

Manual of best practices on soil amelioration in deserts affected by salinization

and

Guidelines of communal forest management in arid and semi-arid areas of Turkmenistan

Content

Introduction

1 Manual

- 1.1 The purpose of the nursery
- 1.2 Selection and characterization of plant species for the area
- 1.3 Collection, processing, preparation and seeding
- 1.4 Care of seedlings (sowing, watering, protection of seedlings)
- 1.5 Transplanting of seedlings in the open ground

2. Guideline. Creating a nursery

- 2.1 The Foundation of the nursery (outline, parameters, materials)
- 2.2 Preparation of soil (substrate) for filling containers
- 2.3 The method of sowing seeds in containers and placing them in the nursery
- 2.4 Organization of nursery irrigation
- 2.5 The structure of the shed

Conclusion

Introduction

In accordance with the National forest program of Turkmenistan in Dashoguz velayat around the hill “Botendag”, located to the East of lake Sarykamysh, in the period of 2013 – 2020 in the area of 20 thousand hectares it is planned to plant different types of trees. On sandy, sandy loam and loamy soils salinity resistant desert species will be planted, such as saxaul, cherkez, kandym. On lands with shallow groundwater, and various degrees of salinity there will be the woody deciduous species (elm, poplar, Asiatic poplar, oleaster, quince, etc.). During 2013 - 2015 the forestry of Turkmenistan produced planting in the area of 5000 hectares. From 2016 to 2020 it is planned annually to carry out planting on an area of 3000 hectares.

To execute the planned volumes of planting it is necessary to prepare a sufficient quantity of quality planting material (seedlings, saplings). To this end, in the framework of the project "Technical support to align national action programs in Turkmenistan" the support will be rendered to the forestry Administration of the State Committee of Turkmenistan for the environment protection and land resources in terms of construction in Dashoguz forestry of modern forest nursery.

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1.1 The purpose of the nursery.

The projected forest nursery will be designed for growing seedlings and saplings with closed root system, using best practices (domestic and foreign) of nursery management, comprising the whole cycle of growing of planting material, starting from preparation of seed up to the product issue. Up to the present the forest nursery of Department of forestry has been growing just some of the types of tree species with the closed root system, mainly conifers (Turkmen Archa, Eldar pine, arborvitae, cypress, juniper virginianus) and nut (Pistachio, walnuts). Other types of trees and shrubs were transplanted in the planting forest with open root system that did not give the opportunity to the expected survival rate of plants. In foreign

countries with developed forestry the seedlings intended for the creation of artificial forests or conservation lands, are cultivated only with closed root system. This "Guideline" uses the Turkish experience of cultivation of seedlings with closed root system in special nurseries.

Forest nursery (Turkey)

1.2 Selection and characterization of plant species for this area

In accordance with soil and climatic conditions of the aforestated area – Aral Sea basin – Dashog region, "Botendag" it is recommended to plant the following types of hardy-shrub species:

1. The **black saxaul** (*Haloxylon nigra*) – a desert tree 8m of height, trunk diameter of 60-70 cm, lives up to 70-80 years. Grows on all types of desert soils, except very salty (the shore), but is better developed in valley-like depressions on sandy and sandy loam soils with shallow groundwater.
2. **White saxaul** (*Haloxylon persicum*) - tree up to 5m, trunk diameter up to 40cm, age 40-50 years. Grows on sand dunes and hilly sands. Can grow in smooth, finely gravelly (kyr), takyrs soils, acquiring a bush form.



