

# MANUAL ON CULTIVATION OF SUNFLOWER



**MINISTRY OF AGRICULTURE AND ENVIRONMENTAL  
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**MANUAL ON CULTIVATION OF  
SUNFLOWER**

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The scientific and production manual was prepared on the basis of research data carried out in various climatic conditions of Turkmenistan and in the relevant research institutions of Central Asia.

The manual gives advice on agro technical rules, methods and timing of the development of sunflower cultivation. It also describes the main diseases and insects encountered in this crop, which adversely affect the quantity and quality of the crop, as well as how to control them.

The manual is intended for agricultural specialists, tenants, farmers, teachers and students of agricultural specialties of higher and secondary educational institutions.

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## INTRODUCTION

The program for the development of the agro-industrial complex of Turkmenistan for 2019-2025, adopted under the leadership of President Gurbanguly Berdimuhamedov, provides for an increase in the volume of agricultural products in our country and a reduction in its imports. In the program it is aimed increasing the production of vegetable oil in the country by 89,334 tons in terms of the main indicators of agricultural production in 2019-2025. To achieve these goals, it is necessary to increase the number of cultivated oilseed varieties in our country. In particular, it is necessary to expand the crops of sunflower, corn and sesame, which are oilseeds, and to give the possibility of their cultivation on a scientific basis. Sowing these crops increases the supply of food to the population and strengthens the fodder base of animal husbandry. There is also the possibility of scientifically based crop rotation and soil reclamation. With the introduction of crop rotation, diseases, insects and weeds that affect crop yields are reduced, the soil is enriched and, as a result, the use of chemicals is limited.

The economic and industrial importance of sunflower cultivation is very significant. Sunflower seed ingredients are nutritious food for humans. Its fat-containing residues can contain over 36% protein, 20-22% carbohydrates and 6% high-quality fats and are used as a high-calorie feed for livestock. A 100 kg feed unit is stored in 100 kg of sunflower silage. Long-stemmed sunflower varieties are planted as silage crops in several countries around the world.

Given the importance of sunflower in food processing and agriculture, this guide has been prepared to improve the skills of farmers, tenants and growers.

## BIOLOGICAL FEATURES OF SUNFLOWER

North America is considered the homeland of sunflower. That is, archaeological excavations confirm that the Indians who lived there planted this crop 2,000 years ago. In the International Nomenclature of Botanical Systematics of sunflower, it belongs to the Astral family and is named after *Helianthus annuus L.* Sunflower is an annual plant in which the arrow root reaches a depth of 2-4 meters, and the lateral roots spread up to 120 centimeters in diameter. Height 2.5-5.0 meters, but 50-70 centimeters is also widely cultivated in production. As a result of long-term selection from wild sunflower species, a cultural form was created (*Fig. 1*).



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**Picture 1.** 1-wild-type sunflower; 2- Cultivar sunflower

The process of sunflower emergence is divided into the formation of the first true leaves, flowering, ripening, and the formation of baskets. In favorable soil and climatic conditions for these periods, the average sowing is 9-15 days from sowing to germination, 30-40 days from germination to basket formation, 19-28 days from basket formation to flowering, 12-17 days from flowering germination to formation seeds, it takes 21-30 days from seed formation to full maturation. Depending on the variety, the duration of the total development period is 90-140 days.



fact that its basket is always directed in the direction where the sun is. Throughout its growth, it requires a lot of intense sunlight. Stretching its ranks south-north or east-west has a positive effect on its growth. If there is not enough sunlight, the process of photosynthesis decreases, and the development of the sunflower stops and the yield decreases.

**Sunflower's requirement for heat.** For sunflower seeds, before ripening, an average of 2600-2800 ° C of usable heat is required. Its seeds germinate at a temperature of + 4- + 6 ° C, therefore it is recommended to sow at a soil temperature above + 6 ° C at a depth. Then, if the soil is moist enough, germination appears after 8-9 days. The optimum temperature for seed germination is + 20- + 27 ° C. Young plants can withstand temperatures of -7-8 degrees. From sunrise to flowering, the sunflower's need for heat increases. The optimum temperature for its good growth during flowering requires + 20 + 25 ° C. Temperatures above 30 degrees Celsius have a detrimental effect on the plant, at +40 degrees Celsius the rate of photosynthesis decreases, the leaves wither and curl. If the heat of the air gets during the flowering of a sunflower, pollination of flowers, germination of seeds, then this leads to non-yield. The presence of cool air negatively affects its flowering and productivity during the period when 8-12 leaves appear.

