LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie

Le Ministre de l'Économie,

Vu la loi du 20 juillet 1992 portant modification du régime des brevets d'invention, telle que modifiée ;

Vu le règlement grand-ducal du 17 novembre 1997 concernant la procédure et les formalités administratives en matière de brevets d'invention ;

Vu le dépôt de la demande de brevet luxembourgeois daté du : **11/01/2023** ;

Arrête :

**Art. 1er.-** Il est délivré à la (aux) personne(s) mentionnée(s) sur le tableau des données bibliographiques attaché au présent arrêté, sous le numéro de code 73, un

**BREVET D'INVENTION N° LU503330**

pour : NON-IRRIGATION AFFORESTATION METHOD FOR GRAVELLY DESERT SOILS IN MID-LATITUDE DESERT-STEPPE AREAS OF SUB-FRIGID ZONE
tel que décrit dans les duplicata des pièces techniques joints en annexe.

**Art. 2.-** Le brevet est délivré sans examen préalable de la brevetabilité de l'invention, sans garantie de l'exactitude de la description et aux risques et périls des demandeurs.

**Art. 3.-** Le présent arrêté, qui constitue le titre de protection, est expédié au(x) mandataire(s) agréé(s), mentionné(s) sur le tableau des données bibliographiques attaché au présent arrêté, sous le numéro de code 74 ou, à défaut, à la (aux) personne(s) visées(s) à l'article 1er, pour servir de document probant à celle(s)-ci.

LE GOUVERNEMENT DU GRAND-DUCHÉ DE LUXEMBOURG

Luxembourg, le **11/07/2023**

Pour le Ministre de l'Économie,

Corinne Müller
Attachée
Office de la propriété intellectuelle

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(54) **NON-IRRIGATION AFFORESTATION METHOD FOR GRAVELLY DESERT SOILS IN MID-LATITUDE DESERT-STEPPE AREAS OF SUB-FRIGID ZONE.**

(57) The application relates to a non-irrigation afforestation method for gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone, including the following steps: seedling preparation (tree species selection, seedling quality and seedling preparation), micro terrain modification (trench digging and soil breaking, fine material backfilling), afforestation (afforestation mode, afforestation timing and afforestation technology) and the like. In view of the climate of the sub-cold mid-latitude desert steppe zone, the method adopts drought-tolerant, cold-tolerant and saline-tolerant tree and shrub species; for the difficulty of plant roots to penetrate the gravelly desert soil layer, it utilizes a soil breaking method applicable to this soil; based on the precipitation characteristics of the region with moderate and stable winter snow, the micro terrain modification measures of accumulating snow water is adopted.

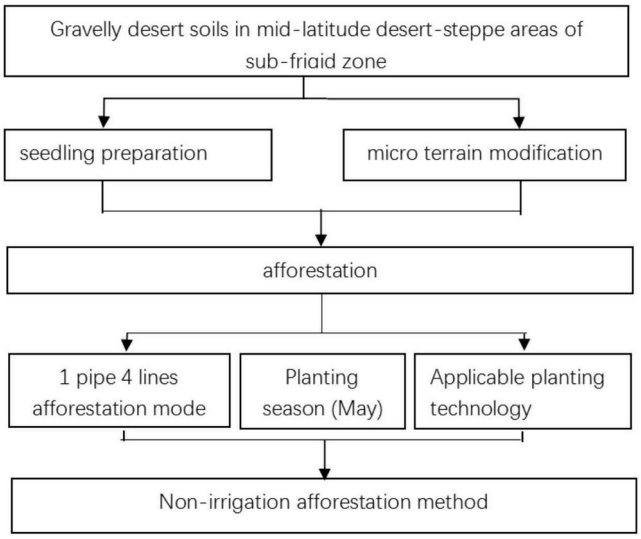


FIG. 6

**DESCRIPTION** LU503330

# NON-IRRIGATION AFFORESTATION METHOD FOR GRAVELLY DESERT SOILS IN MID-LATITUDE DESERT-STEPPE AREAS OF SUB-FRIGID ZONE

## TECHNICAL FIELD

The present application relates to a non-irrigation afforestation method for gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone; this method is applicable to areas with annual precipitation of 150-300 mm, stable snow cover in winter, average snow thickness ≥ 25cm, latitude in the middle latitude of sub-frigid zone, and soil type of gravelly desert soils.

## BACKGROUND

The Republic of Kazakhstan (Kazakhstan for short) is the first place to initiate the Silk Road Economic Belt, located deep in the hinterland of the Eurasian continent and an arid zone in the central part of Asia, bordering Russia in the north and China in the east; it is an important ecological barrier in Central Asia and connects a major land trade route from China to Europe. Kazakhstan has a typical continental climate with arid summers and cold winters, the terrain is mostly plains and lowlands, with deserts and semi-deserts accounting for 60 percent (%) of Kazakhstan's land area. The forest in Kazakhstan is limited in area and is dominated by shrubs and barren forests, and the forestry strategy is positioned to control desertification, protect water catchment areas and regulate microclimate and other ecological functions, with economic functions as a supplement.

