

THE INFLUENCE OF ENVIRONMENTAL FACTORS ON SUNFLOWER (HELIANTHUS ANNUUS L.)

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Annotation.

This article presents information on the importance of achieving high technological quality indicators of sunflower in the Republic of Uzbekistan through the application of various agro technologies. It also discusses the significance of sunflower seeds for human health when consumed, their role in the prevention and treatment of various diseases, as well as the plant's requirements for environmental factors.

Keywords: variety, soil, oil, grain, sunflower, fertilizer, temperature norm, optimal, variant, vegetation, legume, vegetable, canned products, confectionery.

At present, "the irrigated land area in the world amounts to 1.6 billion hectares. Of this, nearly 23 million hectares of agricultural land are used for cultivating sunflower in order to meet the demand for vegetable oil for a population of 7.4 billion people. In recent years, due to the continuous growth of the population, the demand for vegetable oil has also been increasing. Therefore, when cultivating sunflower as a secondary crop for oil production, it is one of the urgent issues to develop economically efficient agro technical measures aimed at determining the effects of sowing dates and fertilizer application rates on its yield and oil content."

Under the soil and climatic conditions of Uzbekistan, sunflower can be cultivated both in spring and summer seasons. However, during the period of uniform germination, the early seedling stage, and the initial growth phase, sunflower plants require cool climatic conditions. Sunflower seedlings can tolerate a certain degree of cold until they develop 4 to 8 leaves. However, after full

emergence and until the flowering and complete ripening stages, sunflower exhibits a high demand for warm air temperatures.

If, during the flowering stage, precipitation and cloudy weather are accompanied by high humidity, this may lead to reduced pollination and, consequently, lower yield formation. From germination to full seed maturity, sunflower requires a total heat accumulation of 2600 to 2850°C. This indicator varies depending on the variety and soil-climatic conditions. The growing period becomes longer toward northern regions.

Sunflower seeds germinate at temperatures of +5 to +10°C, while germination occurs more rapidly at +10 to +12°C. The optimal temperature is +18°C.

At temperatures higher than this, the germination process accelerates. Seedlings can tolerate temperatures as low as -6°C. However, when temperatures are high and water is insufficient, yield decreases sharply. The negative effects of high temperatures are observed from full emergence until the end of the flowering period.

For sunflower plants to carry out the photosynthesis process under normal conditions, they require sufficient light and heat. When light intensity is low, the rate of photosynthesis decreases significantly. For example, when cultivated under shaded conditions with 40% reduced sunlight, yield decreases by 64%. In particular, insufficient light during the flowering and seed formation stages leads to a considerable reduction in yield. Therefore, sunflower is considered a plant that does not tolerate cloudy and low-sunlight conditions.

Sunflower heads and leaves exhibit heliotrope behavior, meaning they orient toward the sun. For this reason, farmers in the Thrace and Marmara regions have referred to this crop as “sunflower” or “sun-turning plant.” This characteristic of sunflower leaves enhances photosynthesis and, consequently, positively affects yield formation. According to research data, leaves that move toward light utilize 9% more light compared to stationary leaves, and phototropism increases the photosynthetic rate by 10–23%.

Sunflower is classified as a C3 plant (C3 refers to the international classification of plants based on their environmental requirements).

Water requirements. Although sunflower is not highly resistant to drought, it has been successfully cultivated under unfavorable conditions where other crops cannot grow. It is highly efficient in utilizing soil moisture. This is due to its well-developed root system, as the taproot can penetrate to depths of more than 2 meters. Although the plant may appear to stop growing under drought stress, it continues the process of photosynthesis, which is one of its distinguishing and advantageous features compared to other plants. Therefore, short-term drought does not significantly affect yield.

Due to its well-developed root system, sunflower is relatively drought-tolerant and can extract required water from deeper soil layers; the dense hairs on the stem and leaves reduce water loss through evaporation. However, water demand is not uniform throughout the growing period. From germination to the stage of head development, the plant requires 20–25% of the annual water requirement. During the flowering stage, water demand is highest, accounting for about 60% of total water consumption. Under drought conditions, yield decreases significantly.

During the growing season, sunflower requires approximately 500–600 mm of natural precipitation. It is desirable that this rainfall be evenly distributed throughout the growth period. Water requirements vary depending on the region due to differences in soil structure, temperature, relative humidity, and wind effects. Under normal conditions, daily water consumption of sunflower is 3.5–3.8 mm, but at high temperatures of around 35°C, it can reach up to 7.5 mm.