**Sunflower's water requirement.** Although considered a drought tolerant crop, sunflower is in high demand for water. The transpiration coefficient is 450-570. The need for water in sunflower at different stages of development is not the same. It uses 23% of the water it needs throughout its growth, from germination to basket formation, 60% from basket formation to flowering, and the remaining 17% from flowering to harvest. Lack of moisture and nutrients at a time when water for sunflower is in high demand make the baskets small and the seeds empty. At the beginning of its development, the sunflower receives water from the upper layers of the soil, and from the lower layers after 40-50 centimeters from the moment the basket is formed. The most demanding period for watering a sunflower is from flowering before the formation of the basket. The sunflower should not be watered until the seeds are ripe from flowering (until the color on the back of the baskets turns yellow) without losing moisture. This should be taken into account when fishing for growth reservoirs.

**Sunflower's nutrient requirements.** Sunflower differs from other crops in its nutrient requirements. At different stages of development, the need for sunflower nutrients is not the same. The sunflower receives 16% nitrogen, 10% phosphorus and 9% potassium, which it needs from the soil throughout its life, up to 30 days after germination. When it starts to bloom, it gets 60% nitrogen, 80% phosphorus and 90% potassium. It replenishes feed leftovers until it ripens after flowering. Typically, most of the phosphorus is absorbed from the bud to the flowering period, from the time when the basket requires a lot of nitrogen from the beginning of formation to the end of flowering, and potassium is absorbed throughout its development. Adequate nutrition of sunflower has a good effect on the normal development of growth probes (leaves, baskets). It gets 2 times more nitrogen, 2.6 times more phosphorus and 10 times more potassium than winter wheat. Sunflower absorbs 6 kg of nitrogen, 2.6 kg of phosphoric acid and 18.6 kg of potassium oxide from the soil, which gives an average yield of 1 quintal. Excessive or insufficient supply of nitrogen before the formation of the basket negatively affects the quality of the formed seeds. Excessive nitrogen excretion after flowering sunflower reduces the oil content of the seeds. The combination of phosphorus with other mineral fertilizers helps the roots of the seed baskets. They will become drought resistant, fertile and strong.

## **SUNFLOWER VARIETIES**

Depending on the structure of the sunflower, the length of the stem, the characteristics of the leaves, the size of the baskets, the size and color of the seeds, the yield of the oil, its resistance to pests and its use in the national economy, they are divided into varieties for oilseeds and sowing. In many parts of the world, several varieties and hybrids of sunflower are grown, which are characterized by high oil content, resistant to diseases and pests and to adverse environmental conditions. Each of the varieties and hybrids has its own unique characteristics. Currently, a number of sunflower varieties are produced for the production of sunflower oil and the preparation of feed for domestic animals (livestock).

## Groups of sunflower varieties by ripeness

Depending on the duration of the growing season of sunflower, varieties are distinguished fast-growing, early ripening and mature in the intermediate period. Early ripening varieties ripen in 80-90 days, early ripening - in 100 days, mid-ripening - in 110 days. The yield of fast-growing and early-maturing varieties averages 3.0 tons per hectare, with an oil content of up to 48-52% in seeds. The yield of mid-season varieties averages 4.0 tons per hectare and retains up to 50-54% oil.

Fast-growing varieties include Yengish, Gundogar, Yyldyz, Yengiji, and Gunesh variets. Fast growing varieties are intended for planting in areas where frosts fall early. (*Figure 3*).



*Picture 3.* Sunflower genus Yenisey

**Early ripening varieties** - ripen 10 days earlier than mid-ripening ones, i.e. 80-100 days pass from germination to ripening. The yield of early-maturing varieties and the fat content of seeds are lower than those of mid-season varieties. However, there is information that they collect 2.5-3.8 tons per hectare and up to 4.5 tons from the irrigated area. Fat

content of seeds is 48-52%, sometimes 55%. Industrial varieties include YABI-8883 improved, Shapak, Chigitli Hybrid, Saray Hybrid, Shapak-2, Zer, Sakhra-272, Sakhra-50, Sakhra-296 hybrids.

**Mid-season varieties** mature in 90-130 days and are considered the most productive varieties. The results of regional trials of these varieties show that 3.01-3.48 tons of yield per hectare and 1.55-1.75 tons of oil are obtained from each hectare. Their seeds are large, weighing 65-90 grams per 1000 seeds. Plant height is 150-210 centimeters. Examples of them: Ýeňiş gowulaşdyrlan, Sowgat-60, Ak mangyz -3497.

The oil is also extracted from mid-season varieties and used to fertilize their seeds. The appearance of the plants of these varieties and the characteristics of the household are similar to those planted for food. Plant height, stem thickness and basket size are less than varieties planted for hulling and more than varieties planted for oil. Length of the growing season and infectious instability are similar to cultivated varieties (hulling). The density of the seed and basket cells is the same for oil production.

**Groups of sunflower varieties by characteristics of use.** According to their characteristics, sunflower varieties are divided into groups, from which extracted for oil and also extracted for shelling.