Nur-Sultan, the capital of Kazakhstan, is established in 1997 with an altitude ranging from 340 - 400 meters (m) above sea level, and is located in the vast semi-desert steppe of north-central Kazakhstan; the city is in the mid-latitude desert-steppe sub-frigid zone with fragile ecological environment, where the average annual precipitation is around 300 millimeters (mm) and there is a 30 centimeters (cm) thickness of stable snow in winter, and natural vegetation here is mainly herbaceous, with sparse distribution of

trees and shrubs. A large-scale ecological protection forestry project, the Capital Ring Project, has been implemented in the city to improve the local ecological environment. Up to now, the reforestation work has been going on for 23 years, and nearly 100,000 hectares of forests have been planted around Nur-Sultan, greatly contributing to the improvement of the ecological environment of the town. Ever since the project started, forest cover in the area has increased significantly, soil erosion has been effectively controlled, and the ecological environment has been significantly improved. However, there are gravelly desert soils in some desert-steppe areas around the city, the main soil type of which is chestnut soil, composed of gravel, calcium-containing gypsum layer and meadow soil mixture (soil surface layer contains 10% - 30% gravel and gypsum at 0 - 100 cm depth). Trees planted on such gravelly desert soils suffer from low survival rate, slow growth, slow establishment, and cannot bring about normal ecological benefits.

Although the desert-steppe area around Nur-Sultan is arid and frigid, the ecological environment is different from the above; firstly, Nur-Sultan is located in the northern part of Kazakhstan, with the different species of weather-resistant, drought-tolerant and saline-tolerant species available for screening; secondly, under the site conditions of gravelly desert soil, the soil surface layer contains 10-30% gravel and gypsum mixture at the depth of 0 - 100 cm, and the the calcareous gravelly soil layer of this hard soil texture is difficult for plant roots to penetrate without artificial auxiliary measures, the survival rate is therefore low even for the local planting of *Tamarix* L., *Calligonum mongolicum* Turcz. and other shrub species with relatively drought and salinity resistance, and the survived trees after years of growing appear to be small and crooked, with low ecological protection function; thirdly, there is a stable snowing in the region in winter, with an average thickness of 30 cm for many years, which can be used to implement the non-irrigation afforestation technology.

Under the harsh environmental conditions in the mid-latitude desert-steppe areas of the sub-frigid zone, temperature and soil moisture as well as soil quality are the main limiting factors for ecological restoration on gravelly desert soil in this region, and the techniques to improve soil water retention capacity and facilitate plant roots penetrating the lightly salinized calcareous gravelly soil layer are crucial to the ecological barrier construction in

this region. According to the present application, plants and shrubs that are adapted to the local climate are selected in combination with a planting method of breaking soil and controlling soil moisture, so as to greatly improve the survival rate of tree species and promote root penetration into the calcareous gravel layer; and for the problem of low soil organic matter content and poor soil quality, fine soil is utilized with additional organic fertilizer to improve soil quality and promote the growth of trees; in addition, normal growth can be achieved under the conditions of gravelly desert soil in the mid-latitude desert steppe area in the sub-frigid zone with 150 - 300 mm annual rainfall and without irrigation.

## SUMMARY

It is an objective of the present application to provide a non-irrigation afforestation method for gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone; the method is applicable to sub-frigid mid-latitude desert-steppe zone and gravelly desert soil with site conditions of 150-300 millimeters (mm) annual precipitation, stable snow accumulation in winter with an average snow thickness of ≥ 25 centimeters (cm); this method includes steps of seedling preparation, land preparation and afforestation, and achieves normal growth without irrigation under the conditions of 150 - 300 mm annual precipitation. It overcomes the shortcomings of the existing technology of afforestation, such as low survival rate, poor growth and slow forest establishment.

