Experimental Research on the Estimation of Productivity of Application of Systems Microwood on slope Lands and Recommendations for its Improvement

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Abstract

The article discusses the results of our 2004-2009 research period at the Erosion and Irrigation Research Facilities of the Ministry of Agriculture of the Republic of Azerbaijan in Upper Shirvan, in the Guba-Khachmaz RACS and also in the Ganja RACS in the village, Bagmanli, Alazani Valley in the Zakatalsky region with a different area under a certain type of crop (horticulture, vineyard, tobacco, corn for silage, soybeans, sugar beets, etc.), where the effects of irrigation with an IDAD sprinkler were studied. On irrigated mountain-brown, brown-brown and light chestnut soils with a maximum moisture capacity of 3000-3100m³/ha and on sierozems with deep groundwater in the Alazani Valley in Zakatalsky with an irrigation rate of 1890m³/ha. Only the topsoil layer was moistened (28-30cm). During the study it was found that in mid-July the soil moisture in the 30cm layer decreased to 40% (of the WSP), and in early September, it dropped to 40-60% (in the meter layer), which led to drying and reducing the yield of corn for silage and winter wheat. At the same time, in the control plot (five irrigation over furrows with an irrigation rate of about 16,000m³/ha), the humidity was 80-100% of the PPV. As a result of the studies, it was recommended to optimize irrigation rates, irrigation numbers and a decrease in inter-irrigation periods; it was pointed out that it is advisable to use sprinkling with the use of the design developed by the author of various mollification of micro-sprinklers in experimental plots, where it was difficult to irrigate along furrows, and in some places impossible.

Keywords: Micro-Sprinkling Equipment; Irrigation; Groundwater Occurrence; Furrow Watering; Moisture in the Soil; Irrigation Rates; Rainfed Land; Plant Density

Introduction

The main requirement for artificial sprinkling is the creation of rain with an intensity not exceeding the rate of water absorption by the soil. Various factors significantly affect both the choice of irrigation method and the irrigation technique. One and the same factor may be significant with one irrigation method and may not have much significance with another [1].

Study paths and discussion of materials

Despite this, all these factors and conditions closely interact with each other. At the facility in s. Malham of the Shamakhi region of the Republic of Azerbaijan conducted a study of irrigation with micro-sprinkling on medium and large slopes with a deep groundwater level [2].

At the same time, the effects of watering fruit trees with an IDAD sprinkler were studied in the territory of the experimental section of the EIA Research Institute Erosion and Irrigation of the Ministry of Agriculture of the Republic of Azerbaijan with an area of 4.82 hectares, as well as in the Ganja RACS in the village, Bagmanli with an area of 1.45 hectares, in the period 2004-2007. On irrigated light chestnut soils with a maximum moisture capacity of 3000-3100m³/ha and on sierozems with deep occurrence of groundwater in the Alazani Valley in Zakatalsky district in the period 2004-2006, 99 irrigations (500-650m³/ha each) with an irrigation rate of 1890m³/ha were carried out. Only the topsoil (28-30cm) was moistened [3].

In mid-July, soil moisture in the 30cm layer decreased to 40% (of the WSP), and in early September, it dropped to 40-60% (in the meter layer), which led to drying and lowering the corn crop for silage and winter wheat. At the same time, in the control plot (five irrigation along a furrow with an irrigation norm of about 16,000m³/ha), the humidity was 80-100% of the PPV [4].
As a result of the studies, it was recommended to optimize irrigation rates, irrigation numbers and a decrease in irrigation periods; it was pointed out that it is advisable to use sprinkling with the use of the design developed by the author of various modification of micro-sprinklers in experimental plots, where it was difficult to irrigate along furrows, and in some places impossible [5].

The Research Institute “Erosion and Irrigation” with the participation of the author continued the experiments on watering the IDAD apparatus and other modifications of the micro-sprinkler irrigation technique of various types of agricultural crops on newly developed rainfed lands, i.e., by the example of research objects, on which experiments were laid to study the problems of the development of mountain irrigated agriculture in the zones; Guba-Khachmaz, Ganja-Gazakh, Karabakh, Upper Shirvan, Sheki-Zagatala and other regions of the republic [6].

It should be noted that in the experimental zones, soils are high-altitude, forest-brown, loam (serozem), etc. with different soil characteristics. In all these areas of the experiment, the occurrence of groundwater is deep [7].