**The varieties of the oil group** with a height of 0.60-2.5 meters are distinguished by a thin stem, a small basket diameter (10-14-20 cm), a thin hard (pansir) layer of seed bark and other flowers. They differ from species. Oilseed varieties are used for food purposes. They are small in size and contain a lot of oil. Fat content of seeds of oil-bearing varieties is not less than 52-55%. Oilseed varieties are characterized by a short development period and resistance to infections. It is convenient to harvest them with a combine harvester. Examples of this include sunflower varieties YBI-1646, YBI-6540, YBI-8931, YBI-8883, and -3497. (*Figure 4*).

**Plants of cultivars for hulling** reach 4 meters in height and have thick stems. They represent one large basket, the diameter of the basket is 17-45 centimeters, the length of the seeds is 1.1-2.3 cm, the width is 0.8-2 cm, the weight of 1000 seeds is about 64-159 grams. Fat content is 20-35% lower than that of varieties grown for oil production. The bark of the seeds of this variety is soft (without pansir), therefore, it is

susceptible to massive damage by sunflower. Their harvest ripens late, often dropping due to the length of the neck. Combine harvester is inconvenient to harvest. It contains vitamins that have a positive effect on human health. However, it is not recommended to peel more than 50 grams of it at a time every day. (*Figure 5*).



***Picture 4.*** Sunflower Sakhra-50 variety for oil extraction



***Figure 5.*** Sunflower of the luxury class, grown for shelling

## Characteristics of sunflower hybrids

As it is known, hybrid varieties of agricultural crops differ from their traditional varieties in higher yield and higher quality of the crop. Hybrids are considered to be annual plants with high economic properties. Their yield is on average 15% higher than that of traditional varieties.

**Sapak hybrids** are considered to be less disease resistant than other hybrids. Productivity is not less than 50 centners per hectare. It reaches a height of 180 centimeters; the diameter of the basket is 18 centimeters. The ripening period is 115 days.

The ripening period of **the Sakhra hybrid** is 111 days. He reaches 175 centimeters in height. Basket diameter is 23 cm. Oil extraction is up to 52%. Yields up to 43 cents per hectare.

**Saray hybrid** is grown by a collective for oil extraction. Oil production is over 50%. Loves warmth and humid air, is resistant to infectious diseases. Reaches 170 centimeters in height, the diameter of the basket is 24 centimeters, and the yield is up to 45 centners per hectare. The ripening period is 110 days.

**Yagly hybrid.** This sunflower hybrid is significantly different from other hybrids in high yield. The yield reaches 60 centners per hectare. It has height 170 centimeters, basket diameter 25 centimeters. Ripening period is 105-110 days. Oil extraction is up to 52%.

**Hybrid "Ak mangyz-3497"** is a new hybrid created in recent years. Oil extraction is up to 50%. Productivity is from 45.0 kg / ha. Disease resistance is high and reaches 170 centimeters in height. Basket diameter is up to 20 centimeters.

## Tested varieties and hybrids of sunflower in Turkmenistan

In 2020, on irrigated and sandy soils of joint stock breeding named after S. Rozmetov of the Dashoguz region planted various sunflower hybrids. Regular monitoring of germination, productivity and economic characteristics of sunflower hybrids planted on the experimental plot was carried out.

The characteristics of the tested sunflower hybrids are as follows:

**Hybrid Sakar** - quickly adapt to changes in soil and climatic conditions. The yield of local production averages 20.5 centners per hectare. The mass of 1000 seeds is 47.0 g, the ripening period is 111-115 days, the plant height is 160-180 centimeters. Oil extraction is 46.7%.

**Hasyly hybrid** average yield is 23.7 c / ha, 1000 seeds weighing 48.0 g, vegetation period 100-105 days, plant height 100-110 centimeters. Oil production is 51.8%.

**Sanly hybrid** is distinguished from other hybrids by its high oil yield. The average yield is 29.0 centners per hectare, the weight of 1000 seeds is 47.2 grams, the ripening period is 100-105 days, the plant height is 100-110 centimeters. 47.2% oil extraction.

**Batly hybrid** is resistant to infectious diseases such as flour dust, leakage and phimosi. The average yield is 27.6 kg / ha. The mass of 1000 seeds is 60.2 grams, the ripening period is 100-105 days, and the plant height is 100-110 centimeters. Oil production is 44.6%.

**Gunesh hybrid** grows 160-165 centimeters, ripening period 110 days, mature sunflower basket 21-23 centimeters in diameter, 1000 seeds weigh 55-60 grams, grows in the intermediate period. Productivity is 32.2 kg / ha. Oil extraction is 46.9%.

## SUNFLOWER CULTIVATION

The fact that the sunflower ripens at different times allows it to be planted and grown in spring and summer (as a catch crop). Depending on these dates, the soil is also prepared for sowing.

**Choosing a field for planting sunflowers.** It is important to choose where to plant sunflower in order to grow it. For planting it, it needs to choose light and medium clayey non-saline soils. Highly saline, clayey and light sandy soils are not suitable for planting this crop.

