# MANUAL ON THE CULTIVATION OF ONION

**THE MINISTRY OF AGRICULTURE AND ENVIRONMENTAL PROTECTION OF TURKMENISTAN**

**TURKMEN AGRICULTURAL INSTITUTE**

**AGRICULTURAL RESEARCH CENTER**

# MANUAL ON THE CULTIVATION OF ONION

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The manual contains scientifically grounded information on the conditions of growing onions in the soil and climatic conditions of the country, the rules of agro technical activities, as well as the types of its main pests and control measures.

The handbook is intended for agricultural specialists, lessees, farmers, teachers and students of higher and secondary specialized professional educational institutions.

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# INTRODUCTION

Adopted under the leadership of President Gurbanguly Berdimuhamedov, “Program of Development of the Agricultural Sector of Turkmenistan for 2019-2025” provides for growing onions and obtaining high yields in our country. At present, it is planned to expand the sown areas and increase production by planting onions in spring and autumn to provide the population with foodstuffs. Our country has favorable climatic conditions for growing onions, which are widely used for food. Onions have long been widely used in human life as a food and for taste, nutritional value and usefulness in the canning industry; they are cooked, salted, pickled and canned. Onions are rich in many nitrogenous substances, carbohydrates and vitamins. Essential oils give it a pleasant aroma and a tangy taste. According to the amount and type of essential oils they contain, onions are divided into bitter (containing a lot of essential oils), medium bitter and sweet varieties. Onions have an average dry weight of 14-16.5%, 2.5-14% sugar, 0.5-0.8% fiber, 0.5-, 6% pectin; rich in vitamins C, B1, B2, PP. Green leaves of onion contain riboflavin, carotene, chlorophyll and xanthophyll**.** Onion is widely used in medicine as a treatment for the digestive, respiratory and cardiovascular systems because of its photolytic properties. Today, in order to increase the onion yield and meet the needs of the population in it, it is important to stimulate the production of high-yielding, early- and medium-maturing, drought-resistant varieties and hybrids. However, improving the agro technics of onion cultivation is an urgent problem. Considering the importance of onions as food and health protection, this handbook contains scientific information on the agronomic techniques of their cultivation, as well as the types of major diseases, pests, and control measures for this crop.

## Onion varieties and biology

Onions belong to **the group Allium of the family Liliaceous** and are divided into southern, northern and eastern species. Southern onion varieties include varieties grown in southern Europe, Afghanistan, Iran, Iraq, Central Asia and the Caucasus. The onion varieties are divided into Mediterranean and Asian ecological groups.

The **Mediterranean onion** has a growth period of 160-200 days and consists of large roots with one or two germs, sweet to the taste. The types and colors of their roots can be different and unstable for a long time. Onions of this group, in turn, are divided into Spanish, Italian, Madeira and Yalta varieties.

**Asian onions have a** short growth period (130-170 days) and a sweet or bitter taste. Both the appearance and color of their roots are varied and moderately hardy for long-term storage. This group of onions includes varieties from Afghanistan, the Caucasus and Central Asia.

**Northern onion species** have a development time of 120-160 days. Their roots are one or more buds, medium in size, yellow or red-blue in color, bitter or medium bitter in flavor and are suitable for long-term storage. This variety of onion is divided into ecological groups in Central Europe and North America.

The duration of development of **Oriental onion variety** is 120-150 days when grown from seeds and 80-120 days from root onions. Roots of onions belonging to this species are characterized by abundant germination, small size, diversity of species and long storage ability. There are also northern and southeastern ecological groups of this species. Onions grown in Turkmenistan are mainly Kaka, Farap, Sary gabyk, Narly and Hasylly varieties.

