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In accordance with section 44 (1) of the Patents Act, No. 57 of 1978, it is hereby certified that:

XINJIANG INSTITUTE OF ECOLOGY AND GEOGRAPHY CHINESE ACADEMY OF SCIENCES

Has been granted a patent in respect of an invention described and claimed in complete specification deposited at the Patent Office under the number

2022/02221

A copy of the complete specification is annexed, together with the relevant Form P2.

In testimony thereof, the seal of the Patent Office has been affixed at Pretoria with effect from the **29th** day of **June 2022**




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FORM P2

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WATER-SAVING IRRIGATION METHOD FOR LARGE-SCALE PLANTING OF ECOLOGICAL PROTECTION PLANTS IN ARID DESERT					
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TITLE OF INVENTION

54 WATER-SAVING IRRIGATION METHOD FOR LARGE-SCALE PLANTING OF ECOLOGICAL PROTECTION PLANTS IN ARID DESERT

WATER-SAVING IRRIGATION METHOD FOR LARGE-SCALE PLANTING OF ECOLOGICAL PROTECTION PLANTS IN ARID DESERT

TECHNICAL FIELD

[01] The present invention relates to a water-saving irrigation method for large-scale planting of ecological protection plants in arid desert regions.

BACKGROUND ART

[02] Oasis is an important place for people's production and life in arid regions, and the ecological protection system around the oasis is a protective barrier for ecological security of the oasis. The planting scale of ecological protection plants that constitute an oasis protection system is often limited by regional water resources. The southern edge region of the Taklimakan Desert has been dry with little rainfall for a long time. The local agricultural production and shelter forest construction mostly extract groundwater by digging wells. With the expansion of oases, water shortage has become increasingly prominent. Therefore, it is extremely important to optimize water-saving irrigation and rationally use water resources to guarantee the construction of ecological barriers of oases in arid regions. Through experiments, popularization and application, this technology has been optimized to form a water-saving drip irrigation technology for large-scale tamarix chinensis planting and a water-saving drip irrigation technology for a populus bolleana forest network, which are expected to provide a technical support for the construction and optimal management of ecological barriers on the southern edge of the Taklimakan Desert.

[03] At present, the large-scale planting of tamarix chinensis to produce cistanche mostly uses drip irrigation to save water, but the survey found that producers generally believe the more water the tamarix chinensis is supplied, the faster the growth and the higher the yield of cistanche. Although tamarix chinensis is relatively tolerant to drought, the actual investigation found that the drip irrigation of tamarix chinensis plantations in Hotan regions still has the following problems: 1) the layout of the irrigation pipe network is unreasonable, and there are many wells; 2) the drip irrigation is frequent, and the irrigation schedule is unreasonable, once every 5-7 days on average from the beginning of March to October; and 3) the total amount of irrigation water is large, and the annual irrigation amount (drip irrigation) in some regions exceeds 450 m³/mu. A large amount of irrigation water not only increases the cost of water, but also may result in over-exploitation of local groundwater and salification of soil in the tamarix chinensis woodland, thereby causing the production of cistanche to be unsustainable after a certain period of time. Therefore, the optimization of water-saving irrigation and the reasonable arrangement of an irrigation cycle are necessary for the planting management of tamarix chinensis and the sustainable production of cistanche.

[04] Relying on the cistanche production base of Xinjiang Boyuan Luxin Biotechnology Co., Ltd., the present invention conducts further in-depth research and analysis on the irrigation schedule, suitable irrigation water quantity and irrigation frequency of artificial tamarix chinensis forests through irrigation experiments and physiological characteristics of plants, and concludes an optimized drip irrigation pipe

network mode and irrigation management measures for planting *ammania gracilis* in a large scale to produce *cistanche*. In addition, it was found through years of practice that the irrigation maintenance and management workload and the total amount of irrigation water can be further reduced by irrigating *populus bolleana* forest belts with drip irrigation pipes. This method conducts in-depth experiments and analysis on the irrigation pipe network layout, reasonable irrigation amount and irrigation cycle of the *populus bolleana* forest network, completes the construction of the *populus bolleana* forest network and its internal drip irrigation pipe network system, and determines a reasonable irrigation method and irrigation cycle for the *populus bolleana* forest network.