**The role of sunflower in crop rotation.** Sunflowers should not be planted in the same spot on a regular basis due to the ubiquitous spread of pests and their rapid distribution. It is recommended to plant it on the sown plot after 6-7 years (*Figure 6*). Sunflower is picky about soil and nutrients. The best crops for him are winter grains, cotton, corn, beets and potatoes. It should not be planted on crops of the legume family, that

is, alfalfa, beans, wort. This is because they have many common pests and diseases, and they can be abundant and cause great harm. After sunflower, it is convenient to plant winter crops: cotton, corn, beets.



*Figure 6. Sunflower in crop rotation*

**Spraying with herbicides against perennial weeds.** In the presence of perennial weeds (especially reed, tar, mullein) in a sunflower field, 6-8 liters of octopus, glyphosate or one of the late herbicides per hectare should be sprayed with 300 liters of water per hectare. It is best to carry out this work in the fall of next year - from October 10-30, and in the summer 15-20 days before sowing.

**Pre-arable irrigation.** Irrigation water is essential for improving the quality of basic soil cultivation. This water should be stored at a rate of 600 m<sup>3</sup> per hectare under old furrows. The optimal period for pre-plowing irrigation is from October 20 to November 20 on plots that will be sown in spring. Pre-arable irrigation is not carried out on surface areas of groundwater (Dashoguz, Lebap regions). The best time for irrigation is when sowing sunflower (after crop rotation, after wheat) - from June 5-20.

**Fertilizer before plowing.** The yield increases with the introduction of organic sunflower fertilizers. For this, it is recommended to give 20-40 tons of fertilizer per hectare (cattle, sheep or poultry) before plowing. It is also recommended to add 400 kg of superphosphate and 100 kg of potassium chloride per hectare before plowing. The application of fertilizers before plowing enriches the soil with minerals, improves its water-air and nutrient regime, and has a positive effect on the yield of sunflower. The best time to do this work is from October 25 to December 1 when sowing in the spring and from June 10-25 after sowing wheat.

**Steam plowing.** Correct and timely plowing is an important measure to ensure the effectiveness of all agricultural activities: soil salinization, irrigation, fertilizing crops, processing and pest control, and disease and weed control. Steam plowing should be carried out with two-layer reductions in old irrigated areas to a depth of 30-32 centimeters, depending on the depth of occurrence of harmful salts in grassy areas. Gently plowing the bottom of the solution to a depth of 30-32 centimeters, while softening the bottom of the solution by 10-12 centimeters, especially in areas with a heavy (dense) and accumulated layer of harmful salts under the liquid manure. This allows productivity to be increased by 10-12% compared to conventional plowing. On such lands, this work must be done every 3 years.

The best time for steam plowing is from November 1 to December 5 in spring sown areas and from June 10 to 25 for sowing after winter wheat.

**Flatten.** Good rolling of fields is a guarantee of high yields of sunflower. When the fields are well leveled, it ensures good water retention, water for threshing and growth, good tillage, and normal and healthy germination.

After plowing, leveling is carried out 2 times in a row with longitudinal levelers. If the sunflower planting area is higher or less (not evenly), then before plowing and subsequent plowing, these areas are leveled using bulldozers and scrapers.

The optimal timing for these works is from December 15 to February 25 on spring sown areas and from June 10 to 26 in summer.

### **Preparation of lands for leaching and diversion of main waters.**

If the sunflower field is salty, it is necessary to collect wastewater from these areas. Therefore, it is important to clean the irrigation and drainage systems before collecting wastewater. Temporary irrigation ditches should also be laid in shallow areas and divided into ditches. When this is done, each irrigation field must be covered and watered separately for irrigation. The size of the fields should be 0.15-0.25 ha on light soils and 0.25-0.35 ha on medium to heavy soils. On the slopes of the foothills, sewage is collected by furrows. Furrows are then made at a distance of 70 centimeters, so that they are 120-150 meters in light soils and 150-180 meters in medium to heavy soils. In the 90-cm row, the furrow length is increased by 1.2 times. These works are carried out after the completion of the leveling works.

**Capture of wash water.** According to the study, the recommended flow rate of flushing water is 2000-2500 m<sup>3</sup> per hectare in slightly saline areas, 3000-3500 m<sup>3</sup> (with 2 lesions) in moderately saline areas and 4500-5000 m<sup>3</sup> (with 3 lesions) in highly saline areas. The amount of water supplied each time should be 1500-1700 m<sup>3</sup> per hectare, and the distance between each watering should be 8-10 days. In lightly salted areas, it is beneficial to combine rinse and main water.

It is convenient to carry out flushing water from November 20 to March 10, when the groundwater is lower and its efficiency will be high.

**Main water.** This water is used to achieve the necessary soil moisture for normal seed germination. The main water is irrigated on the slopes at the rate of 1200-1600 m<sup>3</sup> per hectare, on the slopes and on the plains at the rate of 1600-1800 m<sup>3</sup> per hectare. The best time to hold on to throne water is from March 5 to April 5, when the sunflower crop is planted in the spring, and from June 12 to 28, when it is sown in the summer. According to research, this robot should complete 10-15 days before planting on light soils and 20-25 days before planting on medium to heavy soils.