The present application provides a non-irrigation afforestation method for gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone, achieving non-irrigating afforestation under site conditions of sub-frigid mid-latitude desert-steppe zone and gravelly desert soil with site conditions of 150 - 300 mm annual precipitation, stable snow accumulation in winter with an average snow thickness of ≥ 25 cm, and including steps as follows:

seedling preparation:

a, tree species selection: selecting native tree and shrub species with developed root system, salinity tolerance, drought resistance and cold resistance, such as *Ulmus pumila*

L., *Tamarix* L., *Caragana korshinskii* Kom. or *Elaeagnus angustifolia* Linn., where seedlings are selected as follows: *Ulmus pumila* L. seedlings of 1 year old with ground diameter > 1.2 cm and seedling height > 140 cm, *Tamarix ramosissima* Lcdcb seedlings of 2 years old with ground diameter > 0.8 cm and seedling height > 120 cm, *Caragana korshinskii* Kom. seedlings of 2 years old with ground diameter > 0.45 cm and seedling height > 45 cm, or seedlings of *Elaeagnus angustifolia* Linn. aged 2 years with ground diameter > 0.8 cm and seedling height > 120 cm;

b, performing seedling breeding two years before afforestation at nurseries close to n afforestation site, selecting a planting period for seedling preparation in the spring from early to mid-May, transporting the seedlings to the afforestation site within 3 days before planting, and heeling in the seedlings at the afforestation site;

land preparation:

c, trenching and breaking ground: planting on gravelly desert soils, using mechanical trenching to break up the soil; digging trench according to planting row spacing with a depth of 60 cm and a width of 40 cm;

d, backfilling with fine materials: digging above the trench backward with an excavator, placing a screen above the trench and in front of the excavator, pouring soil from above the screen after the excavator digs, filtering fine material soil into the ditch, so as to make fine material soil enter the trench after filtering, coarse gravel and soil material roll down to an outside of the trench (forming a ridge outside the trench for snow water accumulation), continuing to dig, and repeating the digging, pouring and filtering until a whole line is dug;

afforestation:

e, afforestation mode: adopting a row-belt layout planting pattern, i.e., according to 1 pipe 4 lines, with a belt spacing of 15 meters (m), row spacing in the belt at 4 m, where *Ulmus pumila* L. spacing at 3 m, *Tamarix* L. spacing at 1.5 m, *Caragana korshinskii* Kom. spacing at 2 m, and *Elaeagnus angustifolia* Linn. spacing at 3 m; adopting a pure forest of each tree species as a belt structure with staggered trees and shrubs, or adopting a belt structure with two rows of *Ulmus pumila* L. or *Elaeagnus angustifolia* Linn. in a middle and two rows of *Caragana korshinskii* Kom. or *Tamarix* L. on both sides; and

f, planting timing and planting: carrying out artificial planting in May in spring, placing seedlings according to the spacing of different tree species, digging pits 30 cm in diameter and 40 cm deep with shovels in the fine material soil in the trench, putting 500 grams (g) of well-rotted stable fertilizer in each pit and mixing the stable fertilizer and soil evenly with shovels, then putting roots into the pits to be buried, stepping firmly, holding the seedling by hand at middle part, lifting it slightly, then stepping the soil firmly again, stepping the rest of the fine material soil in the trench all over again manually, finally forming a shallow trench 40 cm wide and 20 cm deep, with a 15 cm high ridge formed by coarse gravel soil on one side of the shallow trench.

The present application provides a non-irrigation afforestation method for gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone; in view of the climate of the sub-cold mid-latitude desert steppe zone, the method adopts drought-tolerant, cold-tolerant and saline-tolerant tree and shrub species; for the difficulty of plant roots to penetrate the gravelly desert soil layer, it utilizes a soil breaking method applicable to this soil; based on the precipitation characteristics of the region with moderate and stable winter snow, the afforestation measure of snow water storage by micro-terrain modification is adopted; and ultimately, the survival rate of tree species can be greatly increased and the deficiencies such as slow forestation in afforestation areas can be improved. It is applicable to mid-latitude desert-steppe areas in the sub-cold zone, and gravelly desert soils with site conditions of annual precipitation of 150 - 300 mm, stable snow accumulation in winter with average snow thickness of ≥25 cm; the implementation of afforestation can be conducted without irrigation conditions, thus overcoming the shortcomings of low survival rate and slow forestation of the existing technology in the area.

The present application provides a non-irrigation afforestation method for gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone, in which tree species are selected as follows: native tree and shrub species such as *Ulmus pumila* L., *Tamarix* L., *Caragana korshinskii* Kom., Elaeagnus angustifolia Linn.; see Table 1 for seedling quality requirements.

