GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 11, Issue 06, June (2023)

THE USE OF SPRINKLER IRRIGATION IN CULTIVATION OF VARIOUS CROPS

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ANNOTATION

The article presents the optimal conditions for the development of crops, created during irrigation by pulsed sprinkling, which contributes to an increase in productivity up to 15-20%, which will solve the issues of ensuring the country's food security.

Key words: irrigation, sprinkler, conditions, sprinkling, productivity, water saving.

АННОТАЦИЯ

В статье приводится оптимальные условия для развития сельскохозяйственных культур, создаваемые при орошении импульсным дождеванием, способствующая повышение урожайности до 15–20 %, что позволит решить вопросы обеспечения продовольственной безопасности страны.

Ключевые слова: орошение, спринклер, условия, дождевание, урожайность, экономия воды.

The main needs for irrigation methods are the creation and maintenance of an optimal water regime for plants, uniform distribution of water over the field, ensuring high labor efficiency in irrigation, as well as guaranteeing an increase in soil fertility and a favorable reclamation state of irrigated lands. Irrigation methods should not lead to irrigation erosion and have a high utilization rate of irrigation water.

The development potential of irrigated lands in the world is limited by the availability of water resources. According to FAO, the countries of North Africa, West Asia, Central Asia, as well as large areas of South and East Asia have already reached the limits of their potential or are close to it. Among these countries, eight countries have exceeded their available irrigation potential, and 20 countries (including China) are using over 75% of their potential.

The rate of expansion of the area of irrigated land has slowed down significantly. Based on a comparison between supply (irrigation potential) and demand (for agricultural products), FAO has developed a projection that the global area of irrigated land may increase at a relatively slow pace, reaching 318 million hectares in 2050 (for comparison: in 2006 it was 301 million hectares) [1, 2].

In the countries of the African continent and the Asian region, the predominant method of irrigation is surface irrigation by checks, contours or furrows - 70% and 96%, respectively, and 30 and 2% of irrigated areas are allocated for sprinkling and drip irrigation.

On the other hand, in the European Region, 82% of irrigated areas are sprinkled and drip irrigation and 14% are surface irrigation. In the US, the irrigated area is 19.99 million hectares, of which 11.11 million hectares were surface-irrigated. At present, 27.7% of irrigated lands are covered by sprinkling and drip irrigation.

In Russia, the irrigated area is essentially 1.2 million hectares. The share of lands irrigated by sprinkling is 90%, and the level of mechanization of surface irrigation is less than 5% [8].

Optimal conditions for the development of agricultural crops, created during irrigation by pulsed sprinkling, contribute to an increase in yields of up to 15–20%, which will solve the issues of ensuring the country's food security.

With surface irrigation, irrigation is distinguished by furrows, irrigation by strips, irrigation by flooding. Irrigation methods have both positive and negative sides.

Today, many sprinkler systems are used all over the world, ranging from simple manual movement to large self-propelled systems. These devices replenish the water consumed by plants or provide soil softening to make it suitable for agricultural activities.

Sprinkler irrigation is a method in which water is distributed from above to the soil surface using sprinklers that break the water flow into small droplets.

Water is supplied to the site and distributed through it through a system of pipes, then it is released into the air through spray heads and gets to the surface of the soil.

Sprinkler systems create in some cases conditions more favorable for growth than with drip irrigation by lowering the soil temperature and increasing the humidity in the surface layer.

Suitable cultures. Sprinkler irrigation is suitable for most grain, vegetable, fruit and berry, tree crops, etc. However, large sprinklers are not recommended for irrigation of delicate crops, such as lettuce, because large drops of water created by sprinklers can damage the crop. Water can be sprayed both under a canopy and in greenhouses.

Suitable slopes. Sprinkler irrigation can be adapted to any agricultural slope, whether it is uniform or undulating. Side pipes supplying water to sprinklers should be laid out along the line with the smallest height difference, if possible. This will minimize pressure changes on sprinklers and ensure uniform irrigation.