Black saxaul



White saxaul

3. **Cherkez** (Saltwort) - Richter and Paletsky Salsola, Garaja cherkez and Ak cherkez, large shrubs 2 – 4 m tall. Distributed on all types of desert, lives up to 20 years. Richter cherkez grows on the smoother sand, while Paletsky cherkez - on dune sands.
4. **Kandym** (Caligonum) – In Turkmenistan there are more than 30 types of Kandym. The species promising for the territory “Botendag” are sertissage K. (Gizil gandym) and K. “Head of Medusa” (the ADAT gandym). The advantageous species for the territory of "Botendag" are “Hairy-legged K.” (Gizil Gandhi) and “Medusa-head K.” (adat Gandhi).
5. **Sand acacia** (Amodendron) - sandhill wattle (Sözen) – Tree, up to 10 m tall, endemic to the Karakum desert, growing in poorly fixed and shifting sands, anchoring them, and on sandy soils.
6. **Pistachio** (Pistacia vera) - nut tree. Very drought-resistant plant with a strong root system (in adult tree roots get to a depth of 10 m.). In the territory of the Central Karakum station Karrykul НИИРЖМ, since 2000, pistachio has been sowed and planted and now there are already yielding trees.
7. **Eastern oleaster** (Eleagnus orientalis) - a tall salt tolerant tree, growing on the flood plains of rivers (the Amu Darya, the Murghab, the Tejen) on lands with shallow ground water.
8. **Poplar, downy and blue** (Populus efratica) - Forms floodplain forests of Turkmenistan, grows also on the banks of canals and drainage collectors. Salt-tolerant and not soil-demanding tree.
9. **K. prostrata**, (Vitex) - shrub up to 4-6 m high, grows naturally in Turkmenistan through the gorges of the Kopetdag. When watering can grow in saline soils, resistant to dry and hot climate.
10. **Quince** (Ayva) - Fruit shrub up to 8 m, resistant to heat and saline soil.
11. **Asiansumach or Chinese tree of heaven** (Aylantus altissima)- high tree (up to 30 m) when watered grows in any soil - climatic conditions, tolerant to heat, drought and salinity, resistant to pests and diseases.
12. **Feather-branch Karagach or Turkestan Elm** (Ulmus) - A tree up to 15 m high, endures well heat and dryness of the air, and soil salinization, the roots have the ability to store nitrogen in the soil.

13. **Mulberry** (*morus nigra & alba*) - a tall tree with a dense well branched crown, endures well heat and dryness of the air, not soil-demanding.
14. **Chinaberry tree** (*Melia Azedarach*) - a small tree with dark green leaves, heat resistant, when watered grows in any soil.

1.3 The seeds harvesting, processing, preparation and sowing

Harvesting and preparation of seeds is performed during the period of their maturation. In most trees the seeds ripen in autumn, in some - in summer (mulberry - June, kandym and the sand acacia - June, elm - April). Treatment consists of extracting seeds from fruits, cones, boxes and other coatings by thermal, physical and mechanical exposure.

Preparation of seeds for sowing is necessary in order to bring the seed out of dormancy to the germination readiness. There are different methods of seed preparation for sowing, but the most simple and effective method is the soaking of seeds in water - cold, warm, or hot. However, for germination of some seeds with very hard surface a long preparation is required in cold, then in warm medium. Such seeds include: pistachio, sand acacia, almond, oleaster, kandym, etc. For these seeds, the method of cold stratification is used. In winter the seeds in boxes or other containers are laid in moist sand and stored in a cold room in the wet state for a period from one to three months (December, January, February). In March with the onset of warm time the seeds begin to sprout and they can be sown. If it is not possible to do stratification, seeds can be sown in winter (late Nov, Dec). After planting be sure to water and keep the soil moist until the first frosts. In this case, seeds will be naturally stratified in the soil.

The table below provides data on the harvesting, processing and preparation of seeds for sowing.

Table 1.

Name of species	Timing of preparation	Ways of processing (purification)	The methods of preparation for sowing	The timing of seed sowing (month)
Bitlik (<i>Vitex</i>)	Nov. – Dec.	After collecting they are dried and	Seeds that have been aged for 3-5 days in cold	XI-XII

		cleaned of debris	water, are sown.	
Saxaul (haloxilon) Cherkez (Salsola richteri)	Rounded samara seeds Oct. – Nov.	The collected seeds are dried, cleaned from impurities and debris	No preparation. After sowing, watering is necessary.	XII-I-II
Kandym. (caligonum)	June	Seeds are cleaned from impurities and debris	In the nursery they are sown in autumn and constantly moisturized	XI
Asian sumach (Aylantus altissima)	Oct. – Nov. Winged seeds	They are cleaned from debris and empty seeds.	After harvest they are dried. Before sowing are soaked in water for 2-3 days, changing the water daily	XI-XII
Pistachio (Pistasia vera)	Sept.	They are peeled, dried for 5 days in air at a layer thickness 5cm.	Soaked in warm water for 2-3 days, changing water daily.	XI-XII
			Cold stratification (Jan.-Feb.)	III
Karagach – Elm. (Ulmus)	Apr. Rounded samara seeds	After collecting they are dried and cleaned of debris	Soaked for 1 day and seeded	IV-V
Chinaberry (Melia Azedarach)	Nov.-Dec. Seeds-drupe, clusters	Seeds are dispensed from a soft shell, and dried.	Seeds that have been soaked for 3-5 days in cold water, are sown.	XII
			Cold stratification (Jan.-Feb.)	III
Mulberry black &	May-Jun.	The fruit is	The fruit is ground	VI-VII-