*Figure 1. Kaka onion variety*

**Kaka variety**. This variety is a local variety of Kaka of Akhal region of Turkmenistan. It has been improved by Turkmen scientists through continuous breeding under field conditions. Kaka onion variety was released for production in 1952 for planting in all regions of the country. This variety ripens late. Sowing and seed maturation takes 170-190 days. The base of the onion is flat, dry bark of purple color, bitterness in taste is moderate. The average weight of one of its bases is 60 g. It adapts well to local conditions and yields up to 250-350 cents per hectare. Its fully mature base is kept in good condition and is suitable for long distance transport.

*Figure 2. Farap Onion variety*

**Farap variety.** This variety is an indigenous variety of Farap district of Lebap region of Turkmenistan. Lebap variety was introduced into production in 1952 for Dashoguz region. It ripens late. It takes 175-190 days to mature before the seeds are sown. The shape of the base of this variety is round, the density is medium, the bark and inner part is white, and the bitterness in taste is moderate. The average weight of each of its bases is 50 grams. Yields average 200-220 quintals per hectare, which is well adapted to local conditions. Its fully mature base is capable of holding medium to long distances. (Figure 2)

**Sary gabyk variety**. This variety was created by Kazakh scientists at Garatal experimental farm. It was introduced to

Turkmenistan in 1982.Onion variety Garatal is considered to be early maturing, high yielding. It takes 170-180 days for the seeds to germinate after sowing. The base of this variety is round, densely packed, the outer shell is glossy yellow, the inner is white, and the taste is medium bitter. Well adapted to the soil and climatic conditions of our country, the yield per hectare reaches 250-300 quintals. One onion base weighs 70-90 grams. Its fully mature base is maintained in good condition and is suitable for transportation over long distances.

This onion variety is recommended to be planted in September to grow in early spring.

*Figure 3. Sary gabyk variety*

**Galyng gabyk variety**. This onion variety ripens early in our soil and climatic conditions. It ripens in 180-190 days before winter sowing. The crop can be harvested in April-May. The color of the base of this variety is yellow, elongated appearance, bitterness in taste is moderate. The average weight of one of its bases is 150-180 grams. Yield per hectare reaches 300-350 cents. Its fully mature base is stable over medium to long distances.

**Hasylly variety**. This variety was created by "Bayram Tohum Tumash" (Turkish State). It matures very early in our soil and climatic conditions. It takes 120-150 days to sow and mature seeds. This variety of onion - likes long days, which is planted in the spring. The fruit is round, the bark is yellow and the inside is white. Yield per

hectare reaches 700-800 quintals. Its fully grown crop can be stored for a short time.

*Figure 4. Galyng gabyk onion variety*

**Narly variety.** It is created in Turkey. This variety of onion is planted between September and November. It takes 180-200 days to sow and ripen the seeds. The onion fruit is round, the bark is dark yellow and the inside of the fruit is juicy white. The average fruit weight is 160-180 grams. Yield per hectare reaches 500-700 quintals.

Onion varieties grown in our country are frost-resistant. Sown seeds begin to germinate at + 3 + 5º C, the optimum temperature for their good germination is + 18 + 20º C. Germinated onions can tolerate temperatures of 2 to 3 C and mature roots from -10 to 12 C. Frozen and slowly submerged roots do not lose their ability to survive.

The base of an onion consists of one or more generative and vegetative shoots. Flower buds and seeds germinate from the generative shoots under certain conditions, while new roots are formed from the vegetative shoots. Buds - which have changed shape into leaves, and are covered with fleshy bark? The fleshy bark accumulates additional nutrients. Some of them germinate completely as completely empty green round-shaped leaves, while others remain at the base and serve as food for the newly formed shoots. The shells on the outside of the base are dry, tough, flexible, protecting them from drying out and mechanical stress. The place where the base of

the onion passes to the leaves is called the false stem or neck, and when the roots mature, they wither away. Onion flowers are bipolar, consisting of 6 white or green-white petals and 6 stamens. It is pollinated by honeybees and some other insects.

