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NON-TRADITIONAL IRRIGATION OF TERRACED ADYR SLOPES IN THE CONDITIONS OF THE FERGANA VALLEY

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ABSTRACT:

The article describes a method for developing adyr slopes providing guaranteed soil protection against irrigation erosion, mechanizing the cultivation of crops, the correct and scientifically based organization of irrigation, which increases the utilization rate of irrigation water.

Scientifically substantiated increase in the efficiency of the irrigation network by reducing water loss, increasing the utilization of land due to the use of a closed irrigation network, a significant increase in labor productivity of irrigators, establishing optimal indicators of the elements of irrigation equipment and technology.

For the efficient use of water-land resources, ways have been developed to fundamentally change the attitude to the technical condition of irrigation and drainage systems on the part of water users, to properly organize irrigation through the use of scientifically based, non-traditional irrigation equipment and technology. It is practically proved that one of the main factors of rational use and increase of irrigation water productivity in difficult terrain is the use of non-traditional equipment and irrigation technology.

The cultivation and irrigation of crops in difficult conditions of Adyr lands, on steep and sloping sloping lands, is associated with a great danger of developing water erosion of soils and great difficulties in mechanizing the field work. Adyrs of sharply towering land above the surrounding plain in the form of elongated ridges characterized by fine contour and scattered. The borders of adyr ridges are everywhere represented by steep and high slopes and ledges. In the natural state, Adyrians are almost devoid of vegetation, therefore their surface is easily washed away by water and is usually strongly dissected by dry ravines (sai). Sai give the relief of adyr ridges a lop-hilly character. To use these lands in agricultural production, reliable and effective measures are required to ensure guaranteed soil protection from irrigation erosion and to mechanize the cultivation of crops. The use of anti-erosion measures on steep slopes (cutting grooves across the slope, mechanical impact on the furrow bed, the use of polymer-forming agents, watering along contour grooves, cell furrows, irrigation with a variable stream, along grooves-slots) can reduce soil erosion to a minimum. However, there are rational limits to everything. All these measures on very steep slopes are ineffective, as intensive farming is based on a high return on invested funds, which, in turn, is associated with the level of mechanization of technological processes.

Intensive population growth and the lack of land suitable for development led to the implementation of a large amount of work on the development of adyrs of the Ferghana Valley of the Republic of Uzbekistan. The climate of the Ferghana Valley is characterized by dryness, sharp continentality and a long frost-free period. A high sum of temperatures allows you to grow cotton, develop subtropical crops, stone fruit gardening, sericulture, gardening and melon growing. The cultivation and irrigation of crops in difficult conditions of Adyr lands, on steep and sloping sloping lands, is associated with a great danger of developing water erosion of soils and great difficulties in mechanizing the field work.

Part of the Adyr lands, characterized by steep slopes, is mastered by the installation of stepped terraces (Fig. 1 and Fig. 2).

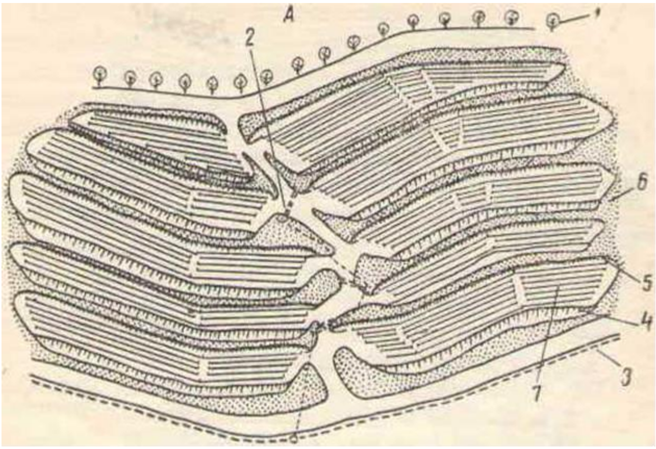

Fig. 1. Placing terraces on adjacent sites of various expositions:
A - separated by a watershed; 1- windproof strip; 2 - drainage shafts; 3 - drainage ditches and pipelines; 4 - bulk slopes of terraces; 5 - excavation slopes of terraces; 6 - berm; 7 - rows of vineyards.

