Notice

DESCRIPTION CN113349041A

A method for artificially cultivating duckweed

一种浮萍人工种植方法

[0001]

Technical Field

技术领域

[n0001]

This invention relates to the field of agriculture, and in particular to a method for artificially cultivating duckweed.

本发明涉及农业领域，特别是涉及一种浮萍人工种植方法。

[0003]

Background Technology

背景技术

[n0002]

With the global shortage of feed resources and the continuous rise in the price of bulk feed ingredients, the feed industry is under tremendous pressure, making the development of new and inexpensive feed ingredients an urgent matter.

随着全球饲料资源的紧缺，大宗饲料原料价格不断攀升，给饲料行业造成巨大的压力，开发新型廉价饲料原料迫在眉睫。

Therefore, actively seeking new protein sources and developing new protein feed resources is an effective way to alleviate the shortage of protein resources in my country.

因此积极寻找新的蛋白源，开辟新的蛋白饲料资源，是缓解我国蛋白资源短缺的有效途径。

Duckweed is a small floating aquatic plant that thrives in still waters rich in trace elements and organic matter, such as rice paddies, lakes, and ponds.

浮萍(duckweed)是一种小型的浮水植物，喜生于富含微量元素以及有机质的静水水域，如稻田、湖泊、池沼等。

Duckweed has a wide distribution range, from temperate to tropical regions. The reproduction rate of duckweed is almost exponential, and its biomass can double in about 2 to 4 days under optimal growth conditions. Duckweed is highly nutritious, low in fiber, high in protein, and rich in lutein and lysine. Under suitable conditions, fiber and protein account for 5-15% and 35-45% of its dry weight, respectively, making it a novel high-protein plant source that can replace corn and soybeans. Because of its small size and floating on the water surface, duckweed is an excellent feed for poultry and livestock and a fish food, and deserves extensive research and development. Moreover, duckweed itself can be directly used as green manure for returning to the field.

浮萍的广布范围较广，从温带到热带区域均有分布。 浮萍的繁殖速率几乎接近指数增长，在最佳生长条件下其生物量约2～4天可翻一倍。 浮萍营养价值高，低纤维、高蛋白、叶黄素和赖氨酸含量丰富，在适宜条件下，纤维和蛋白质分别占其干重的5-15%和35-45%，可替代玉米大豆作为新型高蛋白植物来源。 由于浮萍形状体积小，且漂浮于水面上，是优良的禽畜饲料和鱼类饵料，值得大力研究与开发。 而且浮萍本身也可直接作为绿肥还田。

[n0003]

However, currently, due to the lack of complete planting and management techniques for the artificial cultivation of duckweed, and because the actual cultivation effect of duckweed still depends on the farmers' planting techniques, the quality varies, and duckweed cannot maintain rapid reproduction continuously.

然而，目前由于缺乏成套的种植和管理技术用于浮萍的人工种植，并且浮萍的实际培育效果还是取决于农户的种植技术，品质参差不齐，并且浮萍不能持续地保持快速繁殖。

Therefore, it is of great significance to find a method for cultivating duckweed that allows it to grow continuously and rapidly while maintaining high quality.

因此，如何实现一种浮萍持续快速生长、且品质好的浮萍种植方法，具有重要意义。

[0006]

Summary of the Invention

发明内容

[n0004]

Based on this, the purpose of this invention is to provide an artificial cultivation method for duckweed, which enables continuous and rapid propagation of duckweed and produces duckweed of high quality with high chlorophyll content.

基于此，本发明的目的是提供一种浮萍的人工种植方法，其能实现浮萍持续快速繁殖，并且所得浮萍品质很好，叶绿素含量高。

[n0005]

The specific technical solution is as follows:

具体技术方案如下：

[n0006]

A method for artificially cultivating duckweed includes the following steps:

一种浮萍的人工种植方法，包括以下步骤：

[n0007]

(1) Selection of duckweed: Select duckweed or purple duckweed, and wash the duckweed with sodium hypochlorite aqueous solution;

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(1)浮萍选种：选取青萍或紫萍，采用次氯酸钠水溶液洗涤浮萍；

[n0008]

(2) Duckweed cultivation: Add a mixture containing 20-20-20 liquid fertilizer, sucrose and acetamiprid to the water pool in the greenhouse, and then rapidly propagate the duckweed.

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(2)浮萍培育：在温室大棚内的水池中，添加包含20-20-20液体肥、蔗糖和烯效唑的混合物后，再对浮萍进行快速扩繁；

[n0009]

(3) Preparation before release: Clean the outdoor pond, then dry the water, and then apply well-rotted fertilizer;

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(3)投放前准备：对户外池塘进行清洁，然后进行晒水，再施用腐熟肥；

[n0010]

(4) Field management: Place 100-200 kg of duckweed obtained from step (2) per mu into an outdoor pond, cultivate it at 18°C-31°C for 7-18 days and harvest the duckweed. The density of the remaining duckweed should be controlled at 25-50% of the water surface. After placing the duckweed, add fertilizer every 7-18 days.