Table 1 Seedling quality rating list

| S/N | Species | Seedling species | Seedling age | Grade I seedling | | | | | Comprehensive control index | Area of application |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ground diameter cm ＞ | Seedling height cm ＞ | root system | | | | |
| | | | | | | Main root length cm | Number of >5 cm long class I lateral roots | Root width cm | | |
| 1 | *Ulmus pumila* L. | Seeding | 1-0 | 1.2 | 140 | 22 | 8 | | Normal color, fully lignification, no pests and diseases. | Mid-latitude, semi-arid area in sub-frigid zone; the soil is meadow soil, chestnut soil or gravelly desert soil. |
| 2 | *Tamarix ramosissi* | Seeding | 2-0 | 0.8 | 120 | 20 | 5 | | Normal color, fully lignificati | Mid-latitude, semi-arid area in sub-frigid |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *ma* Lcdcb | | | | | | | | on, no pests and diseases. | zone; the soil is meadow soil, chestnut soil or gravelly desert soil. |
| 3 | *Caragana korshinskii* Kom. | Seeding | 2-0 | 0.45 | 45 | 30 | 10 | | No diseases and insect pests, full buds, normal color, strong branches and no mechanical damage. | Mid-latitude, semi-arid area in sub-frigid zone; the soil is meadow soil, chestnut soil or gravelly desert soil. |
| 4 | *Elaeagnus angustifolia* Linn. | Seeding | 2-0 | 1.8 | 120 | 20 | 12 | 20 | Fully lignified, without pests and diseases. | Mid-latitude, semi-arid area in sub-frigid zone; the soil is meadow |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | soil, chestnut soil or gravelly desert soil. |



## BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a schematic diagram of planting structure A of the present application.

FIG. 2 is a schematic diagram of planting structure B of the present application.

FIG. 3 is a 0-100 centimeters (cm) vertical section of gravelly desert soil in the afforestation area of the present application.

FIG. 4 is a picture of planting ditch after soil screening according to the present application.

FIG. 5 shows the growth of the present application in an experimental area of reforestation of gravelly desert soils in the Republic of Kazakhstan-Nur-Sultan city in 2017.

FIG. 6 is a technological roadmap.

In the figures: 1. *Ulmus pumila* L.; 2. *Caragana korshinskii* Kom.; 3. *Elaeagnus angustifolia* Linn.; and 4. *Tamarix ramosissima* Lcdcb.

## DESCRIPTION OF THE INVENTION

The present application is further explained in detail with the following embodiments.

It is implemented in the afforestation area of gravelly desert soil on the outskirts of the capital city of the Republic of Kazakhstan, Nur-Sultan, with an area of 50 mu (1 mu = 667 square meter ($m^2$)).

Embodiment 1

Pure forests of various tree species form a belt structure, and the belts are interlaced by trees and shrubs (structure A):

seedling preparation:

a, tree species selection: selecting native tree and shrub species with developed root system, salinity tolerance, drought resistance and cold resistance, such as *Ulmus pumila* L., *Tamarix* L., *Caragana korshinskii* Kom. or *Elaeagnus angustifolia* Linn., where seedlings are selected as follows: *Ulmus pumila* L. seedlings of 1 year old with ground diameter > 1.2 cm and seedling height > 140 cm, *Tamarix ramosissima* Lcdcb seedlings of 2 years old with ground diameter > 0.8 cm and seedling height > 120 cm, *Caragana korshinskii* Kom. seedlings of 2 years old with ground diameter > 0.45 cm and seedling height > 45 cm, or seedlings of *Elaeagnus angustifolia* Linn. aged 2 years with ground diameter > 0.8 cm and seedling height > 120 cm;

b, performing seedling breeding two years before afforestation at nurseries close to n afforestation site, selecting a planting period for seedling preparation in the spring from early to mid-May, transporting the seedlings to the afforestation site within 3 days before planting, and heeling in the seedlings at the afforestation site;

land preparation:

c, trenching and breaking ground: planting on gravelly desert soils, using mechanical trenching to break up the soil; digging trench according to planting row spacing with a depth of 60 cm and a width of 40 cm;

d, backfilling with fine materials: digging above the trench backward with an excavator, placing a screen above the trench and in front of the excavator, pouring soil from above the screen after the excavator digs, filtering fine material soil into the ditch, so as to make fine material soil enter the trench after filtering, coarse gravel and soil material roll down to an outside of the trench, continuing to dig, and repeating the digging, pouring and filtering until a whole line is dug;

afforestation:

e, afforestation mode: adopting a row-belt layout planting pattern, i.e., according to 4 rows and 1 belt, with a belt spacing of 15 meters (m), row spacing in the belt at 4 m, where *Ulmus pumila* L. spacing at 3 m, *Tamarix* L. spacing at 1.5 m, *Caragana korshinskii* Kom. spacing at 2 m, and *Elaeagnus angustifolia* Linn. spacing at 3 m, and the trees and shrubs are staggered together (configuration mode 1 or configuration mode 2); and

f, planting timing and planting: carrying out artificial planting in May in spring, placing seedlings according to the spacing of different tree species, digging pits 30 cm in diameter and 40 cm deep with shovels in the fine material soil in the trench, putting 500 grams (g) of well-rotted stable fertilizer in each pit and mixing the stable fertilizer and soil evenly with shovels, then putting roots into the pits to be buried, stepping firmly, holding the seedling by hand at middle part, lifting it slightly, then stepping the soil firmly again, stepping the rest of the fine material soil in the trench all over again manually, finally forming a shallow trench 40 cm wide and 20 cm deep, with a 15 cm high ridge formed on one side of the shallow trench.