Terracing is a cardinal measure to combat water erosion of the soil and the most effective way to develop previously considered unsuitable or completely unsuitable adyr lands on steep slopes. Terracing improves terrain, helps to stop the surface runoff of water, which is achieved on steep slopes of great strength, and thus allows rational use of precipitation. When terracing, along with the creation of conditions for the mechanization of planting care and harvesting, there is an increased opportunity for the proper organization of irrigation in steep slopes.

The cultivation of orchards and vineyards on the terraced slopes of the Adyr lands of the Ferghana Valley is based mainly on the experience of lowland areas. Currently, it does not have effective technical solutions for the design of the irrigation network, irrigation equipment and technology, taking into account their specific features. In this regard, here, at first glance, favorable conditions appear for the application of cheap, traditional furrow irrigation techniques. The practice of using traditional techniques and furrow irrigation technologies has shown low operational reliability and labor productivity of irrigators, as well as inefficient use of irrigation water. This led to the fact that, despite more favorable conditions, the productivity of terraced slopes still lags behind their potential capabilities. The organization of irrigation on the terraces is difficult due to the difficulty of uniform distribution of water across the terraces and the danger of the destruction of the terraces during water discharge.

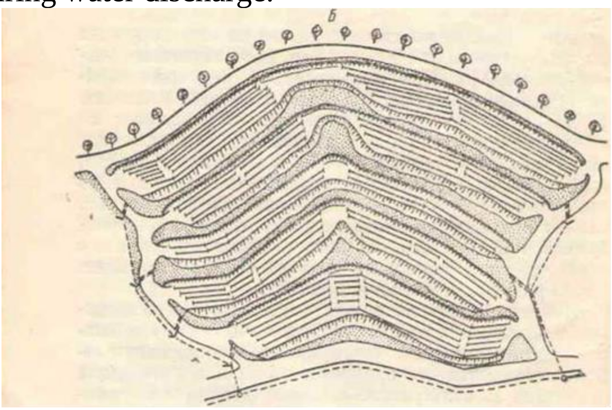

Fig. 2. Placing terraces on adjacent sections of various expositions:

B-separated by a hollow.

This requires the development and widespread adoption of advanced promising resource-saving irrigation technologies to maintain and increase soil fertility, further increase agricultural productivity in the region along with the most efficient use of land and water resources. In this regard, the scale of such work carried out on the basis of the State Program of the Republic is growing from year to year and bear fruit. Ensuring the viability of these types of activities depends on the organization of a scientifically based approach to the use of effective, resource-saving methods for organizing irrigation of agricultural crops.

In this regard, the study examined the technological parameters of the design of the elements of irrigation systems used in areas with complex terrain, the feasibility of switching to drip irrigation, or other techniques and technologies. As a result, it was recommended the construction of irrigation systems in accordance with the peculiarities of the organization of irrigated agriculture in the hilly regions of the region with complex terrain. In our

study, the level of opportunities for using cost-effective methods in these areas was studied using scientific and methodological analysis, taking into account the specifics of areas with complex terrain. Many scientists (Kostyakov, 1960; Krivovyaz, 1966; Surin, 1982) consider the use of drip irrigation to be ineffective in certain circumstances, including:
- in areas with difficult terrain;
- in areas with a heavy mechanical composition, saline and subject to salinization, as well as near groundwater (less than 1.5 m and mineralization more than 3 g / l);
- in the areas used for rice cultivation at the next sowing;
- in conditions where there are serious power outages;
- irrigation water in mineralized conditions more than 3 g / l;
- recognize that it cannot be used in areas with complex terrain, small and scattered contours.

The aim of the research work was to increase the level of exploitation and productivity of terraced slopes on the adyr lands of the Ferghana Valley, by improving the on-farm irrigation network and surface irrigation technology for furrows.

As a result of the studies, the patterns of soil water regime formation on terraced slopes were established with dispersed irrigation water supply along the length of the furrows and the hydraulic regime in the elements of the tubular irrigation network with elevated irrigation pipelines. On this basis, the design of a low-pressure irrigation network has been developed (Surin, Sabitov et al., 1991), new irrigation technologies, and irrigation network design techniques aimed at saving irrigation water and protecting the soil from degradation.

A water-saving and erosion-safe technique for irrigation of a dispersed water supply into the furrows from holes in irrigation polyethylene pipelines of small diameter located above the ground along rows of stands is proposed (Fig. 3).