white (morus nigra & alba)	The stem-berry dark red, or light yellow	harvested from the trees by shaking	through a sieve and the pulp is washed with water. After drying, seeds are soaked in water for 1-2 days and sown.	VIII
Igde – Eastern oleaster. (Eleagnus orientalis)	Oct.-Nov. The fruit is edible "date", hard seeds	The seeds are separated from the shell and dried.	Seeds that have been aged for 3-5 days in cold water, are sown.	XII
			Cold Stratification (Jan.-Feb.)	III
Sand acacia Sözen (Amodendron)	Jun. Seeds are very hard, in winged shell	Seeds in dry state are rubbed, being separated from wings.	Seeds are soaked in hot water (80-85°) to cool. Then sown	XII
Turanga – Downy poplar (Pupulus efratica)	Propagated vegetatively – by cuttings and root suckers, which are prepared in Asiatic poplar plantations.			
Quince- Behi (Ayva)	Nov.	Seeds are extracted from Mature fruits, washed and dried	Soaked for 1 day in warm water and seeded	III
Almond – Badam (Amigdalus)	Nov.-Dec. Stone fruit seeds.	The fruit stones are cleaned from the shell.	Seeds-stones are soaked for 1 day in warm water.	XII-I



Saxaul - seeds



Cherkez – seeds



Sözen – Sand acacia (seeds)



Kandym - seeds



Igde - blossom



Meliya - blossom



White Mulberry



Black Mulberry



Vitex



Pistachio



Almond

1.4 Care of seedlings (sowing, watering, protection of sprouts)

Sowing term. In Turkmenistan for the last 15-20 years climatic factors have been changing. Summer season extends, starting usually from mid-April and lasting until mid-October, and during the summer months there is an increase in maximum temperatures. Winters become warm and dry, and springs are short. The annual rainfall is reduced, which, moreover, fall not in regular intervals according to the seasons. In this regard, measures to care of crops in the nursery should be adapted to climate change. As can be seen from the table almost all the seeds are sown in winter, because since the end of November until the end of January the temperature almost never drops below zero. This allows carrying out the sowing campaign timely and qualitatively. Besides, the seeds, until spring, will get a natural stratification.

Watering. Immediately after planting the seeds, watering is performed, filling the trench with water to completely wet the soil in containers. In the future, to keep the upper layers of the soil moist, watering is best done by sprinkling method.

Protection of sprout. After seeding, the surface of the small containers is mulched with sawdust (0.5 cm); the trench is covered with clean straw (2-3cm). This protects the top layer of soil from blowout in high winds, and the little shoots - from spring frosts, the soil moisture is also maintained in the container. In summer, you need to build a shed over the nursery using a special mesh material made of artificial fibers, to protect the seedlings from the hot sun.

Care. In spring, with the emergence and establishment of warm days (April), the straw from the surface trenches is removed, if you have weeds, it is also removed and in the future, constantly cleared of weeds.

1.5 Transplanting seedlings in the open ground.

Given the climatic features of Turkmenistan forestation work is best done in autumn and winter (November, December, January). Before planting, in the reforestation area "Bëtendag" the seed-spots (holes) are prepared, the size and the scheme being in accordance with the working draft. It is advisable to carry out the transportation of seedlings in polyethylene containers (bags) to the site over long distances in packaging (boxes, etc.), in order to avoid damage to the package and spilling root soil. Immediately in planting seedling into the hole the plastic bag is removed and the root system with the ground lump is dug. Immediately after planting, watering is carried out (at least 20 liters of water in each hole). In the future, before the onset of the winter wet season the soil in the hole needs constant moisturizing, preventing it from drying.

Guidelines of communal forest management in arid and semi-arid areas of Turkmenistan