[05] On the basis of the organic combination of ecological construction in arid regions and rational utilization of water resources, the planting, growth and survival of ecological protection plants in arid desert regions based on the technology of efficient utilization of water resources can be realized, and excellent ecological and social benefits can be exerted.

SUMMARY

[06] The objective of the present invention is to provide a water-saving irrigation method for large-scale planting of ecological protection plants in arid desert regions. For water saving in large-scale planting of *tamarix chinensis* and *populus bolleana*, the method concludes an optimized drip irrigation pipe network mode and irrigation management measures for planting *ammania gracilis* in a large scale to produce *cistanche* on the basis of irrigation time arrangement, suitable irrigation water quantity and irrigation frequency for an artificial *tamarix chinensis* forest. Through years of practice, the irrigation maintenance and management workload and the total amount of irrigation water can be further reduced by irrigating *populus bolleana* forest belts with drip irrigation pipes. This method conducts in-depth experiments and analysis on the irrigation pipe network layout, reasonable irrigation amount and irrigation cycle of a *populus bolleana* forest network, completes the construction of the *populus bolleana* forest network and its internal drip irrigation pipe network system, and determines a reasonable irrigation method and irrigation cycle for the *populus bolleana* forest network.

[07] A water-saving irrigation method for large-scale planting of ecological protection plants in arid desert regions according to the present invention, for water saving in large-scale planting of *tamarix chinensis* and *populus bolleana*, the specific operation is performed according to the following steps:

[08] water saving in large-scale planting of *tamarix chinensis*:

[09] a. Layout of a drip irrigation pipe network: after the ground is leveled, laying a main pipe and branch pipes, wherein the main pipe is a PVC pipe having a diameter of 160 mm and is buried by 1 to 1.5 m, the branch pipes are PE hoses having a diameter of 63 mm and a length of 120 m and are laid on the surface; after the main pipe and the branch pipes are laid, planting *tamarix chinensis* in the form of wide and narrow rows in early April, with a narrow row spacing of 1 m and a wide row spacing of 2 to 3 m, wherein the wide and narrow rows are arranged alternately, and the plant spacing of

each row is 1 m; laying a drip irrigation belt having a diameter of 10 mm under main stems of *tamarix chinensis* seedlings, inoculating *cistanche* on both sides of the open space of the wide rows after the *tamarix chinensis* survives, and keeping the soil between the narrow rows without turning;

[10] b. Sufficient water for seedlings: mainly performing drip irrigation before the *tamarix chinensis* seedlings are planted, and irrigating the annual *tamarix chinensis* seedlings thoroughly once after transplanting, then once every 7 days within 2 to 3 months, and 24 hours each time;

[11] c. Water retention for survival seedlings: after the *tamarix chinensis* seedlings survive, extending the drip irrigation cycle, that is, once every 15 to 20 days and 12 to 24 hours each time, and stopping the drip irrigation before October;

[12] d. Inoculation for turning green: performing first drip irrigation at the end of March of the second year for 24 hours to turn the *tamarix chinensis* green as soon as possible, starting inoculation in the middle and late April, watering inoculation ditches, then performing drip irrigation once every 30 days and 24 hours each time, and stopping the drip irrigation before October;

[13] e. Maintenance of stable production: after the *tamarix chinensis* becomes a forest, watering once respectively during the two growth periods of *cistanche*, that is, once in late May and once again in the middle and late July, and prohibiting drip irrigation before October to prevent the *cistanche* from freezing;

[14] water saving in large-scale planting of *populus bolleana*:

[15] a. Layout of a drip irrigation pipe network: after the ground is leveled, laying a main pipe and branch pipes, wherein the main pipe is a PVC pipe having a diameter of 160 mm and is buried by 1 to 1.5 m, the branch pipes are PE hoses having a diameter of 63 mm and a length of 120 m and are laid on the surface; after the main pipe and the branch pipes are laid, leveling the ground; planting 4 to 6 rows of *populus bolleana* in a 120 m wide × 300 m long forest network on the basis of a main wind direction, to form a protection forest belt with a row spacing of 1 m and a plant spacing of 1 m;