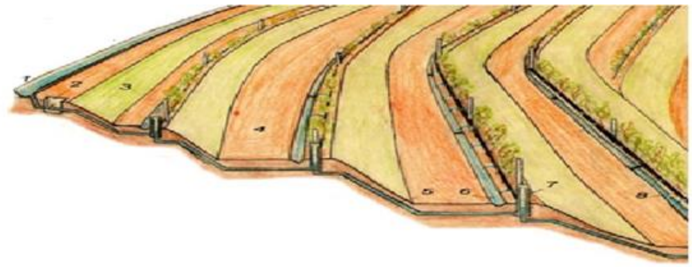

Fig. 3. Terraced irrigation network
1. Tray network; 2. Head valve; 3. Slope slope; 4. Cloth terraces;
5. Distribution network; 6. Irrigation furrows; 7. Pressure regulator;
8. Irrigation pipeline

When organizing irrigation on the slopes of the Adyrs, concrete or reinforced concrete trays or pipelines are used. Water consumption for irrigation is provided using a head valve located in the upper part of the network, cleaned of leaking objects using a synthetic mesh material.

The high pressure created by the natural relief conditions of the slope is quenched with the help of devices placed for each row of plantings, irrigation is provided with the necessary amount of water, while the required low pressure is maintained - 0.9 ... 1.0 meters. Excess water exceeding the need for plantings on the terraces is transferred to the lower part of the slope through a distribution network.

Another of the main design features of pressure regulators is the ability, if necessary, to perform or stop irrigation on a certain (terrace) row of stands.

The water flow transmitted by these devices is distributed in the form of the same number of irrigation jets along the length of the furrows through holes of different diameters, uniformly open along the length of the irrigation pipes. The number and flow rate of irrigation jets and the distance between the holes are determined using special calculation methods depending on the length of the row and its longitudinal slope. The maximum reduction in the distance between the irrigation holes ensures a uniform distribution of moisture along the length of the furrows, which leads to the maximum possible total water flow in this series. As a result, the irrigation process can be carried out in a short time with a high level of quality. Using the irrigation technique that we recommend to use in intensive orchards or vineyards on the slopes of Adir. The consumed water is distributed evenly over very short distances (1.5–4.0 m). From start to finish, evenly along rows of stands [1]. In this case, the norm of a single watering ends before 3/4 ... .4/5 of the depth of the furrow is filled with water.

1. The distribution part is made up of pipes laid at a depth of 65-70 cm on the terrace itself in the form of a cross section of terrace slopes from polyethylene pipes with a diameter of 50-75 mm; and on slopes at a depth of 20-25 cm.

2. Water pressure stabilizers are installed at the beginning of rows of stands on terraces.

3. The irrigation part is made of polyethylene pipes with a diameter of 25-32 mm. It is connected to a water pressure stabilizer at a height of 10-15 cm above the ground, in parallel in a row of seedlings, equipped with irrigation calibrated holes and plugs in the last part.

Irrigation pipelines 100 ... 180 m long are fixed on the lower trellis wire, stretched along a number of perennial plantings (Krivovyaz, 1966).

On non-sloping terraces, furrows are recommended to be cut through (Fig. 4).

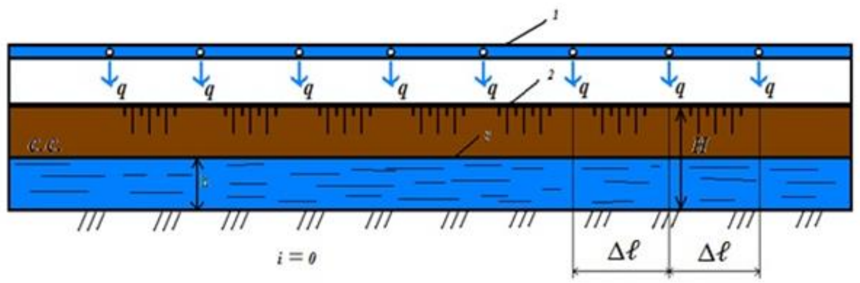

Fig. 4. Through grooves with the same permissible slope.
1- irrigation pipeline (d = 25 ... 32 mm-equipped with calibrated water outlets over short (1.5-4.0 m.) distances determined by a special calculation method); 2-crest of the furrow; 3-level of filled water in the furrow;
q-costs of irrigation jets; Δℓ-distance between outlets holes; h is the depth of water in the furrow; H-depth of the furrow.