With all this, it was planned to increase the density of plants and not to conduct international processing.

In the research area, a “reference plot” with more friendly seedlings was identified, with a total area of 4.82 ha, located in the Gubinsky RACS special economic zone in the Guba region (Table 1).

### Table 1: The density of plant standing and germination in a dedicated accounting area

<table>
<thead>
<tr>
<th>Width Options</th>
<th>Row spacing, sm</th>
<th>Density of standing plants, thousand units / ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>4.5-5.0</td>
<td>198</td>
</tr>
<tr>
<td>II</td>
<td>2.8-3.0</td>
<td>280</td>
</tr>
<tr>
<td>III</td>
<td>2.2-2.5</td>
<td>383</td>
</tr>
</tbody>
</table>

During the growing season, 94 irrigations were carried out with an estimated irrigation norm of 4590 m³/ha, which did not ensure normal soil wetting. The height of the fruit tree plants (about 5.0 cm) and the area along the humidification contour (16-11 m²), which was less than when irrigating along the furrows. The root system spread in the layer 2.0-3.0 deep, and with groove watering in the layer more than 3.0 m deep [8].

The humidification of such a small plot was uneven, and the yield of apple trees in more humid areas in the Guba region was 210.9 c/ha and in the Ganja RCAS, and in the dried out 147.3 and 113.9 c/ha, respectively [9].

The lack of treatment of crops with narrowed row spacing led to a strong compaction of the soil and a decrease in water permeability, which increased the surface runoff during irrigation.

The increase in standing density did not have a noticeable effect on weed inhibition.

The development and growth of fruit trees (apples, pears, peaches, persimmons, etc.) took place at a relative soil moisture of 20-40%, soaking did not exceed 25 cm.

In the future, micro-solutions of the type IDAD and others available in the republic, proposed for serial production, were not tested anywhere else for sprinkling.

Initially, in 2003, we selected a pilot experimental site on the territory of the GEP of the Gubinsky RCSAN in the Guba region, on the foothills of the Shohdag, with a total area of 2.8 hectares, and on the GES of the Ganja RCAS settlement. Bagmanli with an area of 1.45 hectares. The soils of these massifs are medium-thick (30-40 cm), slopes greater than -0.02-0.025.

Furrow irrigation is difficult, due to the complex terrain. Therefore, sprinkling with small norms was planned here with the use of micro-sprinklers of various modifications and IDAD [9].

Water supply for irrigation of these areas was carried out from hydrants installed through 85,120,200.

It was found that at irrigation rates of 300-420 m³/ha, the soil is soaked to a shallow depth (20-30, sometimes 40 cm). The low rate of absorption of the upper soil layer and large slopes provided a significant surface discharge (30%), increasing from irrigation to irrigation. The increase in moisture in the soil was only 100-300 m³/ha. Small irrigation rates require private watering (after 5-6 days).

The supply of large irrigation rates (600-700 m³/ha or more) is difficult due to the mismatch of rain intensity (2-3 mm/min) and the rate of absorption of water into the soil [11].

Large raindrops destroy the soil structure, and the upper 2-3 cm swim; absorption rate is reduced, resulting in surface discharge.

Then, a micro-sprinkling pilot area of 1.5 hectares was organized for irrigation of soybeans, sugar beets, corn for silage, fruit trees, on the territory of the AIA Research Institute “Agriculture” of the Tarter District with an area of 1.5 hectares [12].

The soils of the site (with a total area of more than 30 hectares) are medium loams, slopes of 0.005 (Fig. 1). And so in 2004 irrigation was carried out with an irrigation rate of 3700 - 4200 m³/ha (irrigation rates from 350 to 550 m³/ha).

Humidity in the 60 cm layer did not fall below 60% of the PPV, and after irrigation was 80-90% of the PPV.
Soaking the soil was not more than 30-50cm (most of the water was in a layer of 20cm). Productivity was 14-17kg/ha [13].

In 2005, late spring moisture recharging was carried out on the upper part of the 0.6ha site (the groundwater level was deep here, and on the rest of the site it ranged from 2 to 6.5m) [14].

The moisture reserves in the soil turned out to be insufficient to obtain seedlings, therefore, in mid-May, re-sowing was carried out after pre-sowing irrigation with a norm of 250-300m³/ha.

