DEVELOPMENT OF AN ALGORITHM FOR PRODUCTIVE USE OF THE IRRIGATED LAND

Diana Abdumuminova¹, Igor Kravchenko², Yury Kuznetsov³, Vladimir Goncharenko³, Yulia Mikhaylova³

¹Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Tashkent, The Republic of Uzbekistan
²Russian State Agrarian University - Moscow Agricultural Academy, K.A. Timiryazev, Moscow, The Russian Federation
³Orel State Agrarian University, Orel, The Russian Federation

Abstract: The studies have established that the yield of winter wheat variety «Chillyaki» on an area of 5 hectares averaged 5.5 t/ha, corn – 2.89 t/ha, mung – 2.08 t/ha, potatoes – 0.59 t/ha, melon – 9.74 t/ha, rice – 4.36 t/ha, marks – 14.64 t/ha. The total profit from the sale of wheat is 423,750,00 UZS, and the net profit is 254,250,00 UZS. 129,000,00 UZS were spent per hectare of re-crops cultivation. The largest net profit comes from rice cultivation after wheat harvest, followed by corn and mung bean, and melon comes the third one, raw cotton is in the last place.

Keywords: level groundwater, mineralization, irrigation, variety, yield.

INTRODUCTION

Today, about 12.3% of the main cultivated areas in the world are irrigated, basically all the food products for the needs of the mankind are cultivated in these areas. The protection of these areas from erosion for many countries of the world located in the regions with a dry climate is an urgent problem. Today 1.094 million hectares or 56% of the area in the world are subject to irrigation erosion.

¹Corresponding Author. E-mail address: kentury@yandex.ru
The main area subject to degradation is located in the countries of Asia, Africa, South America. The damage caused by the irrigation erosion is up to 12-42 billion per year in the United States, and worldwide it’s up to 400 billion.

In the world practice of agriculture on lands confirmed by erosion, special interest is paid to conducting research on sowing winter wheat with various methods of soil cultivation and improving the agricultural technology of its cultivation, effective use of the mineral fertilizers and obtaining high yields, in this way, reducing the washout of soil aggregates and improving soil agroecology.

The studies carried out to improve the ecological state of soils, preserve their fertility, increase the grain yield of winter wheat, which are relevant and serve to provide the population with food, are of particular interest.

In the recent years, the structure of crops in Uzbekistan has dramatically changed, i.e. almost 50% of the irrigated area is occupied by grain crops. After harvesting grain crops (depending on the availability per year), part of the vacated area is used for double crops. However, it has not yet been precisely established which of the crops are more economical when sowing. To solve this issue, we carried out some experiments on the territory of the Dustlik farm in the Besharyk district of the Fergana region.

LITERATURE REVIEW

Science and practice of the advanced farms have proven that the rational use of the irrigated land, obtaining the largest amount of products per unit area while saving labor and means of production and improving soil fertility is achieved on the basis of correct crop rotations, sowing repeated crops with progressive agricultural techniques and extensive mechanization of the agricultural work. In the cotton crop rotations the main components are alfalfa, corn, sorghum, winter crops and intermediate and secondary crops (rapeseed, rye, early maturing corn, mung bean, rice, carrots, melon and other legumes).

In the conditions of the irrigated typical sierozem of the Tashkent region, the option with sowing corn for silage and re-sowing corn together with alfalfa turned out to be the most highly productive one. For both options, 81.6 t/ha of silage mass (22357 fodder units) or 5 times (512%) more in comparison with pure sowing of alfalfa were obtained [1, 2].

In the conditions of the irrigated typical sierozem and meadow soils of the Khatyreichinskaya group of areas of the foothill plains, an increase in the yield of fodder per unit area can be achieved by obtaining two yields of corn together with peas for silage and stubble peas for green mass. According to the data, on the irrigated lands of the Zarafshan Valley, corn together with peas of early spring sowing provides 78.29 t/ha, and double peas 54.53 t/ha of green mass (21266 fodder units) or 25-30 times more compared to the pure sowing of alfalfa [10, 11].