**Presowing works.** Before sowing, in irrigated areas, a harrow and leveling work are carried out. Then his processed with a chisel, rake and harrows. The working depth should be 12-14 centimeters on light soils and 14-16 centimeters on medium to heavy soils.

In areas where main water is provided by furrows, seedbed preparation is carried out by rotating the rake or light rake and harrow in the direction of the row. If, for any reason, fertilizers are not applied to the lower part of the plowing, 400 kg of superphosphate, 100 kg of urea and 100 kg of potassium per hectare must be applied before pre-sowing treatment.

**Planting sunflower.** To get the maximum yield from this crop, it is important that the sowing is carried out in a timely manner and with high quality. Sowing sunflower should be started when the daytime stable air temperature of 8-10 degrees Celsius. The deadline for work is from March 10 to April 20 and when sowing winter crops - from June 20 to July 5. To prevent various diseases, the seeds should be treated in the prescribed manner with one of the fungicides apron (mefenoxam), rovril (iprodion) or scarlet (imazazil + tebuconazole). Seeds should be planted 5-6 cm deep in medium to heavy soils, 6-8 cm deep in light sandy soils. Sowing should be started with light-textured, fast-burning soil. In heavy, clayey, slowly warming up areas close to groundwater, sowing is beneficial with late replanting. When sowing sunflower, 8-10 kg of seeds are consumed per hectare. There are a few extra steps you need to take to get a full and healthy sprout. That is, after the rain, the lid breaks with a light rake. In some areas, where full germination has not yet been achieved, with a lack of moisture per hectare, 500-600 m<sup>3</sup> of water is applied.

When 1-2 true leaves are formed from the ground after sunflower sprouting, it is necessary to pull out without delay for normal plant growth (*figure 7*).

Normally growing healthy plant roots should be left in the field while pulling. Delays in pulling or over-planting can lead to poor plant development, lack of nutrients and light, thinner branches, poor yields and poor quality. As a result of measures for pulling at 50-60 thousand root crops per hectare, this gives 25-30 centners of high yield per hectare. As with other crops, this is one of the most important tasks when sowing sunflower seeds at the same frequency. Violation of the uniform size of sunflower roots in the field leads to the formation of baskets of different sizes and their ripening at different times, and this reduces the quality of the crop.



*Figure 7.* The growing seeds of the sunflower

One of the main factors to consider when growing sunflower is row spacing. It depends on the rules of agro technical measures, the care taken and the density of sunflower roots per hectare. The optimal row width is considered from 45 centimeters to 60 centimeters. To obtain high-quality seeds from sunflower when growing, its area per hectare should not exceed 20,000 root crops.



*Figure 8.* Inter-row processing of

**Inter-row processing.** The purpose of inter-row cultivation is to maintain the softness of the soil, reduce moisture loss, prevent salt accumulation, destroy weeds and create favorable conditions for good plant growth and yield up to 10% yield in addition. Therefore, intermittent treatment should be started immediately after germination. The first inter-row cultivation is carried out at a depth of 8-10 cm, the second 12-14 cm. The width of the protective zone should also be 10-12 centimeters. For the entire development period, 3-4 rows of treatments are carried out (*figure 8*).

Inter-row treatments should be carried out after each reclamation. Inter-row cultivation should be carried out without delay and without hardening of the soil in its depths. Delaying this work can degrade processing quality, increase moisture loss, create unfavorable water and air conditions, and result in lower yields. Inter-row cultivation after reclamation reduces the evaporation of this growth water, ensures its efficient consumption by plants.

**Application of mineral fertilizers during the growth period.** Timely and full-fledged feeding of sunflowers during the growing season has a positive effect on their rapid growth and early harvest. Top dressing with urea at the rate of 150 kg per hectare at the beginning of the cultivation of this crop has a beneficial effect on their growth. The sunflower is fed by consuming 200-250 kg of ammonium nitrate per hectare at the beginning of the formation of the second basket. It also has a positive effect on yield if, during the second feeding apply 50-60 kg of potassium chloride per hectare.

**Watering during the growing season.** Effective use of water in the harvest is important. With the consumption of the first growth water of 800 m<sup>3</sup> of water per hectare, the acclimatization of the 40-45 cm soil layer takes place. The term for this work is from May 20 to June 15. Subsequent growth water is captured by consuming 900-1000 m<sup>3</sup> of water per hectare. It is recommended to provide a total of 2-3 waters for development in the western part of Dashoguz region and 5-6 waters for development in other areas (*Figure 9*).