Studies on sprinkling at this facility showed that the rain intensity of IDAD (3mm/min) is greater than the rate of absorption of water into the study soil. Therefore, with a flow of 500m³/ha, puddles and a surface discharge at the facility were formed [15].

The discharge was 20-30%, which led to uneven wetting. At the beginning of the growing season due to timely treatments, surface discharge was reduced (up to 8-10%).

When the processing of crops ceased, the discharge again reached 16-17%. Soil wetting during irrigation did not exceed 30-60cm. Greater wetting and better uniformity of moisture distribution under these conditions is achieved with irrigation rates of more than 300-400m³/ha. At such rates, about 60-70% of the water remains in the upper (20cm) layer, and the plants are not fully provided with moisture.

There are observed drawbacks of sprinkling with the IDAD apparatus, in the presence of an irrigation network impassable for mechanisms during soil cultivation. It was found out that irrigators and roads along them occupy 6% of the area, water losses in irrigators in the Guba RCAN amounted to 25-30% per 1 km, and in Terter AIA -15%.

Micro-sprinkling water distribution is presented in Table 2. While the greatest losses were due to discharge and evaporation. The water balance during sprinkling in the experimental plots is presented in Table 3.

Table 2: Conditions for sprinkling IDAD apparatuses on the territory of the Guba RACS, when watering orchards on the territory of the AIA Research Institute “Agriculture” in Terter (“Terter RACS”) district, in s. Sarydzhal sugar beets and layers in the Ganja RACS in the village. Bagmanli orchards and vineyards

<table>
<thead>
<tr>
<th>Indicators</th>
<th>“Guba RACS”</th>
<th>«Terter RACS”</th>
<th>“Ganja RACS”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil type</td>
<td>Loesslike loam</td>
<td>Pebble-gravel (thin)</td>
<td>Loesslike loam</td>
</tr>
<tr>
<td>Maximum field moisture capacity, m³/ha</td>
<td>2970</td>
<td>1100</td>
<td>2500</td>
</tr>
<tr>
<td>Water permeability in the 1st hour, m/hour</td>
<td>0,03-0,05</td>
<td>0,06</td>
<td>0,04</td>
</tr>
<tr>
<td>Slopes</td>
<td>0,001-0,0001</td>
<td>0,02-0,03</td>
<td>0,004-0,007</td>
</tr>
<tr>
<td>Groundwater depth, m</td>
<td>01-Apr</td>
<td>more than 10</td>
<td>2,5-7-10</td>
</tr>
<tr>
<td>Mineralization, g/l</td>
<td>03-Oct</td>
<td>until 30</td>
<td>13-14</td>
</tr>
<tr>
<td>Surface discharge from the irrigated area, %</td>
<td>no</td>
<td>until 30</td>
<td>max 10-20</td>
</tr>
<tr>
<td>Moisture charging and washing irrigation, m³/ha</td>
<td>Conducted in the winter of 2500-3000</td>
<td>It is impractical</td>
<td>Conducted in the late spring, 1500</td>
</tr>
<tr>
<td>Productivity, kg/ha</td>
<td>30-40</td>
<td>05-Oct</td>
<td>15-20</td>
</tr>
</tbody>
</table>

Table 3: Water balance during sprinkling at experimental sites of Terter and Ganja RACS. Balance articles of the Ganja RACS Tertersky RANS

<table>
<thead>
<tr>
<th>Balance articles</th>
<th>Ganja RACS</th>
<th>Terter RACS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m³/ha</td>
<td>%</td>
</tr>
</tbody>
</table>

https://peernest.org/ebooks.php
Irrigation rates for various soils and slopes at which water flow begins are given in tab. 4. According to B.H. Aliyev, the surface discharge in the Gubinsky RCAS zone with a half of apple orchards in the experimental area until August is 7-8%, and in August -20%, which was confirmed by the results of studies presented in 2005-2009. It should be noted that according to the results of studies in the Terter district on small slopes and fertile soils, where field leveling is carried out annually, after supplying 350-400m³/ha, puddles appear on the field surface.

When testing and IDAD with reflex nozzles working positionally, both at the Guba-Khachmaz State Aviation Plant and at the Terter RACS, puddles and runoff formation were detected on medium and heavy soils with irrigation rates of 250-300m³/ha. was established.