Among sorghum-sowing countries, the United States occupies a leading position both in terms of the area under crops of about 6 million hectares and almost in yield. In the warm climate of the irrigated agriculture in the Central Asia, corn and sorghum are a powerful reserve for increasing production of the concentrated and succulent fodder.

It is difficult to overestimate the role of leguminous crops in the system of cotton-row crop rotation as a protein component and source for increasing soil fertility.
It is recommended (for non-alfalfa crop rotations) to sow forage crops in such combinations as peas for grain + corn for silage during the first year and corn for grain with peas during the second year. Such combinations provide 23 thousand of fodder units and 1440 kg of protein totally within two years [3, 4, 16].

In the conditions of the irrigated light sierozem of the Zarafshan Valley, peas for grain and stubble corn for grain yield 34.2 thousand fodder units and 3152 proteins [12, 17].

Increasing protein production is impossible without expanding soybean crops. Soybean grain contains 30-40% of protein, amino acids, which are absorbed by 90%, 17-27% of fat, 25-27% of carbohydrates, vitamins and phosphates. In Uzbekistan soybeans can be sown as a double crop.

In cotton-growing fogs after harvesting a number of major crops before the first frost, usually occurring in the last decade of October, frost-free days with an average air temperature of 20-24º are enough for growing soybeans for grain and green fodder. This is confirmed by the experiments conducted on the cultivation of soybeans in the conditions of Turkmenistan, in the conditions of Samarkand, Kashkadarya and Jizzakh regions of Uzbekistan, on meadow soils, on the newly developed lands of the Kyzylkum massif, on newly developed desert-sandy soils [8, 9, 13, 15, 20].

In the conditions of the irrigated typical sierozem of the Tashkent region it was revealed that from winter rye sown in the first half of October after two machine harvests and the selection of raw cotton after loosening between the beds, 26.8-33.6 t/ha of green mass were obtained. After plowing the rye, corn was sown. On average, for two years, the corn grain yield in the control plot was 6.98, against the background of rye 8.04 t/ha, silage mass 53.15 and 61.00 t/ha. The possibility of cultivating intermediate double crops (rye, rapeseed, oil radish) in the crop rotation system in various cotton growing zones has been widely and comprehensively studied in the former All-Union of SRICG (All-Union scientific and research institute of cotton growing), THIAME (Tashkent Institute of Irrigation and Agricultural Mechanization Engineers) and other scientific and research institutes [5, 6, 18, 19, 22].

As you know, crop rotations should first of all contribute to a progressive improvement in soil fertility and an increase in the yield of the main crop of cotton, and now of grain crops.

Organic debris left by plants in the soil, being the main energetic material for microbiological activity, has a noticeable effect on the physical, agrochemical and biological properties of soil.

The main source of the organic matter in the soil is root system and crop residues. Both annual and perennial crops are capable to accumulate organic matter in the soil. The material factor gives stable strength to the soil structure.

Mould is a source of food for plants. Humic substances (mould) are actively involved in the initial stages of soil formation, contributing to the biological weathering of minerals and rock destruction. The elements necessary for the nutrition of microorganisms and higher plants are extracted from the minerals. The strongest destructive effect is exerted by sulfonic acids and some low-molecular decomposition products of organic residues - organic acids, amino acids, etc., aqueous solutions that have a strongly acidic reaction [23].

The removal of elements, necessary for plant nutrition and soil structuring, from the soil profile depends on the content and composition of humus.
Humic substances are the main accumulator of soil nitrogen - the most important element of plant nutrition.

In addition to nitrogen, humus accumulates a number of ash elements used for plant nutrition: phosphorus, potassium, iron, calcium, and other macro and microelements, which are released during the decomposition of humus.

The scientists have found that some preparations of humic acids contain tens of times more cobalt and copper, 3-5 times more manganese and 20 times more zinc than the original soils from which these preparations were obtained.