[16] b. Sufficient water for seedlings: transplanting annual *populus bolleana* seedlings, laying the drip irrigation pipes at the base of *populus bolleana*, and connecting water droppers every 30 cm in two adjacent rows of drip irrigation pipes at the end of the forest belt, the water output rate of the water droppers of the drip irrigation pipes being 0.5 L/h;

[17] c. Water retention for survival seedlings: irrigating in time after transplanting, one-time drip irrigation for 24 hours, and then drip irrigation every 5 days;

[18] d. After the seedlings survive, extending the drip irrigation cycle to irrigation once every 7 to 10 days and 12 hours each time; after the seedlings are hardened, extending the drip irrigation cycle to 15 to 20 days and 24 hours each time by “less irrigation and thorough irrigation each time”, wherein the average water supply for each plant each time is 43.2 L;

[19] e. Field management: regularly checking the field irrigation and soil moisture conditions, supplementing water 1 to 2 more times when dull leaves appear, and stopping the drip irrigation at the end of November.

[20] The present invention provides a water-saving irrigation method for large-scale

planting of ecological protection plants in arid desert regions, which organically combines the large-scale planting of ecological protection plants in arid desert regions with rational utilization of regional water resources.

[21] On the basis of long-term experimental research and technology research and development, according to the water resource conditions and natural environment characteristics of typical oases in Hotan Prefecture, Xinjiang, proposed is a technical solution of water-saving irrigation for large-scale planting of ecological protection forest species in arid desert regions, which is an important precondition of this technology application.

[22] On the basis of efficient and rational utilization of water resources, the improvement on the large-scale planting efficiency of regional ecological protection plants and the preservation rate and the survival rate of plants is the key element in the technical content.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[23] The method of the present invention has been applied in Cele County and Hotan County on the southern edge of the Taklimakan Desert. It is now functioning normally.

[24] Example 1

[25] Water saving in large-scale planting of tamarix chinensis:

[26] a. Layout of a drip irrigation pipe network: after the ground is leveled, a main pipe and branch pipes are laid, wherein the main pipe is a PVC pipe having a diameter of 160 mm and is buried by 1 to 1.5 m, the branch pipes are PE hoses having a diameter of 63 mm and a length of 120 m and are laid on the surface to facilitate drilling and placement of a drip irrigation belt; after the main pipe and the branch pipes are laid, tamarix chinensis are planted in the form of wide and narrow rows in early April, with a narrow row spacing of 1 m and a wide row spacing of 2 to 3 m, wherein the wide and narrow rows are arranged alternately, and the plant spacing of each row is 1 m; the drip irrigation belt having a diameter of 10 mm is laid under main stems of tamarix chinensis seedlings, and cistanche are inoculated on both sides of the open space of the wide rows after the tamarix chinensis survives, which is conducive to the protection of hosts during the production process of cistanche, avoids damage to the hosts by repeated digging, and is conducive to the retention of soil moisture under the host forest to the greatest extent; the soil between the narrow rows is kept without turning, which is conducive to the production activities of cistanche, including the entry of light machinery and the like;

[27] b. Sufficient water for seedlings: drip irrigation is mainly performed before the tamarix chinensis seedlings are planted, and the annual tamarix chinensis seedlings are irrigated thoroughly once after transplanting, then once every 7 days within 2 to 3 months, and 24 hours each time to ensure moist soil under the tamarix chinensis seedlings and ensure the survival rate and growth rate of the tamarix chinensis seedlings; ;

[28] c. Water retention for survival seedlings: after the tamarix chinensis seedlings survive, the drip irrigation cycle is appropriately extended, that is, once every 15 to 20 days and 12 to 24 hours each time, depending on the water shortage of the tamarix

chinensis forest land; the soil at 50 cm under the tamarix chinensis seedlings is irrigated to be relatively moist, so as to ensure that the roots of tamarix chinensis are mostly distributed above more than 50 cm, which can improve the success rate of inoculation in the second year; the drip irrigation is stopped before October, when tamarix chinensis basically stops growing; excessive drip irrigation also keeps the soil moist, but is not beneficial to overwintering of the tamarix chinensis;