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(4)田间管理：向户外池塘每亩投放所述步骤(2)扩繁得到的浮萍100～200kg，18°C～31°C培养7～18天收割浮萍，剩余浮萍密度控制在覆盖水面的25～50%；投放浮萍后每隔7～18天追加肥料；

[n0011]

The additional fertilizer is urea and phosphate fertilizer.

所述追加肥料为追加尿素和磷肥。

[n0012]

In some embodiments, in step (4), duckweed is harvested after being cultured at 18°C to 31°C for 7-12 days.

在其中一些实施例中，所述步骤(4)中，18℃～31℃培养7-12天收割浮萍。

[n0013]

In some embodiments, the additional fertilizer in step (4) is 0.5-2 kg of urea and 0.4-1 kg of phosphate fertilizer per mu.

在其中一些实施例中，步骤(4)所述追加肥料为每亩追加0.5～2kg尿素和0.4～1kg磷肥。

[n0014]

In some embodiments, the additional fertilizer in step (3) is 1-1.5 kg of urea and 0.4-0.7 kg of phosphate fertilizer per mu.

在其中一些实施例中，步骤(3)所述追加肥料为每亩追加1～1.5kg尿素和0.4～0.7kg磷肥。

[n0015]

In some embodiments, in step (3), the composted fertilizer is human or animal manure.

在其中一些实施例中，步骤(3)中，所述腐熟肥为人畜粪。

[n0016]

In some embodiments, in step (3), the amount of decomposed manure used per mu of pond is 100kg to 300kg.

在其中一些实施例中，步骤(3)中，每亩池塘用腐熟肥的量为100kg～300kg。

[n0017]

In some embodiments, when harvesting duckweed, the density of remaining duckweed is controlled to be 30-45% covering the water surface.

在其中一些实施例中，所述收割浮萍时，剩余浮萍密度控制在覆盖水面的30～45%。

[n0018]

In some embodiments, step (1), washing duckweed with sodium hypochlorite aqueous solution includes washing duckweed with sodium hypochlorite aqueous solution with a concentration of 1wt% to 3wt% for 3 to 5 minutes.

在其中一些实施例中，所述步骤(1)中，所述采用次氯酸钠水溶液洗涤浮萍包括：采用浓度为1wt%～3wt%的次氯酸钠水溶液洗涤浮萍3～5min。

[n0019]

In some embodiments, in step (2), the concentrations of the 20-20-20 liquid fertilizer, sucrose, and uniconazole in the pool are 2 g/L to 5 g/L, 5 g/L to 10 g/L, and 0.6 g/L to 1 g/L, respectively.

在其中一些实施例中，所述步骤(2)中，所述20-20-20液体肥、蔗糖和烯效唑在水池中的浓度依次分别为2g/L～5g/L、5g/L～10g/L和0.6g/L～1g/L。

[n0020]

In some embodiments, the water exposure includes filling a pond with water to a depth of 1.0 to 1.5 m and then exposing it to the sun for 3 to 5 days.

在其中一些实施例中，所述晒水包括：在池塘中注入水至1.0～1.5m深，然后暴晒3～5天。

[n0021]

In some embodiments, step (3) includes cleaning with 0.05wt% to 0.5wt% sodium hypochlorite, with the amount of 0.05wt% to 0.5wt% sodium hypochlorite per acre of pond being 0.005L/m³ to 0.05L/m³.

在其中一些实施例中，步骤(3)中，所述清洁包括：用0.05wt%～0.5wt%次氯酸钠进行清洁，每亩池塘用0.05wt%～0.5wt%次氯酸钠的量为0.005L/m³～0.05L/m³。

[n0022]

In some embodiments, in step (3), after injecting 5-10 cm of water into the pond, it is then cleaned with sodium hypochlorite.

在其中一些实施例中，步骤(3)中，在池塘中注入5～10cm的水后，再用次氯酸钠进行清洁。

[n0023]

Compared with the prior art, the present invention has the following beneficial effects:

与现有技术相比，本发明具有以下有益效果：

[n0024]

The inventors of this invention have discovered in practice that in order to achieve high-quality duckweed while continuously and rapidly propagating, the appropriate combination of duckweed density, fertilization amount and cultivation conditions is crucial.

本发明的发明人在实践中发现，要实现浮萍高品质的同时持续快速繁殖，合适的浮萍密度、施肥量和培养条件之间的配合很关键。

In this invention, by controlling the amount of duckweed released (100-200 kg/mu), cultivating it at 18°C-31°C for 7-18 days, and using well-rotted manure as base fertilizer and chemical fertilizer as supplementary fertilizer, a method for artificially cultivating duckweed with excellent quality that can achieve continuous and rapid reproduction was finally realized through the overall coordination of all steps and parameters.