*Figure 5. Onion blooming period*

Onion seeds are covered with a crust and contain a large amount of essential oils. Therefore sown seeds germinate very slowly in the soil, i.e. germinate in 15-18 days. Onion seeds are 2.5-3.0 mm long and 1.8-2.0 mm wide, irregularly triangular in shape, with an average of 250-400 seeds per gram.

Sprouted onions grow very slowly at first, negatively affected by all adverse conditions (weeds, dehydration, and soil salinity). After the formation of leaves (nuts) of onion in the plant it increases metabolism, the formation of carbohydrates. The formed carbohydrates are carried to the bottom as a reserve and all conditions are created for the formation of the base. The optimum temperature for root formation is + 20 + 30 $^{o}$C, and their growth is greatly influenced by the type of fertilizer and water. In the first year of development, the buds are formed at the roots, and in the second year they form flower stalks (additional lateral stems). If the stems are kept at + 2 + 10 $^{o}$C for a long time, flower buds will form from the germs. If they are stored above + 18 + 20 C $^{o}$ below $^{0}$C, extra lateral bases will form. Therefore, store onion seeds at temperatures

below + 18 + 20 C ºor above 0 ºC. Onions intended for seed storage are stored at + 2 + 10 ºC.

Normal germination of onion seeds is 95-98% and lasts for 2-3 years.

## Onion farming techniques

**Selection of onion planting fields.** Onions give high yields when they grow on light soils, lightly clayey and well nourished soils. Saline soils are not suitable for growing onions. Onion crops give good results when planted after cabbage, cucumbers, tomatoes, cereals, cotton. Onions give even higher yields if they are planted in newly developed areas.

**Moistening before ploughing**. Plots for planting onions should be prepared as soon as the previous crop has been harvested and removed. First the crop residues should be removed from the area. If soil moisture is low, it is important to irrigate with damp water before ploughing to improve tillage. This is achieved by applying 600 m3 of water per hectare. In the catchment area the sowing becomes smooth, even and its normal depth can be achieved.

**Tillage.** Tillage is one of the most important measures in growing high yields, with which the physical properties of the soil, weed control, pest control are improved. Autumn plowing is carried out at a depth of 30-32 cm per hectare with 30-40 t/ha of spraying, 500 kg of superphosphate, 70 kg of potassium chloride

**Leveling before planting**. Land levelling is one of the important preparation measures for sowing. Annual levelling is carried out transversely. Quality levelling ensures good quality of sowing agronomic measures (seedbed preparation, sowing, irrigation, inter-row treatment). Where normally levelled, water is retained, soil amelioration is improved, seeds germinate steadily, plants grow normally and harvest high yields.

**Presowing cultivation**. The importance of seedbed preparation is very important for regular sowing and good germination. This measure should ensure that small areas of land are cultivated. Plots are ploughed by disk rake, then by cultivator to a depth of 12-14 cm on light soils, 16-18 cm on medium and heavy soils, grinded and stretched by cattle.

When drawing the ridge, great care is taken to ensure that their row coincides with the area to be planted, the straightness of the ridge, and the position of the ridge (level or vertical).

**Planting**. Onions are planted in the southern regions of the country in early spring and early autumn. Onions are planted in our country in early spring from February 1 to March 5. In this period, it is recommended to plant the varieties Kaka, Farap, Karatal. If by this time to postpone sowing of the above varieties, it rarely sprouts, does not grow normally, and the yield decreases. Onions are planted en masse in early spring from onions planted between October 15 and November 1. However, with persistent severe cold during the winter months, seeds sown during this period often fail to germinate. During this period, it is recommended to use the varieties Farap, Karatal, Nart, Texas Grano 502 for planting onions. Onions are planted in northern areas of the country in early spring, from February 25 to March 15, as soon as the ground is frozen. In autumn it is planted in areas from September 15 to October 1. During this period, sown onions produce a crop in June of the following year. Onion seeds are planted in a row with a slightly flat surface in 2-3 rows.