On terraces with a longitudinal slope of the canvas, it is recommended to cut intermittent grooves or divide them with shields into several segments, the length of which is set by calculation (Fig. 5). So, as in the presence of longitudinal slopes, the water entering the furrow creates a certain flow, the amount of which increases significantly at the end of the furrows, forming a discharge and insufficient moisture accumulation in the initial parts or excessive moisture leads to a decrease in the water utilization rate.

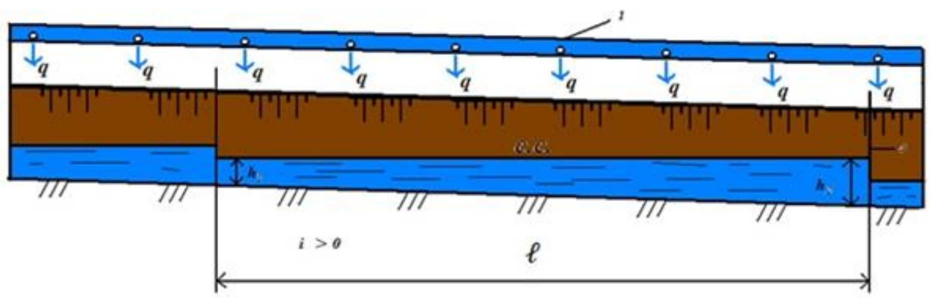

Fig. 5. Intermittent furrow with the same allowable slope.
ℓ- detachable part of the furrow;
h_1, h_2- the depth of water, respectively, at the beginning and end of the separated part furrows; 4- irrigation flaps dividing part of the furrow.

Theoretically and practically, the application of irrigation techniques and their technologies should be developed depending on the longitudinal slope of the terrain. Since depending on the slope, the total water consumption, length, diameter and other hydraulic parameters of the irrigation network are expected to change. In particular, when the slope value is less than or equal to 0.003, it is observed that the longitudinal movement of water in the slopes is limited, there is no flow, only the accumulation of water in the furrows.

The float sensor is mounted on a device that stabilizes water pressure and water flow at the end of the distribution network. Its task is to disseminate information in the daytime using sound and light at night about irregularities in the operation of irrigation pipes, when the stability of water consumption is disturbed during irrigation.

With traditional furrow irrigation, there is a significant movement of water inside the furrow. An unconventional feature of the proposed irrigation technique is that the movement of water inside the furrow runs horizontally to the side slopes of the field, wetting the coastline, and in the vertical direction to filter the bottom and bottom of the field. Water is distributed in the form of the same number of flows along the length of the ridge through openings of different diameters, open at a flat distance along the length of irrigation pipes.

The flow rates of irrigation jets and the distance between the irrigation holes are determined using special calculation methods depending on the length of the row and its longitudinal slope. The maximum reduction in the distance between the irrigation holes provides uniform moisture throughout the length of the furrow, which leads to the maximum possible flow rate of water in this row. As a result, the irrigation process can be carried out in a short time with a high level of quality. Thus, a single irrigation rate should be completed before 3/4 ... .4/5 is filled with water from the depth of the furrow. For this, we use the concept of relative water consumption conditionally, since it is impossible to simultaneously moisten the water supply along the length of the root or a certain part of it. That is, the amount of water consumed is defined as the ratio of the length of the bottom of the well, which can be moistened in a very short period of time (relative to the duration of the irrigation process). Field experimental materials were collected to study the properties of this factor, which is necessary to determine the health of the elements of non-traditional methods of irrigation.