Table 4: Irrigation rates (m³/ha) before runoff appears according to the results of studies in the regions of Guba-Khachmaz and Ganja-Gazakh zone

<table>
<thead>
<tr>
<th>Soil</th>
<th>Slopes</th>
<th>Slopes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0,0002-0,0005</td>
<td>0,002-0,007</td>
</tr>
<tr>
<td></td>
<td>watering the</td>
<td>watering the</td>
</tr>
<tr>
<td></td>
<td>first</td>
<td>last</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>450</td>
<td>230</td>
</tr>
<tr>
<td>Light loamy</td>
<td>340</td>
<td>150</td>
</tr>
<tr>
<td>Medium Loam</td>
<td>290</td>
<td>90</td>
</tr>
</tbody>
</table>

Small irrigation rates (before the formation of runoff) require a large number of irrigations. So, in the Shamaki region, in the experiments conducted by the Shamaki OEB Research Institute “Erosion and Irrigation” (4.8ha) on heavy soils with deep groundwater with the same irrigation rate (7000-7500m³/ha), the number of irrigation by micro-sprinkling (42-53) was significantly larger than with furrow irrigation (6-8).

To combat the crust and compaction, it was necessary to sharply increase the number of row-spacings (up to 10), which did not completely destroy the crust near the stem. Shallow and uneven soil wetting and untimely cultivation of crops resulted in a noticeable decrease in yield during sprinkling.

Micro-sprinkler production experiments were conducted on the territory of the Zakatala district.

Tests of the sprinkling technique such as IDAD, MDL, MDR and developed by us have established that, with a deep groundwater level and difficult terrain, the use of IDAD for irrigation of tobacco, corn, apple trees and others is more promising compared to other dominant traditional irrigation methods.

The test results confirmed that, in order to reduce the intensity of rain on the sprinkler head of the apparatus, it is desirable to install special nozzles of the vortex for sprinkling up to 40-50 m in radius of action and additives of additional devices for regulating the rain layer, contributing to the damping of pressure in the pressure head of the pump.

All this made it possible to reduce the rain intensity and give irrigation rates of 600-700m³/ha (with a daily operating mode) without significant surface discharge and soil erosion. Such measures can reduce runoff, but this reduces labor productivity on irrigation. However, it is also difficult to set up irrigators with a higher water supply intensity in the range of 800-1000m³/ha, where significant planning work is required.

The proposed nozzles installed on the IDAD sprinkler have a relatively low rain intensity, which is explained by the desire to create a microclimate over plants with low water consumption and limited geometry of the irrigated area.

Experience proves that with an increase in the width of the grip, it would be possible to reduce the rain intensity, while maintaining labor productivity.

The experimental work carried out by us at the above research facilities in Terter, Zagatala and Ganja on the irrigation of soybeans, sugar beets, corn and tobacco allows us to give an approximate average rain intensity (mm/min) at irrigation rates of 300-500m³/ha depending on the soil: sandy -0.3-0.4, light loamy -0.2-0.3, medium and heavy loamy -0.1-0.2.

As studies have shown, a wide production test of this irrigation technology, taking into account the recommended rain intensity, will clarify the technical and economic indicators and the conditions of application of micro sprinkling.

As a result of the study, it turned out that the inconsistency of the rain intensity of the rate of water absorption in the soil, the formation of surface discharge and soil erosion, uneven and shallow wetting, the imperfection of the open irrigation network during surface irrigation, the need for different methods of
irrigation during the growing and non-growing periods, low land use coefficient, the high cost of irrigation and other features are, to a certain extent, in conflict with the requirements of the rural owner Watering technology for cultivated agricultural crops in the area of deep groundwater.

The analysis showed that micro-sprinkling irrigation can also find distribution under conditions of close occurrence of non-saline groundwater.

With a deep groundwater level, high yields of agricultural crops can be achieved, however, technical and economic indicators at this level of development of sprinkling equipment and the existing socio-economic conditions of life of farmers and other farms of the republic are less favorable compared to surface irrigation with furrows.

Further improvement of sprinkling with higher technical and economic indicators, perhaps, will allow to expand the areas of micro-sprinkling irrigation to the conditions of mountain irrigated agriculture in the republic.

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