*Figure 6. The highest grade of onion seed*

Onion seeds are sown dry, only in some cases (in case of delayed sowing) the seeds are sown after soaking in water for 36 hours. At the same time the seed should be slightly dried so that the seed does not

clog. Consumption rate of seeds per hectare is increased by 18 kg when sowing in early spring and by 10-15% when sowing in autumn. When planting imported hybrid onions, 8-10 kg of hybrid seeds per hectare are consumed. The seeds should be sown to a depth of 1-2 cm in heavy soils and 2-3 cm in light soils.

**Watering after sowing for germination and growth**. The small leaf surface of the onion plant is able to evaporate water sparingly. Onions need more water during the budding and rooting period, and at the end of growth, during the growing season, the water requirement decreases. Too much watering during this period slows down root growth and reduces their stability in storage. After sowing 600 m3 per hectare should be provided with water for germination, water for growth should be supplied every 7-10 days at the rate of 600-700 m3 per hectare and every 4-5 days during the onion planting season. Onion irrigation should be stopped 15-20 days before harvesting.

*Figure 7. Onion field*

**Conducting treatment during germination**. Interrow treatments provide mechanical destruction of weeds, soften the root of the plant, improve its root respiration and help reduce moisture loss in the soil. Onions should be treated 4-5 times during the growing season. Treatments should not be deep so as not to damage the roots of the

onion, and growing onions should be covered so that they do not cover the soil.

**Fertilizing**. The root of an onion belongs to the soil roots, is poorly developed and cannot penetrate the deeper soil layers. Consequently, the nutrients it needs must be in the root.

Under sowing 30-40 tons of rotten manure, 500 kg of superphosphate and 70 kg of potassium fertilizer per hectare should be applied. The remainder of the annual rate of mineral fertilizer is applied in the following quantities, divided into 3 times (during mass germination, when the roots begin to form and during the period when the roots sprout):

1st time is given urea 200 kg/ha, superphosphate 180 kg/ha and potassium chloride 30 kg/ha;

The 2nd time is given 200 kg / ha of ammonium nitrate, 160 kg / ha of superphosphate and 30 kg / ha of potassium chloride;

3rd time is given ammonium nitrate 200 kg/ha, superphosphate 160 kg/ha.

## Harvesting and storage

The drying of leaves and shoots of onions is a sign of their maturity. However, it is important to harvest onion roots in a timely manner without waiting for them to completely dry out, since if this work is delayed their storage quality is reduced, Early spring onions are harvested in September and autumn onions in June. Roots are harvested using onion harvesting equipment or by hand. The collected roots are dried in the sun for a few days. As a result, the moisture content of the roots decreases, the leaves dry out completely, and the roots are covered with a hard, flexible and hard bark consisting of 3-4 layers.

Root onions are often dried artificially, i.e. in special dryers. Onions are first dried at 25-35º C, then the temperature is raised to 40º C and kept for 8 hours. When the roots are dried in this way, it prevents the spread of the disease they have, as well as fully develop onion neck rot, which allows them to be selected. Raising the storage temperature to 45º C and active air exchange for 8-12 hours prevents the spread of onion neck rot. The dried leaves of dried onion roots are cut into 4-5 cm lengths and divided into varieties according to size.

When the dried leaves are cut less than the prescribed amount, the onion creates a favorable environment for bacteria to enter and rot.

Root onions are divided into varieties manually or by a selector. Onion roots are divided into three groups according to their quality:

Group 1 includes fully mature, medium to large winter hardy roots, Group 2 includes fully immature, long-lived roots due to mechanical damage, and Group 3 includes small, unrooted roots.