When humus decomposes under the conditions of good aeration and sufficient humidity, large amounts of carbon dioxide enter the presoil layers of the atmosphere, which plays an important role in enhancing photosynthesis of the organic substances (vitamins, antibiotics, enzymes) directly stimulating plant growth and development.

Having studied the yield of cotton varieties: «Namangan-77», «Yulduz», «Gulsara», «Termiz-31» under the conditions of the desert zone of the Kashkadarya region of the Kasan region and the Surkhandarya region of the Dzharkurgan region as the main and secondary crop [21], the following recommendations were given for the production:

5-7 irrigations, depending on the year, should be carried out according to the scheme 1-3-1, 1-2-2, with the mode 70-70-60% and 2-4-1, 2-3-2 at a soil moisture regime of 75-75-60% for the varieties «Namangan-77» and «Termiz-31». The irrigation rates at 70-70-60% moisture content are 930-1370 m$^3$/ha, irrigation rates are 5470-6150 and 6190-6370 m$^3$/ha, respectively.

Thus, the scientists have performed certain works for the effective use of the irrigated lands, but the issues have been studied separately: agricultural techniques of the first and double crops separately. On the experimental field with an area of 5 hectares, wheat variety «Chilaki» was sown; after harvesting the wheat, double crops were cultivated according to the following scheme: 4 cotton varieties («Tashkent-6», «Omad», «S-4727», «Andijan-34»), rice (Arpasholi), mung bean, corn variety «Uzbekistan-306», potatoes and melon (variety «Kirkma»).

MATERIALS AND METHODS

The influence of this method on the dynamics of the growth of the varieties «Tashkent-6», «Omad», «S-4727», «Andijan-34», rice (Arpasholi), mung bean, corn variety «Uzbekistan-306», potatoes and melon (variety «Kirkma») for a high yield was observed in the soils with a groundwater level of 1-3 m and a mineralization of 1-3 g/l. The field experiments were carried out in accordance with the methods «Methodology of State Variety Testing of Agricultural Crops», «Methods of Agrochemical, Agrophysical and Microbiological Research in the Irrigated Cotton Regions», «Methodology of Field Experiments with Cotton», Statistical processing of experimental data was carried out according to the method of B.D. Dospekhova using the Microsoft Excel program.
RESULTS AND DISCUSSION

The meteorological conditions are the following: the atmospheric temperature should be favorable to seedlings, further growth and development of wheat. The effective temperature in the reporting year was higher than the multiyear one. The double crop was sown at the end of June, and the average effective temperature from July to October was 34.8 °C. However, it should be noted that the average effective temperature for wheat growth, from July to October, was not sufficient for opening the boll of the above-mentioned early ripening varieties of cotton.

The soil texture of the experimental plot is light loamy on top, medium loamy on the bottom. The bulk density of the soil of the experimental plot is not entirely favorable for the normal growth and development of plants, but the presence of aryl and shook in the horizons led to an increase in the weight by volume. The layering of the soil-ground part also led to a change in HB (the lowest moisture capacity) - from top to bottom, the moisture content gradually increases (Table 1).

Table 1. Volume weight and the lowest moisture content of the soil of the experimental plot

| Depth, cm | Volume weight, g/cm³ | HB, % |
|-----------|----------------------|------|
| 0-10      | 1.36                 | 16.3 |
| 10-20     | 1.38                 | 17.1 |
| 20-30     | 1.39                 | 18.7 |
| 30-40     | 1.41                 | 19.8 |
| 40-50     | 1.43                 | 22.3 |
| 50-60     | 1.44                 | 23.5 |
| 60-70     | 1.46                 | 25.2 |
| 70-80     | 1.47                 | 25.9 |
| 80-90     | 1.47                 | 26.3 |
| 90-100    | 1.48                 | 27.2 |

HB₁₀₀ = 22.2%

Water permeability during first hour is strong, but then it decreases sharply (Table 2).