[29] d. Inoculation for turning green: first drip irrigation is performed at the end of March of the second year for 24 hours to turn the tamarix chinensis green as soon as possible, which promotes the growth of roots; inoculation starts in the middle and late April, and inoculation ditches are watered, which can the survival rate of the inocula; then drip irrigation is performed once every 30 days and 24 hours each time, and the drip irrigation is stopped before October;

[30] e. Maintenance of stable production: after the tamarix chinensis becomes a forest, watering is respectively performed once during the two growth periods of cistanche, that is, once in late May and once again in the middle and late July, and the drip irrigation is prohibited before October to prevent the cistanche from freezing.

[31] Example 2

[32] Water saving in large-scale planting of populus bolleana, taking a populus bolleana forest network outside a jujube field as an example:

[33] a. Layout of a drip irrigation pipe network: after the ground is leveled, a main pipe and branch pipes are laid, wherein the main pipe is a PVC pipe having a diameter of 160 mm and is buried by 1 to 1.5 m, the branch pipes are PE hoses having a diameter of 63 mm and a length of 120 m and are laid on the surface; after the main pipe and the branch pipes are laid, the ground is leveled; 4 to 6 rows of populus bolleana are planted in a 120 m wide × 300 m long forest network on the basis of a main wind direction, to form a protection forest belt with a row spacing of 1 m and a plant spacing of 1 m;

[34] b. Sufficient water for seedlings: the annual populus bolleana seedlings are transplanted, the drip irrigation pipes are laid at the base of populus bolleana, and water droppers every 30 cm in two adjacent rows of drip irrigation pipes are connected at the end of the forest belt, so that the water pressure in the drip irrigation pipes is identical, and the water output rate (0.5 L/h) of the water droppers of the drip irrigation pipes is identical; the water output rate of the water droppers of the drip irrigation pipes is 0.5 L/h, which ensures the survival of the seedlings;

[35] c. Water retention for survival seedlings: the seedlings are irrigated in time after transplanting, one-time drip irrigation for 24 hours, and then drip irrigation every 5 days;

[36] d. After the seedlings survive, the drip irrigation cycle is extended to irrigation once every 7 to 10 days and 12 hours each time (38 cubes for each mu each time); after the seedlings are hardened, the drip irrigation cycle is extended to 15 to 20 days and 24 hours each time by “less irrigation and thorough irrigation each time”, wherein the average water supply for each plant each time is 43.2 L;

[37] e. Field management: the field irrigation and soil moisture conditions are regularly checked, water is supplemented 1 to 2 more times when dull leaves appear, and the drip irrigation is stopped at the end of November.

[38] The water-saving irrigation method for large-scale planting of ecological protection plants in arid desert regions has been applied in Cele County and Hotan County on the southern edge of the Taklimakan Desert after years of exploration. It is now functioning normally. This technology is planned to be promoted and applied to other regions with similar conditions.

[39] The application effects of this method in Xinjiang ecological industry companies (Xinjiang Guorun Ecological Industry Co., Ltd., Xinjiang Boyuanxin Green Biotechnology Co., Ltd.) show that the survival rate of the tamarix chinensis ecological protection forest planted in a large scale is more than 95% (water is saved by more than 35%); the survival rate of the populus bolleana ecological protection forest planted in a large scale is more than 90% (water is saved by more than 30%). The protection and economic benefits of the ecological protection forest are obvious.

