов интересов / The author declares that there are no conflicts of interest

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