Suitable soils. Sprinklers are best suited for sandy soils with high penetration levels, although they adapt to most soils. The average precipitation rate from sprinklers (in mm/hour) is always chosen less than the base rate of soil penetration, so that surface flooding and runoff can be avoided.

Sprinklers are not suitable for soils that easily form a crust. If sprinkler irrigation is the only available method, light small sprayers should be used. Large sprinklers producing large drops of water should be avoided.

Suitable water for irrigation. The supply of clean water free from suspended sediments is necessary to avoid:

- blocking of sprinkler nozzles;
- harming the crop by covering it with sediment.

Typical sprinkler irrigation scheme

1. Pump
2. The main pipeline line, and sometimes underwater lines
3. Side pipeline (distribution)
4. Sprinklers

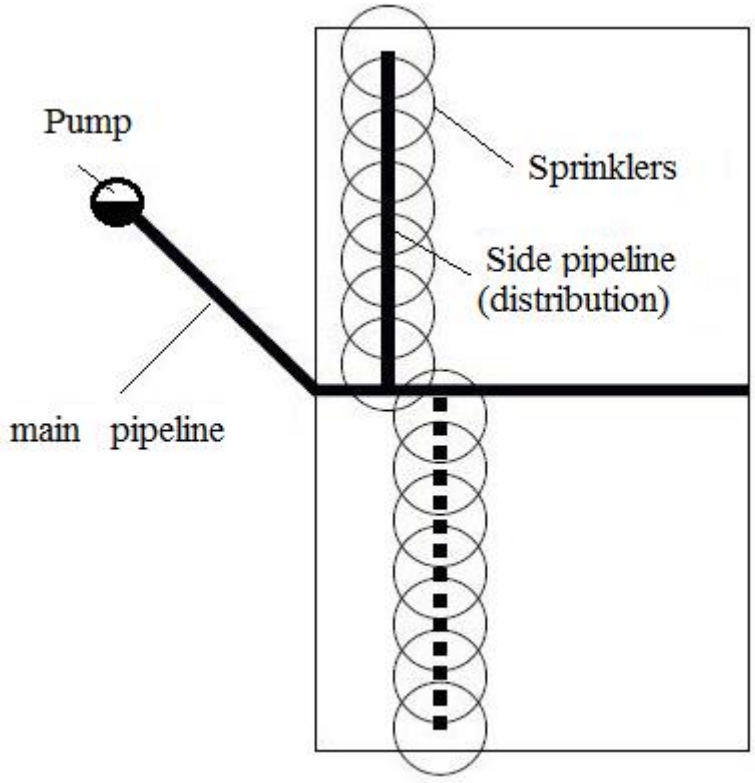

Figure- 1. Typical sprinkler irrigation scheme.

1. A pumping unit that takes water from a source and provides pressure to supply the pipe system. The pump must ensure the flow of water at sufficient pressure so that water is applied at a speed and volume corresponding to the rate of penetration of water into the ground.
2. Main pipes (trunk pipes) that deliver water from the pump to the sides. Pipelines can be permanently located on the surface of the soil or underground, as well as suspended (in protected ground). In other cases, they are temporary and can move from field to field.
3. Side branches of pipelines (distribution) deliver water from the main line or underwater lines to sprinklers. They can be permanent, but more often they are portable and made of plastic so that they can be easily moved.
4. Sprinklers, water-emulsion devices that turn a jet of water into droplets. The distribution of sprinklers on the site should be organized in such a way that the soil surface is moistened as evenly as possible.

A wide range of sprinkler systems is available for both small farms and large-scale applications. Sprinklers can be moved around the site, manually or by machines. The effectiveness of sprinkler irrigation is highly dependent on climatic conditions. Sprinkler irrigation technology can help farmers adapt to climate change by using their water supply more efficiently. This is especially appropriate if there is (or is expected to be) a limited or irregular water supply for agricultural use.