**Onion storage**. Storage of onions in cold stores should be placed at a distance of 0.8-1.0 m from the wall, and the interior of the store should be aired 2-3 times a day. Basic onions should be stored in the field for 3-6 days or kept in refrigerated warehouses after drying in a room with a temperature of 25-35ºC (under a lid). These operations lead to full maturity of the onion, drying of the base, thickening of the outer shell and little damage. The optimum storage temperature should be + 0.5- + 1 ºC, with a humidity of 75-80%. Onions are stored in containers, mesh, synthetic or non-woven bags (2.0-2.5 m high) on a pallet, wrapped in wooden or plastic buckets and spread out on shelves 40-60 cm thick for 3-5 days. cooled to -10 ºC, then transferred to a refrigerated room at 0-2 ºC.

Healthy root onions should be selected for planting and stored in refrigerated containers, mesh bags on pallets, bags of synthetic and non-woven materials (1.8-2.0 m high), wooden or plastic buckets and 40-60 cm thick shelves and checked regularly.

The humidity of refrigerated warehouses for onions stored for food and seed should be 75-80%.

Onions are stored for 5-7 months in spring and 3-4 months in autumn. Prepared onion seeds are stored for 3 months in tight non-woven bags.

It is not recommended to store onions in non-refrigerated warehouses, but only in well-ventilated cooled rooms with clean, normal and stable temperatures

## Main pests and diseases of onions

**Main pests of onion.** Under the conditions of Turkmenistan, onions are particularly susceptible to the onion moth, onion fly and onion mite.

**Onion (root) larvae** are elongated, pale yellow, and 1 mm long. This larvae cause a lot of damage to onions and garlic in the field and

in barns. Onion larvae like humidity and heat, especially when temperatures rise above 13oC and humidity exceeds 70%. Their growth stops temporarily when humidity drops below 60%. The larva penetrates the root into the base of the onion, moves between the bark and eats them. As a result, the onion rots and withers.

**Control measures**. Crop rotation should be carried out in order to sow healthy seeds. Affected and0 rotted roots should be removed from the fields. Onion roots for storage should be dried 5-7 days at 35-37ºC. The storage humidity should not exceed 70%, of which 100 g of sulphur per 1 m3.area should be consumed and disinfected.

**The second generation of onion** flies overwinters as false cocoons. The flies begin to fly in April-May and lay eggs on the ground or on the withered tips of onion leaves. The eggs are white, 1.2 mm long, resembling those of cabbage flies. From them the larvae turn whitish-yellow, up to 10 mm long, 7 to 8 days old, and enter the onion base shells. The green onion turns yellow, rots and withers. After 15 to 20 days of feeding, the larvae enter the soil and become pupae, and in 14 to 20 days a new breed of fly emerges from the pupae. Onion flies produce 2-3 generations per year (Figure 8).

*Figure 8. Onion fly(1) and larva (2)*

**The onion moth** refers to butterflies that fly at night and cause great damage, mainly touching onions and garlic. The moth is up to 8 mm long, with brown forewings with white spots. Egg is elongated, yellowish, 0.4 mm long. Its yellowish-green worms live in leaves and

eat their insides and flowers. The pupae are pale in color, resembling a caterpillar. It produces three generations per year.

**Control measures.** It is necessary to carry out crop rotation on the plot where onion flies and moths are found. Plant debris should be removed from their fields. Sprinkle one of the recommended insecticides (e.g. Best Alpha, Imidor, Dalate or Fascord) on germinating onions during onion fly flight at the established rules and times.

**Onion diseases**. During early growth, onions are affected by fungal diseases (peronosporosis, Alternaria, Stemphiliosis). During onion ripening, onion cervix diseases and root rot occur.