Table 2. Water permeability of soil of the experimental plot

| Hours | mm/min | m³/ha |
|-------|--------|-------|
| 1     | 143.7  | 1437  |
| 2     | 39.8   | 398   |
| 3     | 32.4   | 324   |
| 4     | 25.3   | 253   |
| 5     | 18.2   | 182   |
| 6     | 14.9   | 149   |
| Total during 6 hours | 274.3 | 2743 |

The soils of the experimental plot are very poor in nitrogen, phosphorus and potassium. To obtain high yields with good quality high fertilization rates are required (Table 3).
Table 3. Mobile forms of nutrients

| Horizons, cm | N-NO₃ | P₂O₅ | K₂O |
|--------------|-------|------|-----|
| 0-30         | 18.9  | 21.4 | 160 |
| 30-50        | 15.6  | 12.0 | 100 |

Wheat variety “Chillyaki”

Analysis of the water extract shows that the soils of the experimental plot belong to the categories of low salinity (Table 4).

Table 4. The content of the water extract, (%)

| Horizons, cm | HCO₃⁻ | Cl⁻ | S₄O₆²⁻ | Ca | Mg | Na | K | Saline amount | Solid |
|--------------|-------|-----|--------|----|----|----|---|---------------|-------|
| 0-30         | 0.027 | 0.017 | 0.123 | 0.035 | 0.021 | 0.005 | 0.002 | 0.230 | 0.262 |
| 30-50        | 0.027 | 0.014 | 0.079 | 0.030 | 0.012 | 0.005 | 0.002 | 0.169 | 0.187 |

Watering was carried out with the determination of cell sap using a hand-operated refractometer OC-101, when at 12 o’clock the concentration of cell sap reached 8.3-9.2%.

The phenological observations show (Table 5) that at the beginning of the 3rd decade of April, the height of wheat reached 45 cm, tillage capacity was 4.6% per 1 m².

Table 5. Growth and development of the winter wheat

| Variety      | Height, cm | Tilling capacity, units. | Density of planting, 1m² units. |
|--------------|------------|--------------------------|---------------------------------|
| Chillyaki    | 45.2       | 4.6                      | 78.3                            |

Wheat indicators are given in Table 6. The yield of wheat variety “Chillyaki” on the area of 5 hectares averaged 5.50 t/ha.

Table 6. Wheat indicators

| Wheat variety | Quantity of plants for 1m², units. | Height, cm | Number of grain in the spike | Weight 1000 of grain, g | Weight of grain for 1m², g | Yield, t/ha |
|---------------|-----------------------------------|------------|-----------------------------|------------------------|---------------------------|-------------|
| Chillyaki     | 127.3                             | 72.4       | 35.8                        | 39.4                   | 667.1                     | 5.50        |

The growth and development of cotton are given in Table 7, 8. The recording carried out on October 25 shows that among the tested varieties of cotton, Tashkent-6 turned out to be more productive, but it should be noted that there were no open bolls on the date indicated above. The conclusion is that the cotton variety “Tashkent-6” should be sown earlier.
Table 7. Growth and development of cotton for 1 of August

| Cotton variety | 1-replication | 3-replication |
|----------------|---------------|---------------|
|                | Height, cm    | Amount of leaflets, units. | Height, cm | Amount of leaflets, units. |
| Tashkent-6     | 12.5          | 5.5             | 11.5        | 4.2             |
| Omad           | 15.4          | 6.3             | 12.1        | 5.4             |
| C-4727         | 15.1          | 5.8             | 11.3        | 4.4             |
| Andizhan-34    | 13.8          | 4.9             | 8.7         | 3.9             |

Table 8. Growth and development of cotton for 1 of September

| Cotton variety | Height, cm | Fruit spurs, units. | Flower bud, units. | Flower, units | Sets, units. | Height, cm | Fruit spurs, units. | Flower bud, units. | Flower, units | Sets, units. |
|----------------|------------|---------------------|--------------------|---------------|--------------|------------|---------------------|--------------------|---------------|--------------|
| Tashkent-6     | 56.2       | 9.1                 | 8.8                | 1.2           | 0.5          | 61.2       | 8.9                 | 10.1              | 1.1           | 0.8          |
| Omad           | 72.7       | 11.4                | 14.5               | 1.9           | 2.0          | 75.6       | 12.9                | 16.1              | 1.5           | 2.1          |
| C-4727         | 71.0       | 10.2                | 12.7               | 0.95          | 0.5          | 70.3       | 9.9                 | 11.1              | 1.2           | -            |
| Andizhan-34    | 76.0       | 13.4                | 11.3               | 0.1           | -            | 77.1       | 13.3                | 12.1              | 0.31          | -            |