Water requirements vary across different growth stages. For uniform seed germination, sufficient soil moisture is essential. Compared to other crops, sunflower seeds require relatively less moisture for germination. According to scientific studies, from germination to head formation, sunflower utilizes approximately 20% of its total annual water requirement.

The period of highest water demand is the 40-day interval before and after flowering, during which the plant uses approximately 60% of its total water consumption. If the plant experiences water stress during the flowering period, a decrease in yield is observed. Particularly, water stress during the 10-day period of flowering and pollination has a strong negative impact on yield. For example, a 20% reduction in water supply during this period may lead to a 50% decrease in seed yield. This is due to the inhibition of proper development required for fertilization under severe drought conditions.

After flowering, the plant utilizes about 20% of its total water requirement. Scientific studies have shown that water stress during the 20-day period after flowering negatively affects the oil content of the seeds. Under extreme drought, lower leaves begin to dry, and as stress continues, this drying progresses upward. Leaf shedding reduces the photosynthetic capacity, which negatively affects yield.

Sunflower does not favor excessively humid conditions. High relative humidity increases the incidence of diseases that cause head rot. Therefore, sunflower is more successfully cultivated in regions with lower relative humidity. Under the conditions of Uzbekistan, it has been observed that natural precipitation during the summer season is insufficient for sunflower cultivation. Therefore, additional irrigation is required during the growing period.

Sunflower Cultivation under the Conditions of Uzbekistan

It has been established that natural precipitation during the summer season in Uzbekistan is insufficient for sunflower cultivation. Therefore, additional irrigation is required during the growing period.

Soil Requirements. Sunflower can be grown on various types of soils. It can develop well even in relatively low-fertility soils. However, it does not grow well and fails to produce a good yield on excessively stony, sandy, waterlogged, or loose soils. Compared to other field crops, one of its advantages is its tolerance to salinity. Sunflower can be cultivated in saline soils of Uzbekistan depending on the degree of salinity.

Sunflower grows and develops best in black, gray, and meadow soils with a pH level of 6.0–6.8. The optimal soil pH for sunflower cultivation ranges from 6.0 to 7.2. It cannot develop normally in highly acidic soils. Additionally, soils used for sunflower cultivation should not have high groundwater levels and must be free from drainage problems.

Nutrient Requirements. According to scientific data, sunflower absorbs about 25% of its required nutrients after flowering, while the majority is absorbed during the flowering stage. Phosphorus is mainly absorbed from germination to head formation; nitrogen from head formation to the end of flowering; and potassium from head formation to seed maturity.

At the initial stages of growth, applying small amounts of nitrogen, phosphorus, and potassium promotes better plant development. The remaining portion of mineral fertilizers applied during the head development stage ensures rapid growth and higher yields. A deficiency of nitrogen leads the plant to absorb more phosphorus, while potassium uptake decreases. High rates of phosphorus after head formation can have negative effects.

To produce 1 ton of seeds along with the corresponding by-products, sunflower absorbs approximately 60 kg of nitrogen, 26 kg of phosphorus, and 186 kg of potassium.

Sunflower is a light-demanding, short-day plant; it does not grow well in shaded areas or under cloudy conditions, and its leaves become smaller.

Pollination Biology. Sunflower is primarily a cross-pollinated plant, although self-pollination can also occur under natural conditions. Studies show that about 25% of pollination may occur through self-pollination, but this often results in empty seeds. According to researchers, the ability for self-pollination can be inherited, and in some varieties, it may reach up to 90%.

Cross-pollination mainly occurs with the help of insects, and in some cases, by wind. A single plant flowers for approximately 8–10 days, while an individual flower remains open and receptive for 24–36 hours. During the flowering period, if

the plant is adequately supplied with water, nutrients, and light, effective cross-pollination occurs, resulting in well-filled seeds. The seeds develop their characteristic color, and upon full maturity, the head turns yellow or brown, while seed moisture decreases to 12–18%.

Conclusion.

In conclusion, achieving high technological quality indicators in sunflower cultivation largely depends on the application of appropriate agro technical practices, especially environmental factors. Scientific studies conducted by researchers also highlight the beneficial properties of sunflower seeds for human health.

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