Embodiment 2

The belt structure B is the matching pattern (structure B) of arbors (*Ulmus pumila L. or Elaeagnus angustifolia Linn.*) in the middle and shrubs (*Caragana korshinskii Kom. or Tamarix L.*) on both sides.

Seedling preparation:

a, tree species selection: selecting native tree and shrub species with developed root system, salinity tolerance, drought resistance and cold resistance, such as *Ulmus pumila* L., *Tamarix* L., *Caragana korshinskii* Kom. or *Elaeagnus angustifolia* Linn., where seedlings are selected as follows: *Ulmus pumila* L. seedlings of 1 year old with ground diameter > 1.2 cm and seedling height > 140 cm, *Tamarix ramosissima* Lcdcb seedlings of 2 years old with ground diameter > 0.8 cm and seedling height > 120 cm, *Caragana korshinskii* Kom. seedlings of 2 years old with ground diameter > 0.45 cm and seedling height > 45 cm, or seedlings of *Elaeagnus angustifolia* Linn. aged 2 years with ground diameter > 0.8 cm and seedling height > 120 cm;

b, performing seedling breeding two years before afforestation at nurseries close to n afforestation site, selecting a planting period for seedling preparation in the spring from early to mid-May, transporting the seedlings to the afforestation site within 3 days before planting, and heeling in the seedlings at the afforestation site;

land preparation:

c, trenching and breaking ground: planting on gravelly desert soils, using mechanical trenching to break up the soil; digging trench according to planting row spacing with a depth of 60 cm and a width of 40 cm;

d, backfilling with fine materials: digging above the trench backward with an excavator, placing a screen above the trench and in front of the excavator, pouring soil from above the screen after the excavator digs, filtering fine material soil into the ditch, so as to make fine material soil enter the trench after filtering, coarse gravel and soil material roll down to an outside of the trench, continuing to dig, and repeating the digging, pouring and filtering until a whole line is dug;

afforestation:

e, afforestation mode: adopting a row-belt layout planting pattern, i.e., according to 4 rows and 1 belt, with a belt spacing of 15 meters (m), row spacing in the belt at 4 m, where *Ulmus pumila* L. spacing at 3 m, *Tamarix* L. spacing at 1.5 m, *Caragana korshinskii* Kom. spacing at 2 m, and *Elaeagnus angustifolia* Linn. spacing at 3 m; adopting a combination pattern of two rows of *Ulmus pumila* L. or *Elaeagnus angustifolia* Linn. in the middle and two rows of *Caragana korshinskii* Kom. or *Tamarix* L. on either side; and

f, planting timing and planting: carrying out artificial planting in May in spring, placing seedlings according to the spacing of different tree species, digging pits 30 cm in diameter and 40 cm deep with shovels in the fine material soil in the trench, putting 500 g of well-rotted stable fertilizer in each pit and mixing the stable fertilizer and soil evenly with shovels, then putting roots into the pits to be buried, stepping firmly, holding the seedling by hand at middle part, lifting it slightly, then stepping the soil firmly again, stepping the rest of the fine material soil in the trench all over again manually, finally forming a shallow trench 40 cm wide and 20 cm deep, with a 15 cm high ridge formed by coarse gravel soil on one side of the shallow trench.

**CLAIMS** 

1. A non-irrigation afforestation method for gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone, characterized in that the non-irrigation afforestation is carried out at gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone under site conditions of annual precipitation of 150 - 300 millimeters (mm), stable snow in winter with an average snow thickness of ≥ 25 centimeters (cm), and the method includes steps as follows:

a, tree species selection: selecting native tree and shrub species with developed root system, salinity tolerance, drought resistance and cold resistance, such as *Ulmus pumila* L, *Tamarix* L, *Caragana korshinskii* Kom or *Elaeagnus angustifolia* Linn, where seedlings are selected as follows: *Ulmus pumila* L seedlings of 1 year old with ground diameter > 1.2 cm and seedling height > 140 cm, *Tamarix ramosissima* Lcdcb seedlings of 2 years old with ground diameter > 0.8 cm and seedling height > 120 cm, *Caragana korshinskii* Kom seedlings of 2 years old with ground diameter > 0.45 cm and seedling height > 45 cm, or seedlings of *Elaeagnus angustifolia* Linn aged 2 years with ground diameter > 0.8 cm and seedling height > 120 cm;