The yield of the double crops is given in Table 9, from which it can be seen that there were no open bolls, so it was impossible to harvest the cotton. Among the crops tested, maize, mung bean, rice, carrots and melon yielded satisfactory results.

Table 9. Double crops yield, t/ha

| №   | Name of the crop | Replication | Average |
|-----|------------------|-------------|---------|
|     |                  | I           | II      | III     |         |
| 1   | Tashkent-6       | The bolls didn’t open |         |         |         |
| 2   | Omad             | The bolls didn’t open |         |         |         |
| 3   | C-4727           | The bolls didn’t open |         |         |         |
| 4   | Andizhan-34      | The bolls didn’t open |         |         |         |
| 5   | Corn             | 2.93        | 2.87    | 2.89    | 2.89    |
| 6   | Mung             | 2.12        | 2.07    | 2.04    | 2.08    |
| 7   | Potatoes         | 0.55        | 0.61    | 0.62    | 0.59    |
| 8   | Melon            | 9.78        | 9.81    | 9.63    | 9.74    |
| 9   | Rice             | 4.41        | 4.35    | 4.32    | 4.36    |
| 10  | Carrots          | 14.26       | 14.20   | 14.26   | 14.64   |

The total profit from the sale of wheat is 423,750.0 UZS, and the net profit is 254,250.00 UZS, 129,000.00 UZS were spent of double crop cultivation per hectare. The largest net profit was obtained from rice cultivation after harvesting wheat, then from corn and mung bean, the third place is taken by melon, raw cotton is in the last place.
CONCLUSIONS

On the basis of the field and production experiments, it can be concluded that under the conditions of the Fergana Valley, it is quite possible to grow two crops during one growing season, and this is very important for the valley region. After sowing double crops, where mung bean, melon and carrots were grown, the yield was 2.99, 3.02, 3.17 t/ha, respectively, and a large volume of raw cotton was obtained.

This work was carried out in accordance with the priority directions of the development of science and technology (agriculture, biotechnology, ecology and environmental protection) of the Republic of Uzbekistan.

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RAZVOJ ALGORITMA ZA PRODUKTINO KORIŠĆENJE NAVODNJAVANOG ZEMLJIŠTA

Diana Abdumuminova¹, Igor Kravchenko², Yury Kuznetsov³, Vladimir Goncharenko³, Yulia Mikhaylova³

¹Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Tashkent, The Republic of Uzbekistan
²Russian State Agrarian University - Moscow Agricultural Academy, K.A. Timiryazev, Moscow, The Russian Federation
³Orel State Agrarian University, Orel, The Russian Federation

Sažetak: Istraživanjima je utvrđeno da je prinos sorte ozime pšenice «Chilliaki» na površini od 5 ha u proseku iznosio 5,50 t/ha; kukuruza 2,89 t/ha; boba 2,08 t/ha; krompira 0,59 t/ha; dinje 9,74 t/ha; šargarepe 14,64 t/ha. Ukupna dobit (Uzbekistan valuta – UZS) kod prodaje pšenice je 423.750,00 UZS, a neto dobit 254.250,00 UZS/ha kod obrade zemljišta za nove useve. Najveća neto dobit je redosledom kod: proizvodnje pirinča, žetve pšenice, kukuruza i boba mung. Manja dobit je kod proizvodnje dinja, dok je dobit kod proizvodnje sirovog pamuka, najmanja, i na poslednjem mestu.

Ključne reči: nivo podzemne vode, mineralizacija, navodnjavanje, sorta, prinos.

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