**The fungus Peronospora destructor** causes the peronosporosis disease. The fungus conidia are mainly formed at +4 + 25º C at night, with 95% humidity, spread by wind and rain, and remain active for up to 4 days. Temperature and water drops of +1 + 28º C are necessary after dark, as fungal conidia proliferate and infect the healthy plant. The latent period of the disease is 11-15 days. The disease slows down when the air becomes dry at night. All varieties of onion are affected by this disease and the diseased leaves wither. Pale green spots appear on the leaves of diseased onions at first, then they spread and turn into a similar inky (black) substance. The leaves turn yellow and wither (Figure 9.1). The source of the disease is seeds from diseased plants, root (mother) onions, and soil residues from diseased plants. All diseases of onions, roots, leaves, twigs, and seeds are susceptible to this disease. The disease is diffuse, i.e., it spreads through previously infected seeds and root of onion (mother onion). In this case, the diseased plant will produce a sprout that is stunted, yellowed, and shiny. The diseased plant produces a dead, small seed. If the humidity is high, the diseased plant will wither away. The second characteristic feature of the disease is that it is transmitted through plant debris in healthy plant soil. The plant forms whitish spots, excretes the same ink-like substance, and dries out diseased leaves. The fungus spreads to all specimens of the plant, the leaves wither and small roots form.

**Control measures**. It is necessary to carry out crop rotation, replacement and weed control, as well as to remove crop residues from the fields. Healthy onions with roots should be kept at 40-43°C for 8 hours. Onion field moisture should be regulated and water should not be kept overnight. Nitrogen fertilizer should not be used

too much. Ridomyl gold fungicide per hectare should be sprayed with 300 L of water per 2.5 kg of water.

**Onion bacteriosis is created by Erwinia carotowora and Pseudomonas spp. living in the soil**. If the neck of the diseased base is squeezed, the solution will come out. The diseased leaves are easily cut, the tissues are watery and have an unpleasant odor (Fig. 9,2). Bacteriosis and onion disease occur in the field, but the disease symptoms are pronounced in the stock. The pathogen infects healthy onions from the affected site (mechanical, cracking, pests). If there is a lot of water in the last week of onion development, or if the air temperature during the last 6 weeks of onion development exceeds 32°C and humidity is high, mass disease of onions is possible.

**Control measures**. Crop rotation and weed control are necessary. Plant residues should be removed from the sown area. The main sown onions should be soaked at 40-43°C for 8 hours. Each hectare of Patamil or Ridomil gold fungicide should be sprayed with 300 litres of water per 2.5 kg of water.

*Figure 9. Peronosporosis diseased(1) bacteriosis(2) onions*

**Onion neck rot** is a fungal disease that occurs when onions are stored in warehouses. The disease affects healthy onions when the leaves begin to sprout even before harvesting from the fields. The fungus passes from the onion to the roots and rots. When harvested, the disease roots do not differ in their appearance from other roots, during storage the disease intensifies and black sclerosis of the fungus is formed, and the roots completely rot. Planting diseased roots leads to the spreading of the disease.

**Control measures**. Sow healthy onions; apply nitrogen fertilizer at the beginning of the growing season and phosphorus and potassium fertilizer at the end of the growing season. Soak the planted roots in a 20% solution of TMTD fungicide for 20 minutes and dry.

**Viruses are caused by onion mosaic disease.** The first symptoms of the disease appear when onions begin to sprout. Diseased bulbs remain underdeveloped, yellow, and often form long (parallel) yellow streaks. Leaves are bent. The diseased plant produces no seeds or few seeds. Seeds and diseased roots are the source of the virus and are spread by whitefly mites, aphids, and lice.

**Control measures**. Healthy seeds should be used for planting. Pest control measures should be taken. The rooted onions should be soaked in 10 liters of water for 20 minutes with a solution of 20 grams of phosphatide.

**Onion head disease is a fungal disease** that occurs immediately after sprouting on onion stems. Leaves in diseased onions first develop uniformly colored long streaks, then they wither, the leaf epidermis tears, and black spongy fungal spores emerge from the cracks. As the onion grows, the disease also affects the roots of the onion. The fungus spores persist in the soil for 5-6 years without losing their activity.

**Control measures**. It is necessary to carry out crop rotation, and not to plant onions in the affected areas for 5-6 years. Sprinkle each hectare of onion area with a mixture of 56 kg of sulfur and 112 kg of lime.