*Figure 9. The watering of sunflowers*

Sunflower requires a large amount of water from the moment of basket formation until the moment of flowering. During this period, the southern regions of the country should be watered for 13-14 days, and in the northern ones - 15-16 days, while a layer of soil 80-100 cm thick should be well watered. During the harvest season, their water demand decreases slightly. During this period, it is enough to water for 18-20 days, while the moist soil layer should be 60-70 centimeters. Water is often held when sowing in summer, and then the distance between them increases.

## **SUNFLOWER DISEASES**

(*Erysiphe cichoracearum*), yalan ak dushme (peronosporosis, *Plasmopara helianthi* Novot). False leprosy (Diseases such as phomosis), *verticillium dahlia* (*Verticillium dahlia* Kleb.) common larvae (*Sclerotium bataticola* Taub.), Phomopsis (*Phomopsis helianthi*), they cause great damage to its quality.

**Sunflower with false leprosy.** *Plasmopara helianthi* Novot, belonging to the Phycomycetes class, to the Peronosporales group, is a disease of the western hemisphere. This is a common disease. At the age

of the mycelium, the fungus, through the plant larvae, infects the cells of healthy plants and causes serious pathological disorders in the tissues. Light green, yellow, whitish spots appear in the veins on the lower leaves of a diseased plant (especially in young plants) (*figure 10, 1*). A white fungus film of the same color forms at the bottom of the leaves (*figure 10, 2*). During the flowering period of the sunflower, the symptoms of the disease appear on the upper leaves. Both sides are covered with a white foil. The branches of a diseased plant grow slowly. Therefore, the distance between the leaves is small. Conidia-carriers of the fungus are branched, colorless, rounded, and elongated (*Fig. 10, 3 and 4*). Affected plants have an average yield loss of 80-90 percent, depending on the severity of the disease. The quality of the product decreases. Symptoms of the disease of the 1st leaf; 2-mold formed on the underside of the sheet; 3-mushroom conidia.



**Figure 10. Sunflower with false leprosy**  
*1-featers of diseases on leaves; 2-the thin curtain formed by the underside of the leaf; 3,4-fungal conidia*

Observations show that the symptoms of false leprosy found in the sun are fourfold. In the first case, the infected sunflower does not grow, the testicles become thick, cannot fully grow and mature. Leaves, in particular, turn yellow, turn white, and the underside is completely covered with white matter (spores). The white matter is found both in the root collar and in the roots of the sunflower. Sick plants usually dry out, and those that do not dry out, form small baskets 1-3 centimeters in size.

The second type of diseased plants remains from development. Their twigs thicken, and the leaves are shortened. The leaves are large and wobble in one place. At the top of the leaves are spots that form a yellow pepper, and at the bottom are white spores of the fungus. Spores also appear on stems and roots. The baskets are small and stand upright.

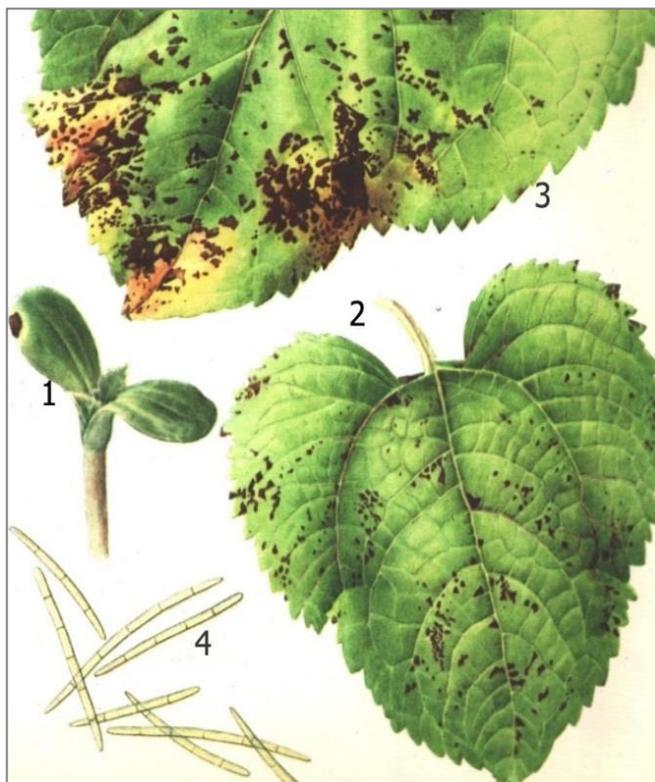
When the seeds germinate, the first and second forms of the disease occur as a result of the transfer of pathogens present in the soil.

The third and fourth types of symptoms in plants infected with false positives result from the spread of spores from infected plants of the first and second forms to infection in the last days of the growing season. The diseased plant usually grows normally; large yellow spots covered with veins appear on its leaves. White spores under the spots. In the fourth form of the disease, its symptoms are secret (closed) and outwardly do not differ from healthy plants. Fungus spores form at the roots and at the root collar and do not pass into the upper testes.