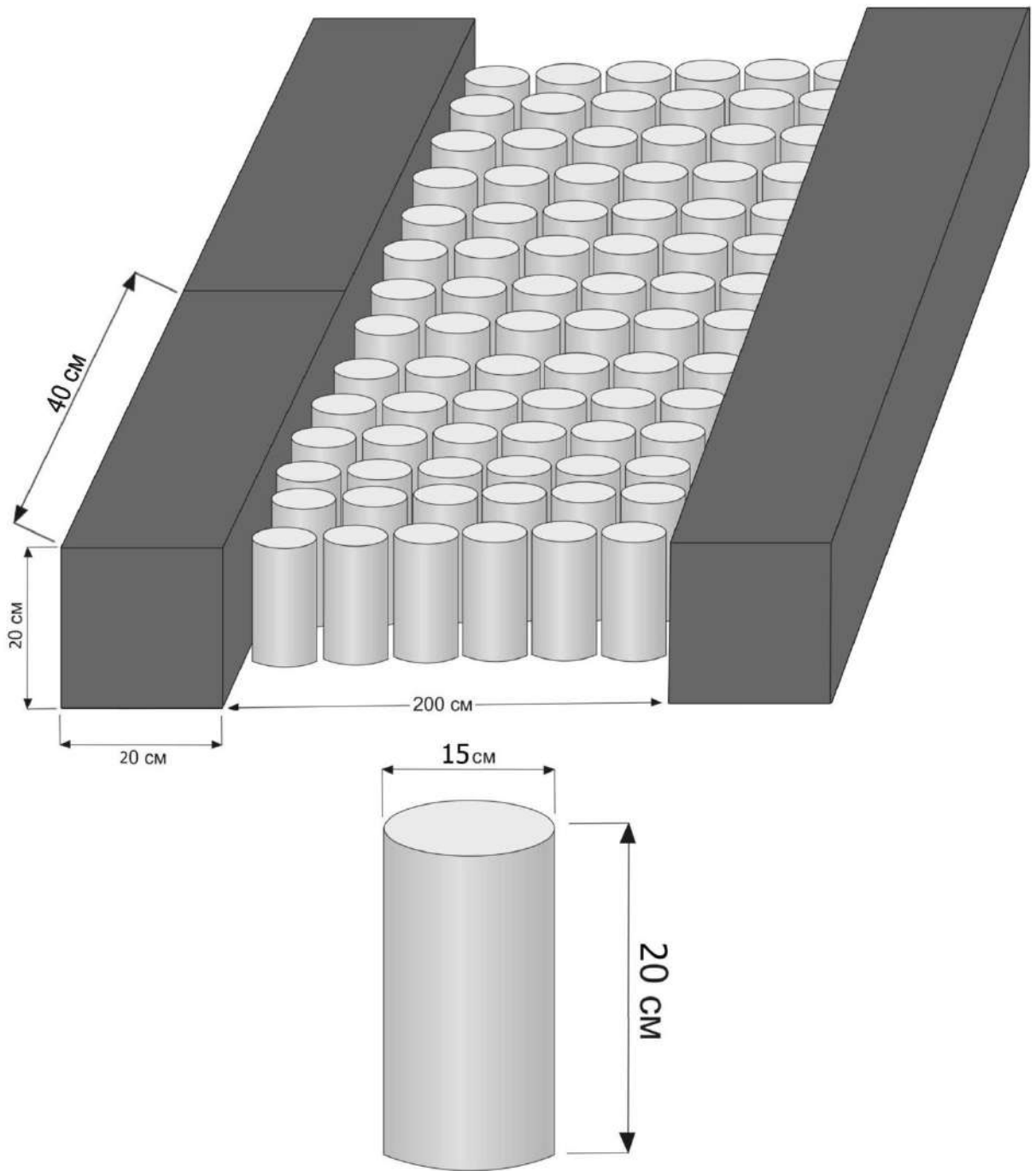
Guideline. Creating a nursery.

2.1. Laying of the Foundation of the Nursery

The soil, chosen for the nursery foundation laying is the light, well-drained soil, so that water when watering seedlings does not stagnate in the upper horizons and does not create the threat of salinization of the root layer of the earth. Ground water needs to be fresh and lie at a depth not greater than 3 m. The site should have the access roads, sources of irrigation and electricity. It is desirable that the nursery is protected from the strong winds by a wind-breaker. The proposed option of nursery will be built in the territory of Dashoguz regional department of the Forestry Administration, in the Dashoguz leskhoz, the area is a width of 9 m, length 40 m.

The nursery is based on concrete blocks, lined up in rows, "dices" with a height of 20 cm, the distance between rows - 2 m. The number and length of rows may be different, depending on the amount of cultivated planting material. The bottom of

inter-row spacing is coated with a layer of gravel. In addition to building materials it is necessary to prepare plastic bags (height 20 cm, diameter 15 cm), fine sawdust, cereal plants straw, materials for shelter, tools, and equipment for sprinkling.