The advantages of the surface irrigation method are: extensive experience gained all over the world, simplicity and cheapness of the elements of irrigation technology; it does not require the use of energy, machines, scarce materials. The surface irrigation method has the following disadvantages: the need for manual labor, dependence on the relief, the need for significant planning work, destruction of the soil structure, the need for additional agricultural work, deterioration of the soil air regime, uneven moistening in area and depth, difficulty in regulating the degree of moistening, an obstacle to the mechanization of agricultural work.

The advantages of sprinkling are: mechanization of irrigation, the possibility of automation, increased labor productivity, uniformity of soil irrigation by area, humidification of air and plant leaves, the possibility of frequent watering by small standards, low requirements for surface layout, no obstacles to mechanization of agricultural work, high efficiency of the irrigation network, high coefficient of land use, the possibility of making fertilizers with irrigation water, preservation of soil structure, reduction of depth filtration.

The principle of applying irrigation norms in accordance with the current course of water consumption of plants is the basis for the operation of pulse sprinkling systems. Such sprinkling is consistent with the trend of improving sprinkler technology in the direction of reducing the intensity of rain and increasing the number of simultaneously operating sprinklers and installations [7].

Technical means and technological schemes of irrigation by pulse sprinkling allow:

– maintain the humidity of the active soil layer and the surface air layer at an optimal level without sudden fluctuations characteristic of periodic watering;

– to provide a long-term directed effect of artificial rain on the conditions of plant growth and development and the external environment;

– to supply plants in accordance with the course of their water consumption;

– to disperse the irrigation current as much as possible and thereby reduce the cost of building a pipeline network.

Along with the advantages of pulse sprinkling, there are some disadvantages:

– the influence of unfavorable wind conditions;

– additional water consumption to create a microclimate in the environment of plant development.

From the considered disadvantages, the creation of a microclimate with additional water costs is aimed at improving the water regime of plants and, in general, can be excluded from the disadvantages [5].

Sprinkler irrigation is a method of irrigation that provides artificial rain similar to natural rain. Such irrigation can be used in the cultivation of various agricultural crops, such as wheat, corn, potatoes, sugar and table beets, carrots, grapes, strawberries, as well as fodder crops [4-9]. Sprinkler irrigation is most effective on sandy soils characterized by a significant degree of infiltration. The irrigation rate should be set below the infiltration value in order to prevent the formation of effluents.

Sprinklers can be: small (from 3 to 18 m), medium (up to 25 m), long (up to 70 m) range. Small-range sprinklers, as a rule, provide fine sprinkling. To prevent clogging of the sprinkler nozzles, in particular of a small radius of action, it is desirable to use clean water without suspensions and impurities [3, 11].

With the help of a pump, water is usually supplied through a pipe system. Then, with the help of sprinklers, the water flow is broken into droplets, sprayed through the air and lowered to the ground. The pumping unit supplies water from the source to the hydraulic system under the necessary pressure to ensure uniform distribution of water throughout the irrigated area. Rotating sprinkler devices are placed in increments of 9-50 m so that the irrigation zones overlap each other. Several side lines are used to irrigate large areas. Wind exposure negatively affects the degree of uniformity of irrigation, therefore it is necessary to rationally place sprinkler devices on the surface of the field.

Qualitative changes in new generation sprinklers should be associated with deep transformations of their technological and technical characteristics, automated movement of mobile units and automation of technological processes [10]. To develop the theoretical and practical foundations for solving this problem, special attention should be paid to the requirements for the instrumentation of a multi-support wide-reach sprinkler machine, which provides a better technological process of the sprinkler machine.

The sprinkler machine is equipped with the instrumentation of the control system, which allows for the automatic execution of the hydraulic reclamation technological process during the implementation of precision farming by the machine in a long-term operation mode [12].

Uniformity of irrigation of agricultural crops becomes important in the system of precision agriculture, since under-watering leads to a decrease in yield, and an overabundance of moisture leads to soil degradation. Manufacturers of sprinklers are striving to develop and introduce into agricultural production machines that allow them to issue irrigation rates differentially, which will meet the need of crops for moisture, while reducing irrigation and irrigation standards and preserving soil fertility [6, 13].

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