b, performing seedling breeding two years before afforestation at nurseries close to afforestation site, selecting a planting period for seedling preparation in the spring from early to mid-May, transporting the seedlings to the afforestation site within 3 days before planting, and heeling in the seedlings at the afforestation site;

land preparation:

c, trenching and breaking ground: planting on gravelly desert soils, using mechanical trenching to break up the soil; digging trench according to planting row spacing with a depth of 60 cm and a width of 40 cm;

d, backfilling with fine materials: digging above the trench backward with an excavator, placing a screen above the trench and in front of the excavator, pouring soil from above the screen after the excavator digs, filtering fine material soil into the ditch, so as to make fine material soil enter the trench after filtering, coarse gravel and soil material roll down

to an outside of the trench, continuing to dig, and repeating the digging, pouring and filtering until a whole line is dug;

afforestation:

e, afforestation mode: adopting a row-belt layout planting pattern, i.e., according to 4 rows and 1 belt, with a belt spacing of 15 meters (m), row spacing in the belt at 4 m, where *Ulmus pumila* L spacing at 3 m, *Tamarix* L spacing at 1.5 m, *Caragana korshinskii* Kom spacing at 2 m, and *Elaeagnus angustifolia* Linn spacing at 3 m; adopting a pure forest of each tree species as a belt structure with staggered trees and shrubs, or adopting a belt structure with two rows of *Ulmus pumila* L or *Elaeagnus angustifolia* Linn in a middle and two rows of *Caragana korshinskii* Kom or *Tamarix* L on both sides; and

f, planting timing and planting: carrying out artificial planting in May in spring, placing seedlings according to the spacing of different tree species, digging pits 30 cm in diameter and 40 cm deep with shovels in the fine material soil in the trench, putting 500 grams (g) of well-rotted stable fertilizer in each pit and mixing the stable fertilizer and soil evenly with shovels, then putting roots into the pits to be buried, stepping firmly, holding the seedling by hand at middle part, lifting slightly, then stepping the soil firmly again, stepping the rest of the fine material soil in the trench all over again manually, finally forming a shallow trench 40 cm wide and 20 cm deep, with a 15 cm high ridge formed on one side of the shallow trench.

**PATENTANSPRÜCHE**

LU503330

1. Eine Aufforstungsmethode ohne Bewässerung für kiesige Wüstenböden in Wüsten-Steppengebieten der mittleren Breitengrade in der subfrigiden Zone, dadurch gekennzeichnet, dass die Aufforstung ohne Bewässerung auf kiesigen Wüstenböden in Wüsten-Steppengebieten der mittleren Breitengrade in der subfrigiden Zone unter Standortbedingungen mit einem Jahresniederschlag von 150 - 300 Millimetern (mm), stabilem Schnee im Winter mit einer durchschnittlichen Schneedicke von ≥ 25 Zentimetern (cm) erfolgt, und die Methode folgende Schritte umfasst:

a, Auswahl der Baumarten: Auswahl einheimischer Baum- und Straucharten mit entwickeltem Wurzelsystem, Salztoleranz, Trockenheitsresistenz und Kälteresistenz, wie *Ulmus pumila* L, *Tamarix* L, *Caragana korshinskii* Kom oder *Elaeagnus angustifolia* Linn, wobei die c wie folgt ausgewählt werden: *Ulmus pumila L* Sämlinge im Alter von einem Jahr mit einem Bodendurchmesser von > 1,2 cm und einer Keimlingshöhe von > 140 cm, *Tamarix ramosissima* Lcdcb Sämlinge im Alter von zwei Jahren mit einem Bodendurchmesser von > 0,8 cm und einer Keimlingshöhe von > 120 cm, *Caragana korshinskii* Kom; Sämlinge im Alter von zwei Jahren mit einem Bodendurchmesser von > 0,45 cm und einer Keimlingshöhe von > 45 cm, oder Sämlinge von *Elaeagnus angustifolia* Linn im Alter von zwei Jahren mit einem Bodendurchmesser von > 0,8 cm und einer Keimlingshöhe von > 120 cm;

b, Aufzucht der Sämlinge zwei Jahre vor der Aufforstung in Baumschulen in der Nähe des Aufforstungsstandorts, Auswahl eines Pflanzzeitraums für die Vorbereitung der Sämlinge im Frühjahr von Anfang bis Mitte Mai, Transport der Sämlinge zum Aufforstungsstandort innerhalb von drei Tagen vor der Pflanzung und Einsetzen der Sämlinge am Aufforstungsstandort;