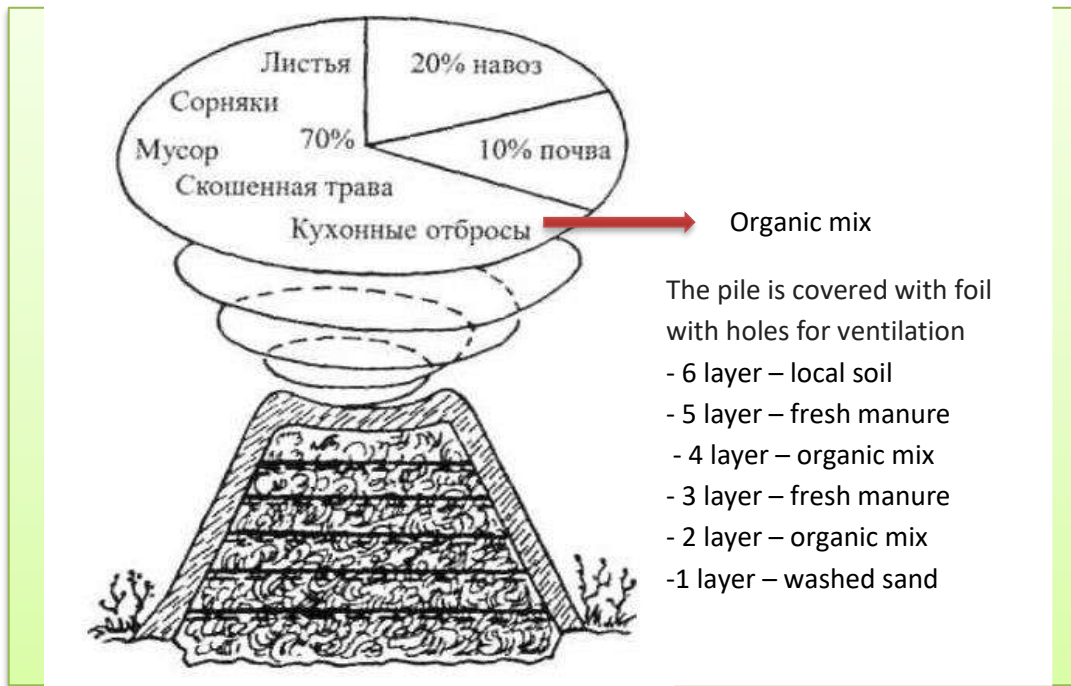


Scheme and dimensions of the nursery's line

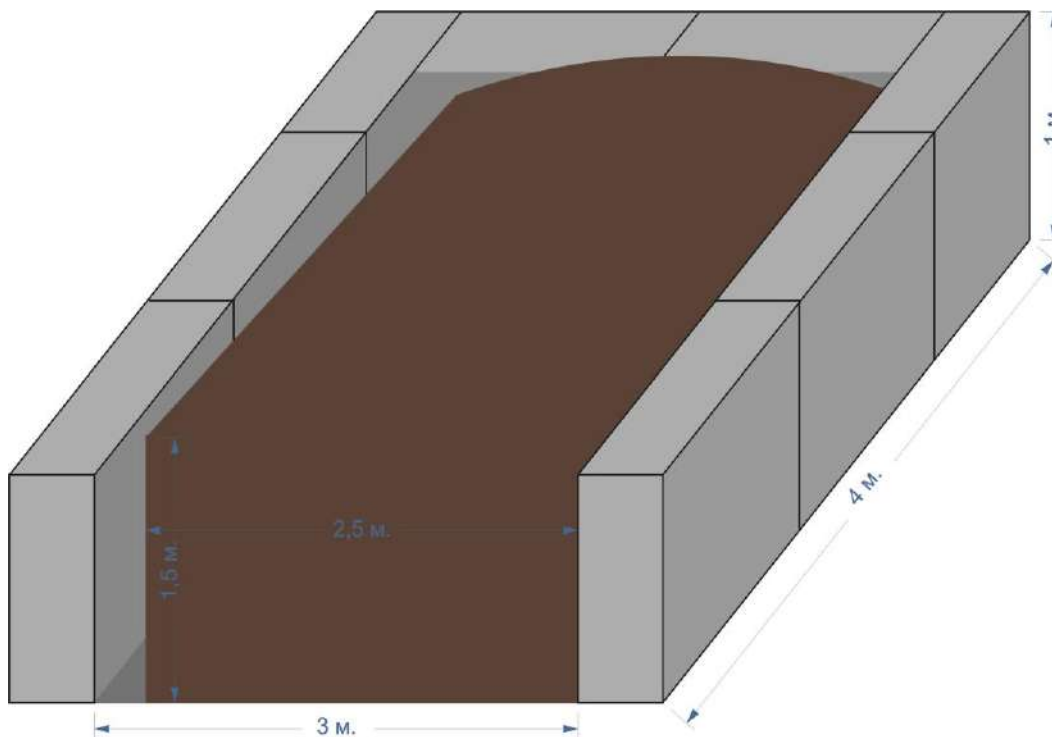
2.2. Preparation of soil (substrate) for filling containers