The main source of the disease is spores that have been living in soil residues (leaves, branches) of plants for 5-6 years. The massive appearance of the disease is facilitated by high humidity and maintaining the temperature at 17-18 degrees.

**Septoria disease.** It is created by *Septoria helianthi* Ell. Et Kell Fungi. The first symptoms of the disease appear as dark brown spots on the leaves of newly sprouted boats (Fig. 11, 1). As the plant grows, the disease intensifies and the spots spread to all true leaves. There are along the edges of some spots of yellowish-brownish color in a wide cache. The number of spots increases at the ends of leaves that merge with each other (Fig. 11, 2 and 3). In rainy, humid weather, all areas of the spots are perforated. The spores of the fungus are leaf-shaped, brown, and consist of 3-6 parts (Fig 11, 4). This leads to a decrease in quality and

yield by 25-30 percent. The source of the disease is soil residues of plants (leaves, stems).



*Figure 11. Septorioz keseli bilen kesellän günebakar  
1- gögeren gämiklerdäki keseliň ilkinji alamatlary; 2 we 3-  
ýapraklardaky keseliň alamatlary; 4 - Septoria helianthi Ell. et Kell.  
kömeleginiň sporalary*

**Gray and white rot of sunflower** occurs en masse throughout its development, which leads to the destruction of all root and surface organs, rotting of baskets and seeds in it (*figure 12, 1 and 2*). The source of these diseases is the seeds obtained from diseased plants and their soil residues (leaves, stems, parts of the basket).

Diseases are the planting of disease-resistant varieties and healthy seeds. In the area where the disease has arisen, it is necessary to carry out a crop rotation, remove crop residues in the area where sowing will take place, and plow the land to a depth of 30-35 centimeters. Sowing seeds should be treated with fungicides (scarlet or apron). To prevent the disease (before the onset of symptoms of the disease) 0.6 kg of ash of the

thanos fungicide (famoxadon + simoxanil) per hectare must be mixed with 400 liters of water and sprinkled with 4-6 sunflower leaves. The method must be repeated when the sunflower is in bloom or when symptoms of the disease begin to appear. In case of false leakage, phimosi and septoria, it is necessary to mix 1 liter of amistar extract per hectare with 300 liters of water and spray the plant.



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2

*Figure 12. 1 – Sunburn gray rot; 2 – Sunflower white rot*

**Yokanchgul** An especially dangerous sunflower fungus is considered an infectious one (snake bite, melon flower, *Orobanehegumana* Wallr., Barazikha). It is even more dangerous when the infection occurs on young plants. This glorious owner feeds on the sap and water of the plant and lives only on them, and the owner leads to the complete drying of the plant. Each of the flowers grows buds of up to 1500 seeds (*fig. 13, c*). The seeds fly in the wind, fall into the soil, move to healthy roots and cause disease.

**Control measures.** It is necessary to regularly carry out comprehensive and coordinated anti-infectious measures. In places where infection has occurred, given its particular danger, they must be collected and destroyed by incineration. Use one of the glyphosate herbicides that are used against perennials and annuals, and rotate vigorously. It is not recommended to replant the sunflower in the area where the infection has occurred.



**Figure 13.** Yökançgöl and its trials.  
 1-sunflower stick; 2-sunflower root; 3-yökançgul's branches;  
 4-yökançgul's flower 5-seeds

## SUNFLOWER PESTS

In the sun, pests such as **sunflower light** (*Homoeosoma nebulellum* Schiff.), Wild beetle larvae (*Agriotes sputator* L., *Atbous niger* L.), sunflower aphids (*Brachyunguis plotnikovi* Nevs.) are more common, they lead to non-yield. In particular, sunflower is considered a particularly dangerous pest. That is, it begins to fly when the sunflower begins to bloom and lays its eggs in baskets. Young larvae hatching from eggs first gnaw and eat flowers and its leaves, and after three years - seeds. In the basket, they make a series of holes and paths that are filled with dirty, worm-like excrement. Causes complete damage to the seeds in the basket (*Figure 14, 1 and 2*).



**Figure 14.**

*1- Butterfly, puppy and worm of the sunflower pest-and the seeds with its damaged basket (2)*

Sunflower seeds should be carried throughout the year. Correct agro technical measures, removal of crop residues from arable land, reduction of their number or, to some extent, their elimination. It used insect of trichogram against butterfly insects, gabrobraco against worms, and a golden eyeball against juices. There are many types of insecticides used against pests, so they can be selected and sprayed according to the direction of use. Supported for juveniles, lice, sunflower (acetamiprid), jetsis (deltamethrin), arsenic (chloropriphos + deltamethrin), karate (lamda-sigalotrin), vertimek (abamectin), butterflies (benedoxatinox), indoxaria (indoxaria), indoxaria should be sprayed alternately with one of the insecticides. The set rate of sprayed insecticide per hectare is added to 300 liters of water and the working solution is prepared and used on the same day. It is repeated the fight if necessary.

