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RESEARCHING THE NATURAL MOISTURE OF THE HILLY SOILS OF THE NAMANGAN REGION WITH THE AIM OF DEVELOPING RAIN-FED GARDENING

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Abstract
This article presents the results of measurements carried out to determine natural soil moisture in the hilly areas of the Namangan region. The possibilities for the development of rain-fed gardening with the effective use of natural moisture in hilly soils are also analyzed.

Keyworts: hilly terrain, natural soil moisture, rainfed landscaping, mulching agricultural technology, terracing agricultural technology.

Introduction

Rainfed farming is a type of farming that uses rainfall to irrigate crops. This type of farming provides most of the demand for agricultural products of the population of countries in many regions. For example, this situation is 90% in Latin America, 75% in the Middle East and North Africa, 65% in East Asia, 60% in South Asia and 95% of agricultural land in Africa [1]. In general, the importance of irrigated and dry lands in providing the world''s population with agricultural products is very great. In particular, in many countries of the world, rain-fed, rain-fed agriculture is carried out only due to natural irrigation, and their area is almost 4 times larger than the area of irrigated lands. That is, the total area of irrigated lands is 301 million hectares, and dry lands - 1 billion 226 million hectares [2, 3].

Climate change on Earth, increasing desertification, and reducing drinking and irrigation water pose the problem of saving water and growing agricultural products in conditions of water scarcity for all humanity. One solution to this problem is the development of rain-fed farming. Therefore, it is important to experimentally analyze the possibilities of dry farming under conditions of water deficiency, not only in regions of the world with a humid climate, but especially in arid climates. The foothills and hilly terrain of the Namangan region of the Republic of Uzbekistan are considered a region with an arid climate with an average annual precipitation of 200-300 mm. Despite the fact that there are many areas with the possibility of obtaining high yields through irrigated agriculture, limited water resources do not allow this. On the contrara, due to the reduction of water resources in recent years, previously irrigated agricultural land is being lost to agriculture and desertification is intensifying. In such conditions, not only the widespread use of water-saving agricultural technologies

in irrigated agriculture, but also the study of the possibilities of rain-fed agriculture, based only on precipitation, becomes relevant.

Main Part

Large areas of the Namangan region are occupied by hills and rolling plains. It extends 118 km from west to east and 23.3 km from north to south. The Northern Fergana Hills approach the Kurama and Chotkol ranges from the north and northwest and continue as the Moylisay Hills in eastern Kyrgystan. In the western part it ends with the Asht hills on the territory of the Republic of Tadjikistan [4]. Due to the elevation of the hills compared to Central Fergana, the amount of precipitation increases, summer temperatures are lower than in the desert, and light, typical and dark gray soils are common. And this allows plants to grow denser and higher compared to the plains of the foothills [5].

Im the hilly areas of the Namangan region, the amount of precipitation increases from west to east and from low hills to high ones. In particular, the amount of precipitation increases from 100-200 mm on the western hills of Chust-Pop and from 220-260 mm to 300-400 mm on the eastern hills of Kasansay, Yangikurgan, Uychi [4].

According to an analysis of precipitation data for the last 10 years (2012-2022) from the Uchkurgan weather station, located at the closest distance (about 10 km) from the Uytschi hills in the easternmost part of the region's hills, the average precipitation was 291.7 mm. According to the Kasansay agrometeorological post, located on the Kasansay Upland, the average annual precipitation was 262.9 mm.

According to lange-term observations, the development of rain-fed (lalmi) fruit growing is observed only in the hilly and mountainous regions of Uzbekistan at an altitude of 1000-1300 m above sea level, where the annual precipitation is 600-700 mm or more [6, 7]. However, in the mountains of the Namangan region there are unlikely to be areas with such conditions. Most of the hills of the Namangan region are occupied by territories with a precipitation amount of 200-400 mm and an altitude of 500-1200 m above sea level. Therefore, it is quite difficult to create a rain-fed garden in the mountains of the Namangan region using traditional methods, without the use of any water-saving agricultural technologies.

Despite the above information, research work was carried out to assess the possibilities for the development of rain-fed gardening based on natural soil moisture in the hihlands of the Namangan region. For this purpose, soil moisture was determined during the growing season of plants in different parts of the hills of the Namangan region.

Research Methodology

Soil moisture was determined by the thermal method and recorded in the accounting book. Thermal method is a method for measuring soil moisture based on the difference in mass of wet and dry soil by drying the resulting soil samples under the influence of a high temperature thermostat.

To measure soil moisture, elevated areas were selected in the Uychi, Chortak, Yangikurgan and Kasansay districts of the Namangan region, where irrigated agriculture is not carried out and is preserved in a natural state. In these areas, holes were dug 1 meter deep and soil samples

were taken from soil layers at depths of 10 cm, 30 cm, 50 cm, 70 cm and 90 cm. During the active growing season of 2022, that is, in April-August, once every soil samples were taken for a month and its moisture was measured. The moisture content of the obtained soil samples was determined by the thermal method.

Soil samples from the experimental area were weighed on electronic scales. Then they dried for 4-6 hours in a thermostat at a temperature of 105-110°C and weighed again. To obtain more accurate data, the soil sample was dried a second time for 2 hrs and measured. Soil moisture was calculated using the following formula:

$$\omega = \frac{(a — б) \cdot 100}{(б — в)}$$ [8]

ω– natural moisture, as a percentage of the dry mass of the soil
a – mass of a cup with wet soil, in grams
b – mass of a glass with dry soil, in grams,
(a – b) – the amount of water evaporating during drying, in grams,
– net weight (without soil) of the glass, in grams,
(b –) – mass of dry soil, in grams.