Bodenvorbereitung:

c, Graben und Aufbrechen des Bodens: Pflanzung auf kiesigen Wüstenböden, Verwendung des mechanischen Grabenaushubs zum Auflockern des Bodens; Ausheben des Grabens entsprechend dem Reihenabstand mit einer Tiefe von 60 cm und einer Breite von 40 cm;

d, Verfüllung mit feinem Material: Aushub oberhalb des Grabens nach hinten mit einem Bagger, Anbringen eines Siebes oberhalb des Grabens und vor dem Bagger, Aufschütten von Erde von oberhalb des Siebes, nachdem der Bagger ausgehoben hat, Filtern von feinem Bodenmaterial in den Graben, damit feines Bodenmaterial nach dem Filtern in den Graben gelangt, und grober Kies und Bodenmaterial an die Außenseite des Grabens rollen, weiter zum Graben, und Wiederholen des Graben, des Gießen und des Filtern, bis eine ganze Linie gegraben ist;

Aufforstung:

e, Aufforstungsmodus: Anwendung eines Reihen-Gürtel-Layout-Pflanzschemas, d.h. entsprechend 4 Reihen und 1 Gürtel, mit einem Gürtelabstand von 15 Metern (m), Reihenabstand im Gürtel von 4 m, wobei *Ulmus pumila* L einen Abstand von 3 m, *Tamarix* L einen Abstand von 1,5 m, *Caragana korshinskii* Kom einen Abstand von 2 m und *Elaeagnus angustifolia* Linn einen Abstand von 3 m haben; Anwendung eines reinen Waldes mit jeder Baumart als Gürtelstruktur mit gestaffelten Bäumen und Sträuchern, oder Anwendung einer Gürtelstruktur mit zwei Reihen *Ulmus pumila* L oder *Elaeagnus angustifolia* Linn in der Mitte und zwei Reihen *Caragana korshinskii* Kom oder *Tamarix* L auf beiden Seiten; und

f, Pflanzzeitpunkt und Pflanzung: Durchführung der künstlichen Pflanzung im Mai im Frühjahr, Setzen der Sämlinge entsprechend den Abständen der verschiedenen Baumarten, Ausheben von Gruben mit einem Durchmesser von 30 cm und einer Tiefe von 40 cm mit Schaufeln in den feinen Bodenmaterial im Graben, Geben von 500 Gramm (g) gut verrottetem Stalldünger in jede Grube und Vermischen des Stalldünger und der Erde gleichmäßig mit Schaufeln, dann Legen der Wurzeln in die zu vergrabenden Gruben, Treten fest, Festhalten der Sämlinge in der Mitte mit der Hand, Anheben leicht, dann Treten von Boden wieder fest, Treten von Rest des feinen Bodenmaterials wieder manuell in den Graben, schließlich Bilden ein flacher, 40 cm breiter und 20 cm tiefer Graben, mit einem 15 cm hohen Ackerrain, gebildet auf einer Seite des flachen Grabens.