**Weed control measures in onion crops**. Several types of herbicides are used against monocotyledonous and dicotyledonous weeds that have a significant effect on onion yield. Seeds planted against bilateral and cereal weeds are mixed with 300 liters of water at 4.5 liters per hectare and covered with soil before sowing. Herbicide Fusillade forte or Helga super is sprayed with 300 liters of water at the

rate of 1.0 liters per hectare, and gondolier grass 240 at the rate of 0.75 liters per hectare after formation of 2-4 leaves on the onion sprouting field.

If there are such weeds as couch grass, bulrush the fields are irrigated before sowing (trickling water). As a result all possible weeds will germinate. The field should then be sprayed with 36% followed by 48 WR or sprouted WR, 36% of each herbicide, 300 liters of water per hectare at a rate of 6 liters per hectare, and after 20 days the necessary agronomic measures should be taken to start sowing.

## Appendix

*Table 1*

### Norms and terms of agronomic measures of onion germination in spring

| No | Agro technical measures | Norma | Duration | |
|---|---|---|---|---|
| | | | Southern Etrap of Akhal Balkan Mary and Lebap velayats | In northern etraps of Dashoguz and Lebap velayat |
| *1* | *2* | *3* | *4* | *5* |
| 1 | Cleaning of fields from vegetation waste | By means of mechanisms and hands | 10-20.10 | 01.-10.10 |
| 2 | Conduct irrigation works (if necessary) before ploughing | 600 m³/ha | 20-25.10 | - |
| 3 | Work carried out against weeds | Recommended herbicides by rule | 01-10.10 | 10-15.10 |
| 4 | Fertiliser before ploughing | Superphosphate-500 kg/ha, Potassium chloride-70 kg/ha, rotten manure 30-40 t/ha | 01-20.11 | 10-30.11 |
| 5 | Conducting ploughing | 30-32 in depth | 01-30.11 | 10-30.11 |
| 6 | Trimming | Cross section | 01-15.01 | 15-30.12 |
| 7 | Measures to be taken before sowing | In light soils - 12-14 cm, in medium and heavy soils - 16-18 cm, cheesel + rake + harrow | 10-20.01 | 01-20.02 |

*Continuation of table 1*

| *1* | *2* | *3* | *4* | *5* |
|---|---|---|---|---|
| 8 | Creating beds | 70 cm between rows | 10-20.01 | 01-20.02 |
| 9 | Work carried out against weeds | Recommended herbicides by rule | Before sowing or after seed germination | |
| 10 | Presowing water | 600-700 m³/ha | 20-25.01 | 10-20.02 |
| 11 | Conducting seeding | Over-beds 2-3 rows, with native varieties 18 kg/ha, with hybrid species 8-10 kg/ha | 01.02-05.03 | 25.02-15.03 |
| 12 | Watering for growth | 600 m³/ha | After seeding. | |
| 13 | Intercropping activities carried out | 10-12 cm deep | 20.04-10.05 | 10-20.05 |
| 14 | Watering for growth | 600-700 m³/ha every 7-10 days, every 4-5 days during germination of root crops, 16-18 times in total | 15.04-15.08 | 20.04-20.09 |
| 15 | Work carried out against weeds | Recommended herbicides by rule | If necessary during onion germination | |
| 16 | Carry out work against diseases and insects | Rule-recommended insecticides and fungicides | For disease prevention when diseases and pests are detected | |
| 17 | Additional 1st time feeding with mineral fertilizers, combining with inter-row work | In the case of mass sprouting of onions: urea-200 kg/ha, superphosphate-180 kg/ha, potassium chloride-30 kg/ha | 20.04-05.05 | 01.05-15.05 |