## **Sunflower harvesting**

Timely harvesting of the harvested crop without losses is the most important task. Ripe baskets are harvested with combines, and in small areas - by hand. For harvesting with combines, sunflower in the field contains glyphosinic acid (3.0 liters per hectare), Extra sprout (1.8 liters per hectare), reglon Super (2.0 liters per hectare), glyphosate (5.0 liters

per hectare) or dehydrated with one of the daphos herbicides (6.0 liters per hectare). Drainage should be carried out by spraying 300 l (50-100 l) of the working solution per hectare with moisture content of not more than 30% when the color of the baskets changes 10-15 days before harvest. When determining the harvest time of a sunflower by hand, it should be borne in mind that the accumulation of oil in its seeds continues until it is completely cooked. The time when the basket turns yellow or gray by 90%, and the dryness and moisture of the seeds is 12-14%, is considered the time of the beginning of harvest.

After collection, the dried baskets are broken up and harvested in a combine. The moisture content of the cleaned seeds should not exceed 12%, and of oilseeds - 7%.

Table 1

**Rules and terms for carrying out agro technical measures for early and intermediate cultivation of sunflower**

T/b	Agro technical measures	Norm	The timing	
			When planting in spring	When sowing after winter wheat
1	2	3	4	5
1	Land reclamation, before plowing	600 m <sup>3</sup> /ga	20.10-20.11	5-20.06
2	Fight against perennial weed	Recommended herbicides are prescribed	10-30.10	15-20 days before sowing
3	Fertilization before plowing	Manure - 20-40 t/ha 1 time in 3 years. Superphosphate – 400 kg/ha Potassium chloride – 100 kg/ha	25.10-01.12	10-25.06
4	Plowing	30-32 cm deep	01.11-05.12	10-25.06
5	Align	Transverse section	15.12-05.02	10-26.06
6	Preparation of land for leaching and diversion of main waters (excavation of temporary dams, ridge, split into ditches)	Inter-row: 70 cm: 18-20 cm, 90 cm: 23-25 cm. The size of the beds: on light soils: 0.15-0.25 ha medium, on heavy soils: 0.25-0.35 ha	20.12-10.02	11-27.06

*Continue of table 1*

<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
7	Combination of rinsing and main water (in saline areas)	900-1200 m <sup>3</sup> /ga	01.03-15.04	12-28-06
8	Presowing treatment: - with temporary ditches, cutting, chisels, rakes + harrow on level areas; - fertilize	In light soil 12-14 cm in light soil; 14-16 cm on medium to heavy soils if not provided earlier Superphosphate – 400 kg/ha Potassium chloride – 00 kg/ha	05.03-15.04	15.06-05.07
9	Seed treatment	According to the rules established by the recommended fungicides	10.03-20.04	20.06-05.07
10	Sowing	6-8 cm deep, 8-10 kg / ha	10.03-20.04	20.06-05.07
11	Vocational work (breaking the lid, supplying wet water)	Rotating rake with soften 700-800 m <sup>3</sup> /ha	15.03-30.04	20.06-05.07
12	Conduct 1st inter-row development	8-10 cm	05.04-10.05	01-15.07
13	Conduct 2nd inter-row development	12-14 cm	20.04-30.05	10-25.07

*Continue of table 1*

<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
14	Pull out the irrigation furrows and apply nitrogen fertilizer for the first time.	Row spacing 70 cm: 18-20 cm, 90 cm: 23-25 cm; Urea - 150 kg/ha	15.05-10.06	15-30.07
15	1st irrigation works	700-800 m <sup>3</sup> /ha	20.05-15.06	15.07-01.08
16	Carrying out processing of the 3rd row	12-14 cm	25.05-20.06	20.07-05.08
17	Pulling cages and applying nitrogen fertilizers a second time	12-14 cm, Ammonia nitrate 200-250 kg/ha	10.06-30.06	01-20.08
18	2nd growing water	700-800 m <sup>3</sup> / ha	10.06-05.07	01-25.08
19	Make room	When the need arises	10.04-10.08	01.07-15.09
20	3rd water for growing	700-800 m <sup>3</sup> /ha	01-20.07	15.08-10.09
21	4th water for growing	700-800 m <sup>3</sup> /ha	20.07-10.08	01-30.09
22	5th growing water	700-800 m <sup>3</sup> /ha	05-25.08	20.09-10.10
23	Carrying out measures against pests, diseases and weeds	Recommended chemicals are within specified times and limits	10.03-30.08	20.06-10.10
24	Harvesting	Combine or manually	20.08-10.09	15-25.10

**Note:** Recommended agro technical terms and rules may vary depending on the weather of each agricultural year, depending on the growing conditions of the plants or the time of the appearance of the pests and the type of new pesticides.

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SUNFLOWER**

K.Mammetgulov, G.Novruzov, Y.Palyazova, M.Nursahedov

**Managing editor**     A. Yollybayev