WHAT IS CLAIMED IS:

1. A water-saving irrigation method for large-scale planting of ecological protection plants in arid desert regions, wherein for water saving in large-scale planting of tamarix chinensis and populus bolleana, the specific operation is performed according to the following steps:

water saving in large-scale planting of tamarix chinensis:

a. Layout of a drip irrigation pipe network: after the ground is leveled, laying a main pipe and branch pipes, wherein the main pipe is a PVC pipe having a diameter of 160 mm and is buried by 1 to 1.5 m, the branch pipes are PE hoses having a diameter of 63 mm and a length of 120 m and are laid on the surface; after the main pipe and the branch pipes are laid, planting tamarix chinensis in the form of wide and narrow rows in early April, with a narrow row spacing of 1 m and a wide row spacing of 2 to 3 m, wherein the wide and narrow rows are arranged alternately, and the plant spacing of each row is 1 m; laying a drip irrigation belt having a diameter of 10 mm under main stems of tamarix chinensis seedlings, inoculating cistanche on both sides of the open space of the wide rows after the tamarix chinensis survives, and keeping the soil between the narrow rows without turning;

b. Sufficient water for seedlings: mainly performing drip irrigation before the tamarix chinensis seedlings are planted, and irrigating the annual tamarix chinensis seedlings thoroughly once after transplanting, then once every 7 days within 2 to 3 months, and 24 hours each time;

c. Water retention for survival seedlings: after the tamarix chinensis seedlings survive, extending the drip irrigation cycle, that is, once every 15 to 20 days and 12 to 24 hours each time, and stopping the drip irrigation before October;

d. Inoculation for turning green: performing first drip irrigation at the end of March of the second year for 24 hours to turn the tamarix chinensis green as soon as possible, starting inoculation in the middle and late April, watering inoculation ditches, then performing drip irrigation once every 30 days and 24 hours each time, and stopping the drip irrigation before October;

e. Maintenance of stable production: after the tamarix chinensis becomes a forest, watering once respectively during the two growth periods of cistanche, that is, once in late May and once again in the middle and late July, and prohibiting drip irrigation before October to prevent the cistanche from freezing;

water saving in large-scale planting of populus bolleana:

a. Layout of a drip irrigation pipe network: after the ground is leveled, laying a main pipe and branch pipes, wherein the main pipe is a PVC pipe having a diameter of 160 mm and is buried by 1 to 1.5 m, the branch pipes are PE hoses having a diameter of 63 mm and a length of 120 m and are laid on the surface; after the main pipe and the branch pipes are laid, leveling the ground; planting 4 to 6 rows of populus bolleana in a 120 m wide × 300 m long forest network on the basis of a main wind direction, to form a protection forest belt with a row spacing of 1 m and a plant spacing of 1 m;

b. Sufficient water for seedlings: transplanting annual populus bolleana seedlings, laying the drip irrigation pipes at the base of populus bolleana, and connecting water

droppers every 30 cm in two adjacent rows of drip irrigation pipes at the end of the forest belt, the water output rate of the water droppers of the drip irrigation pipes being 0.5 L/h;

c. Water retention for survival seedlings: irrigating in time after transplanting, one-time drip irrigation for 24 hours, and then drip irrigation every 5 days;

d. After the seedlings survive, extending the drip irrigation cycle to irrigation once every 7 to 10 days and 12 hours each time; after the seedlings are hardened, extending the drip irrigation cycle to 15 to 20 days and 24 hours each time by “less irrigation and thorough irrigation each time”, wherein the average water supply for each plant each time is 43.2 L;

e. Field management: regularly checking the field irrigation and soil moisture conditions, supplementing water 1 to 2 more times when dull leaves appear, and stopping the drip irrigation at the end of November.



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ABSTRACT OF THE DISCLOSURE

Disclosed is a water-saving irrigation method for large-scale planting of ecological protection plants in arid desert regions, characterized in an optimized drip irrigation pipe network mode and irrigation management measures for water saving in large-scale planting of *ammania gracilis* to produce *cistanche* on the basis of irrigation time arrangement, suitable irrigation water quantity and irrigation frequency for an artificial *tamarix chinensis* forest. Through years of practice, the irrigation maintenance and management workload and the total amount of irrigation water can be further reduced by irrigating *populus bolleana* forest belts with drip irrigation pipes. This method conducts in-depth experiments and analysis on the layout, reasonable irrigation amount and irrigation cycle of a *populus bolleana* forest network, completes the construction of the *populus bolleana* forest network and its internal drip irrigation pipe network system, and determines a reasonable irrigation method and irrigation cycle for the *populus bolleana* forest network.