*Continuation of table 1*

| *1* | *2* | *3* | *4* | *5* |
|---|---|---|---|---|
| 18 | Supplementary feeding with mineral fertilizers for the 2nd time | At the moment of root crop appearance: ammonium nitrate-200 kg/ha, superphosphate-160 kg/ha, potassium chloride-30 kg/ha | 10-20.06 | 25.06-30.06 |
| 19 | Supplementary feeding with mineral fertilizers for the 3rd time | During sprouting of root crops: ammonium nitrate-200 kg/ha, superphosphate-160 kg/ha | 15-25.07 | 10-15.07 |
| 20 | Harvesting | With the help of hands and mechanisms | 15-30.09 | 25.09-05.10 |

*Table 2*

**Norms and terms of agronomic measures of onion germination in spring**

| № | Agro technical measures | Norma | Timeframe to be carried out | |
|---|---|---|---|---|
| | | | Southern Etrap of Akhal Balkan Mary and Lebap velayats | Northern Etrap of Akhal Balkan Mary and Lebap velayats |
| *1* | *2* | *3* | *4* | *5* |
| 1 | Cleaning of fields from vegetation waste | By means of mechanisms and hands | 10-20.07 | 01-10.07 |
| 2 | Conduct irrigation works (if necessary) before ploughing | 600 m³/ha | 15-20.08 | 10-15.07 |
| 3 | Work carried out against weeds | Recommended herbicides by rule | 25-30.08 | 25-30.07 |
| 4 | Fertiliser before ploughing | Superphosphate-500 kg/ha, potassium chloride-70 kg/ha, rotten manure 30-40 t/ha | 25.08-01.09 | 01-10.08 |
| 5 | Ploughing carried out | 30-32 cm deep | 01-20.09 | 05-20.08 |
| 6 | Trimming | Cross section | 01-20.09 | 10-20.08 |
| 7 | Work to be carried out prior to sowing | In light soil 12-14 cm, in medium and heavy soil 16-18 cm, chisel + rake + harrow in combination | 25.09-05.10 | 15-25.08 |
| 8 | Bed base | 70 cm between rows | 01-05.10 | 01-05.09 |

*Continuation of table 2*

| *1* | *2* | *3* | *4* | *5* |
|---|---|---|---|---|
| 9 | Pre-sowing irrigation | 600-700 m³/ha | 05-10.10 | 05-10.09 |
| 10 | Conducting seeding | Over-beds 2-3 rows, with native varieties 18 kg/ha, with hybrid species 8-10 kg/ha | 15.10-01.11 | 15.09-01.10 |
| 11 | Watering for growth | 600 m³/ha | After seeding | |
| 12 | Conducting intercropping work | 10-12 cm deep | 15-30.03 | 15-25.10 |
| 13 | Additional 1st time feeding with mineral fertilizers, combining with inter-row work | In mass germination: urea-200 kg/ha, superphosphate-180 kg/ha, potassium chloride-30 kg/ha | 20.03-05.04 | 10-15.03 |
| 14 | Supplementary feeding with mineral fertilizers for the 2nd time | During sprouting of root crops: ammonium nitrate-200 kg/ha, superphosphate-160 kg/ha, potassium chloride-30 kg/ha | 15-25.04 | 15-20.04 |
| 15 | Supplementary feeding with mineral fertilizers for the 3rd time | During sprouting of root crops: ammonium nitrate-200 kg/ha, superphosphate-160 kg/ha | 10-15.05 | 10-20.05 |
| 16 | Watering for growth | 600-700 m³/ha by the rule every 7-10 days, when onions become root crops - every 4-5 days in total 16-18 times | 10.04-01.06 | 20.03-10.06 |

*Continuation of table 2*

| *1* | *2* | *3* | *4* | *5* |
|---|---|---|---|---|
| 17 | Work carried out against weeds | Recommended herbicides by rule | If necessary during onion germination | |
| 18 | Work carried out against insects and diseases | Rule-recommended insecticides and fungicides | When diseases and pests are detected or to prevent diseases | |
| 19 | Harvesting | With the help of hands and mechanisms | 10-20.06 | 20-30.06 |

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**AGRICULTURAL RESEARCH CENTER**

# MANUAL ON THE CULTIVATION OF ONION

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