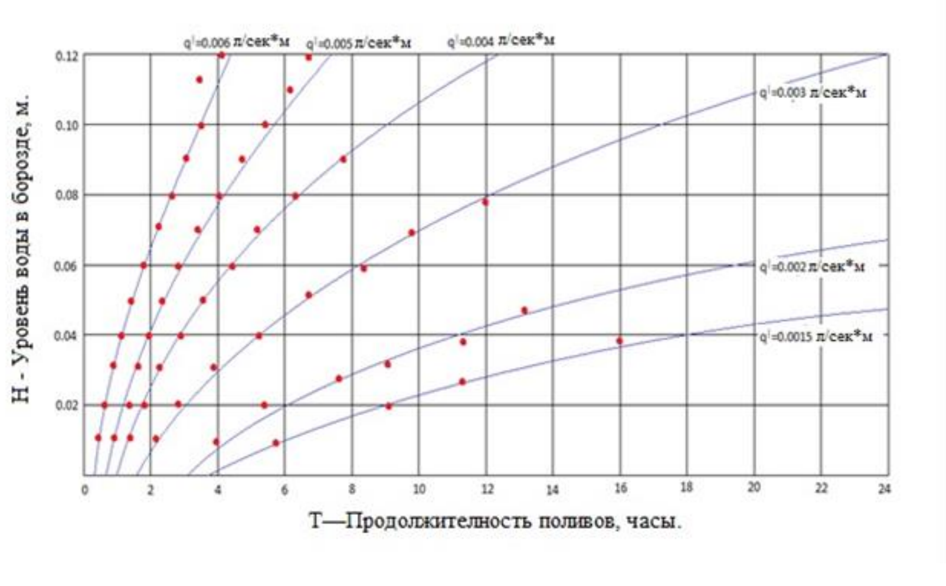

Fig. 6. Graph of water level (H) in the furrow versus specific water flow (q^1)

Scientists (Kostyakov, 1960; Surin, 1982) established the following patterns of furrow irrigation: $\upsilon = (\upsilon_n - \upsilon_u)\, \mathbf{e^{kt}} + \upsilon_u$;

where, υ – water absorption rate in the soil, m / h;
υ_n – initial rate of absorption of water into the soil, m / h;
υ_u – steady rate of absorption of water into the soil, m / h;
e - base of the natural logarithm;
k- coefficient of proportionality of water movement along the furrow, 1 / h; t- the duration of the irrigation spray in the furrow, h

$$X = L_0 (1- B\, e^{kt}) ;$$

where, X is the length of the runoff of the irrigation jet, m;
L_0 - maximum length of runaway irrigation stream, m.;
B - dimensionless paramatr.
The maximum length of the runoff of an irrigation jet is determined by:

$$L_0 = 3.6 q_6 / \mu\, \chi\, \upsilon_u ;$$

where q_6 – flow rate of water supplied to the furrow, l / s;
μ - coefficient taking into account the reduction of the wetted perimeter;
χ – coefficient taking into account the reduction of the wetted perimeter;

Based on the above regularities, we performed hydraulic calculations, which allowed us to describe empirical formulas even in the process of water accumulation in a small amount of flow and flow rate as well as an increase in water level over time (Shevelev, 1984). Field experiments were carried out on the basis of different (0.0016 ... 0.006 l / s * m) specific water consumption. During the experiments, the dynamics of changes in the water level inside the furrows was studied (Fig. 6).
For experiments, a technology was developed that corresponded to the unconventional nature of the irrigation process. One of the main tasks of field experiments is to monitor the accumulation of a certain amount of water in the field. Based on the graphical data developed on the basis of field experiments, it can be concluded that when the specific water consumption during the experiment was 0.0015 ... 0.005 l / s * m, the amount of water corresponding to the irrigation rate of 800 ... 1000 m3 / ha, was 0.04 ... 0.12 m.v.st. the meter creates water pressure; The duration of irrigation ranged from 8 to 22 hours.
Using this process, it became possible to determine the maximum amount of specific water flow. An experiment conducted at 0.006 l / s * m specific water flow rate shows that when the irrigation rate reaches 75-80%, the furrow volume reaches its full capacity for a given soil condition;
The experimental results show that the proposed irrigation technique allows, from the point of view of irrigational soil erosion, the soil to be irrigated qualitatively and in a very short time on irrigated terraced areas with complex terrain.
Production operation of the proposed irrigation network shows reliable performance and its high efficiency:
Thus, the labor productivity of irrigators in comparison with the existing irrigation technique increases from 0.12 to 3 ... 5 ha / shift;
saving of irrigation water during the growing season is 2200m3 / ha;

safe irrigation and terrace stability are provided;
high coefficient (0.9 ... 0.96) of uniformity of soil moisture along the furrow length;
A significant reduction in the duration of irrigation of a modular section (3 ... 12 hours).

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