**FIGURES**



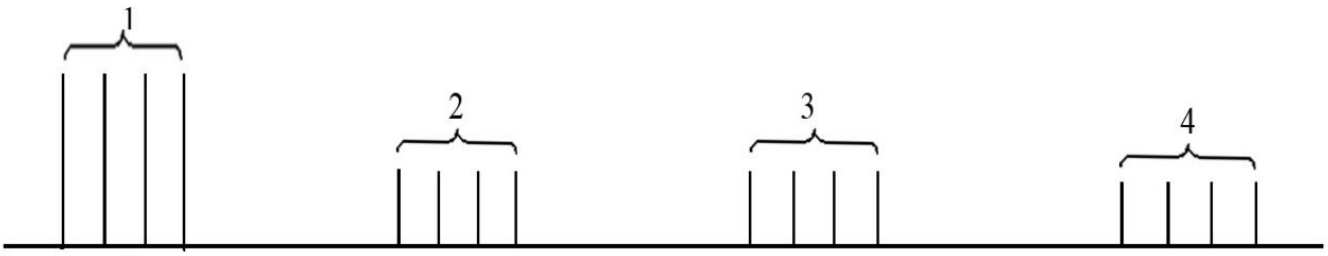


FIG. 1

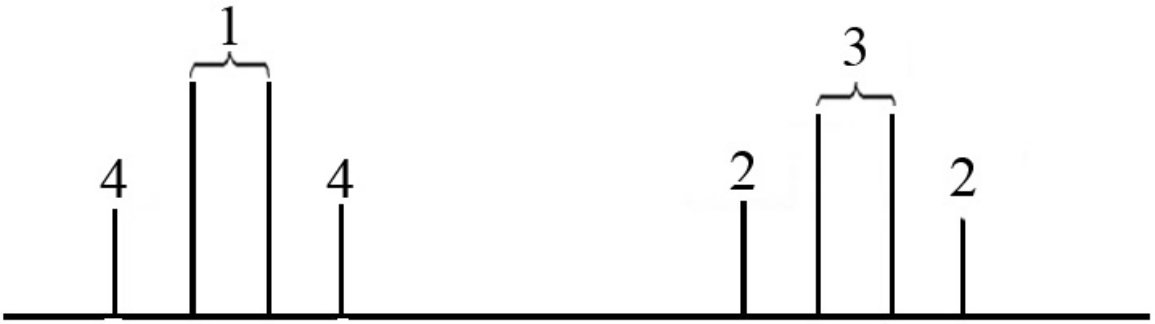


FIG. 2

FIG. 3

FIG. 4

FIG. 5

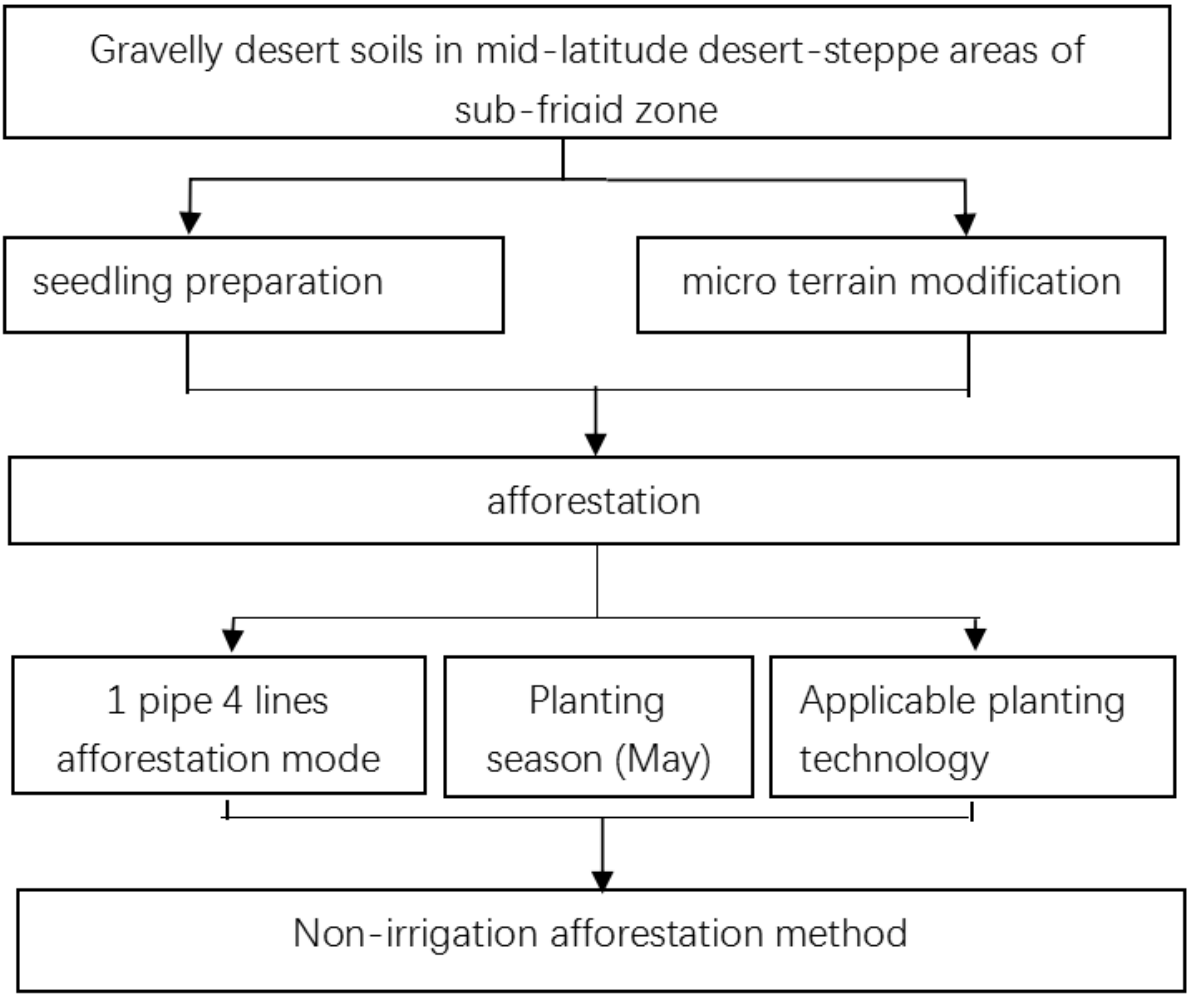
Gravelly desert soils in mid-latitude desert-steppe areas of sub-frigid zone
seedling preparation
micro terrain modification
afforestation
1 pipe 4 lines afforestation mode
Planting season (May)
Applicable planting technology
Non-irrigation afforestation method

FIG. 6