The data obtained can be presented as a percentage of the dry mass of the soil or its volume.

Resultss and discussions. The measurement results for determining natural soil moisture are presented in Table 1.

Table 1 Natural moisture of hilly soils located in Uychi, Chortak, Yangikurgan and Kasansay districts of Namangan region at a depth of 1 meter (according to the growing season of 2022) (in %)

Months	Uychi	Chortak	Yangukurgan	Kasansay
April	12,1	12,1	11,8	12,3
May	10,8	11,1	11,6	10,7
June	11,0	10,1	11,3	11,2
July	11,1	10,5	10,8	10,1
August	10,5	10,5	10,1	10,2

Note: the table was compiled by the authors based on the results of experiments.

As it can be seen from table. 1, the greatest moisture accumulated in April and had almost the same indicators in all hilly areas. That is, the average soil moisture was 12%. In subsequent months it fluctuated from 10.1% to 11.6%. This situation showed that soil moisture is maintained at a high level even in the summer months, that is, as in the spring season. Also, the fact that the soil moisture on the Uychi, Chortak, Yangikurgan and Kasansay hills is almost the same shows that the soil and climatic conditions of these hills are very similar to each other.

According to the results of experiments conducted by M. Umarov [8] on irrigated pale gray soils of the Karshi desert, moisture in the soil at a depth of 0-30 cm is 8.6% of the dry mass of the soil, at a depth of 30-95 cm it is 10. 2% can be absorbed by the plant. However, these amounts are the limit of the

wilting moisture of plants, and when the humidity reaches this value and decreases, the process of wilting of crops begins. If the soil moisture remains in this state for a long time and the crops are not watere, they may dry out. In table Figure 2 compares plant wilting moisture data and soil moisture data collected on Uychi, Chortok, Yangikurgan and Kasansay hills.

Table 2 Results of comparison of plant moisture during wilting (according to M. Umarov) and data on soil moisture in the areas of the Uychi, Chortak, Yangikurgan, Kasansay hills.

(in %)

Date of measuring	Wilting moisture of plants on irrigated light gray soils		Uychi		Chortak		Yangikurgan		Kasansay	
	0-30 sm	30-90 sm	0-30 sm	30-90 sm	0-30 sm	30-90 sm	0-30 sm	30-90 sm	0-30 sm	30-90 sm
April	8,6	10,2	13,8	11,0	13,5	11,2	13,2	10,8	13,3	11,7
May			11,8	10,1	12,5	10,2	12,4	11,1	11,7	10,1
June			11,6	10,6	11,9	10,3	11,7	10,8	11,8	10,8
July			10,1	11,7	10,5	10,5	10,3	11,1	9,7	10,4
Avgust			10,5	10,4	11,0	10,2	10,3	10,0	10,0	10,4

Note: the table was compiled by the authors based on the results of experiments.

According to Table 2, plant moisture in the 0-30 cm soil layer in all hilly areas in April-August is higher than wilting moisture. Soil moisture in a layer of 30-90 cm on the hills of the Uychinsky district in May was 10.1%, which is 0.1% less than the moisture content of wilting plants. The same situation is observed in Kasansay in May. In Yangi-Kurgan, soil moisture in August was 10.0%, which is 0.2% less than the moisture content of plant wilting. During the wet months of April-August, in a layer of 30-90 cm of hilly soil in the Chortok region, plants did not decrease at all due to moisture.

Analysis of the data in Table 2 shows that the natural moisture content of plants collected during the active growing season in the soils of Uychi, Chortok, Yangikurgan, and Kasansay was higher than the wilting moisture content. This shows that there is high potential for development of dryland horticulture in these hilly areas. Having correctly assessed these possibilities, professors and teachers of the Department of Ecology of Namangna State University have been conducting practical experimednts on creating rain-fed arid gardens in the northeastern hills of the Namangan region since 2013. In particular, in 2013, experiments were carried out on 10 apricot trees, 5 apple trees and 1 peach tree in the northern hilly area of the Uychinsky district. This experiment is based on the agricultural technology of mulching, which is very important for preserving the natural moisture accumulated in the soil. The word “mulsch” or “mulschig” probably comes from the German word “molsch”. We are talking about using soft, degradable straw and leaves as mulch [9, 10].

The results of the experiment show that the seedlings had a good growing season even without watering. The growth of the seedlings was about 20-50 cm, no less than when watered. This situation has shown that using this method it is possible to develop gardening even in water-scarce areas [11, 12].

In 2014, a new experimental site was created near the site of the first (2013) experiment. In this case, the experiment was carried out more than in the previous one, that is, on 5 seedlings of apricot, cherry, plum and quince, 15 apple bushes and 10 peach seedlings. In this experimental garden, the agricultural technique of mulching was also used. According to the results of the experiment, the seedlings had a good growing season even without watering. The growign season of experimental seedlings was the same as the growing season of irrigated trees [13, 14]. This experimental work, aimeed at developing dry gardening in the hilly areas of the Namangan region, continues to this day. The results obtained in subsequent times were also very positive, and all the fruit trees were harvested [15].

Conclusion

According to the data presented and the results of measuring soil moisture, in the northern and eastern parts of the hills of the Namangan region (Uychi, Chortak, Yangikurgan and Kasansay hills), the development of rain-fed gardening using water-saving agricultural technologies is possible. By effectively using these opportunities, it is possible to create rainfed gardenss over large areas, grow additional fruit products for export and the domestic market, create new jobs and save a lot of water resources. In addition, by increasing the number of trees and creating agroforests in desert, desert, grassland and steppe landscapes on the hills, more favorable conditions will be created for the living, development and reproduction of flora and faune. As a result, the ability to ensure the sustainability of hilly landschafts will increase.

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