Soil ground for growing seedlings in containers is prepared from three components: a non-saline soil – 40%, washed sand - 30%, humus\manure – 30%. For purification from unwanted impurities, the soil and the manure is sifted through mesh material. The containers are filled manually and installed in the trench. However, the best results of survival rate of seedlings can be obtained by using compost in containers.

Making compost. To produce compost the organic matter of plant and animal origin is used. It is plant waste (stems, branches, leaves, and weeds), food waste, fresh manure, crushed cones of pine and other conifers, wood ash, poultry manure, bones. Rough and hardened particles are crushed, crumbled or crushed in machine. Then all organics are collected in a pile by the layers of 25-30 cm, a width and a length of 2.5-3 m, height 1.5-2 m. When forming each layer they are moisturized, and manure mixed with urea is put between the layers. To enrich the compost 1 ton pile is mixed with 7-10 kg of superphosphate. Formed, compacted and moistened pile is covered on all sides with plastic wrap with holes for ventilation. The formed heaps once in 15 days are stirred and moisturized. The compost ready date is between 4 and 6 months.



An example of a structure of the compost heap



2.3. The method of sowing seeds

The process of planting seeds begins with the installation of filled containers in the trench. The substrate or compost is filled into the container 1.5 - 2 cm below its upper edge. Then proceed to the incorporation (sowing) of seeds. 2-3 seeds are laid in each container. Depth of seeding: Saksaul, Cherkez – 0.5-1cm; sandy acacia, oleaster, chinaberry – 2-3cm; pistachios, almonds, kandym – 3-4cm; bitlik, Ailanthus – 2cm; mulberry, elm – 1cm; quince – 2cm. Pre-sowing treatment, preparation and sowing terms of seeds are indicated in table 1.



Sowing seeds in containers

2.4 Watering and irrigation

Immediately after sowing, watering is done. If the trench is of closed type, the first watering is done by pumping water into the ditches for complete wetting of the soil in the containers. Further watering is carried out by sprinkling. In summer in hot and dry weather sprinkler irrigation is conducted daily and only at night.

The sprinkler irrigation system consists of an electric water pump, PVC pipe, 32mm in diameter and splint-sprinklers. The system will be installed under the roof of the shed. The pipes in two lines across the length of the nursery are fixed on the top of the structure; the distance between the lines is 2m. Splint-sprinklers are hung on the pipe with the 3m interval. Materials needed: Plastic pipes (32mm) – 180 m, splint-sprinklers – 60pcs.



Watering by sprinkler method 1



Watering by sprinkler method 2

2.5 The shed set-up

In summer, the maximum temperature in the sun can reach 50 ° C or more, so it is recommended to build a shed over the nursery, it will protect plants from sunburn. To cover the shed a special mesh of synthetic material is used.



An example of a structure of possible protective shed

Conclusion

Botendag differs from other regions of Turkmenistan in the most severe climatic conditions. It has a minimum rainfall amount (40 to 70 mm), high summer and low winter temperatures, frequent hot winds and dust storms. Therefore, when carrying out tree-planting works, it is necessary to take account of these climatic factors and to observe the following rules:

1. The planting is preferably carried out in the season of rainfall and gentle winds;
2. If the soil is dry the planting holes are watered before planting as well as immediately after planting;
3. Around the planted seedlings the water bowls are made with a diameter of 1 m, which are covered by a layer (2-3cm) of manure (humus);
4. When transporting seedlings to the planting area it is necessary to prevent drying of the soil in the containers; for this purpose preloading watering is needed. Vehicles must have the canopy body.

The survival rate of forest plantation using seedlings with closed root system is much higher than when planting seedlings with open roots.

The proposed option of nursery will be built at the forest nursery of Dashoguz forestry, which is a metal arch design with a width of 9 m, length 40 m. Along the entire length of the structure the 4 rows of concrete blocks (dices) will be constructed. Between them 3 stripes 2 m wide will be formed, to set seed containers (see scheme of the nursery). The upper part of the arch (roof) will be covered with shadow material. Under the arched design the sprinkler equipment will be installed.