本发明中，通过控制投放浮萍投放量100～200kg/亩，培养条件18°C～31°C培养7-18天，并选择腐熟肥为基础肥配合化肥为追加肥，在所有步骤和参数整体配合下，最终实现了一种能实现持续快速繁殖，并且浮萍品质优良的浮萍的人工种植方法。

[0028]

Attached Figure Description

附图说明

[n0025]

Figure 1 is a post-harvest morphological diagram of duckweed obtained in an embodiment of the present invention;

图1为本发明实施例所得浮萍采后形态图；

[n0026]

Figure 2 shows the results of chlorophyll content determination of duckweed obtained in Examples 1-5 of the present invention;

图2为本发明实施例1-5所得浮萍叶绿素含量测定结果图；

[n0027]

Figure 3 shows the morphological diagrams of duckweed after cultivation with different fertilization amounts in Examples 1, 6, and 7 of the present invention. Figure A corresponds to Example 7, Figure B corresponds to Example 1, and Figure C corresponds to Example 6.

图3为本发明实施例1、6、7的浮萍不同施肥量培养后的形态图，A图对应实施例7，B图对应实施例1，C图对应实施例6；

[n0028]

Figure 4 shows the growth curves of duckweed at different harvest densities in Examples 1, 8, and 9 of this invention.

图4为本发明实施例1、8、9的浮萍不同收获密度下的生长曲线。

[0033]

Detailed Implementation

具体实施方式

[n0029]

The experimental methods described in the following embodiments of the present invention, unless otherwise specified, are generally performed under conventional conditions or as recommended by the manufacturer.

本发明下列实施例中未注明具体条件的实验方法，通常按照常规条件，或按照制造厂商所建议的条件。

All commonly used chemical reagents used in the examples are commercially available products.

实施例中所用到的各种常用化学试剂，均为市售产品。

[n0030]

Unless otherwise defined, all technical and scientific terms used in this invention have the same meaning as commonly understood by one of ordinary skill in the art to which this invention pertains.

除非另有定义，本发明所使用的所有的技术和科学术语与属于本发明的技术领域的技术人员通常理解的含义相同。

The terminology used in this specification is for the purpose of describing particular embodiments only and is not intended to limit the invention.

本发明的说明书中所使用的术语只是为了描述具体的实施例的目的，不用于限制本发明。

[n0031]

The terms “comprising” and “having”, and any variations thereof, are intended to cover non-exclusive inclusion.

本发明的术语“包括”和“具有”以及它们任何变形，意图在于覆盖不排他的包含。

For example, a process, method, apparatus, product, or device that includes a series of steps is not limited to the steps or modules listed, but may optionally include steps not listed, or may optionally include other steps inherent to such process, method, product, or device.

例如包含了一系列步骤的过程、方法、装置、产品或设备没有限定于已列出的步骤或模块，而是可选地还包括没有列出的步骤，或可选地还包括对于这些过程、方法、产品或设备固有的其它步骤。

[n0032]

In this invention, "multiple" refers to two or more.

在本发明中提及的“多个”是指两个或两个以上。

"And/or" describes the relationship between related objects, indicating that there can be three relationships. For example, A and/or B can represent three situations: A exists alone, A and B exist simultaneously, and B exists alone.

“和/或”，描述关联对象的关联关系，表示可以存在三种关系，例如，A和/或B，可以表示：单独存在A，同时存在A和B，单独存在B这三种情况。

The character "/" generally indicates that the objects before and after it are in an "or" relationship.

字符“/”一般表示前后关联对象是一种“或”的关系。

[n0033]

This embodiment provides a method for artificially cultivating duckweed, including the following steps:

本实施方式提供一种浮萍的人工种植方法，包括以下步骤：

[n0034]

(1) Selection of duckweed: Select duckweed or purple duckweed, and wash the duckweed with sodium hypochlorite aqueous solution;

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(1)浮萍选种：选取青萍或紫萍，采用次氯酸钠水溶液洗涤浮萍；

[n0035]

(2) Duckweed cultivation: Add a mixture containing 20-20-20 liquid fertilizer, sucrose and acetamiprid to the water pool in the greenhouse, and then rapidly propagate the duckweed.

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(2)浮萍培育：在温室大棚内的水池中，添加包含20-20-20液体肥、蔗糖和烯效唑的混合物后，再对浮萍进行快速扩繁；

[n0036]

(3) Preparation before release: Clean the outdoor pond, then dry the water, and then apply well-rotted fertilizer;

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(3)投放前准备：对户外池塘进行清洁，然后进行晒水，再施用腐熟肥；

[n0037]

(4) Field management: Place 100-200 kg of duckweed obtained from step (2) per mu into an outdoor pond, cultivate it at 18°C-31°C for 7-18 days and harvest the duckweed. The density of the remaining duckweed should be controlled at 25-50% of the water surface. After placing the duckweed, add fertilizer every 7-18 days.

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(4)田间管理：向户外池塘每亩投放所述步骤(2)扩繁得到的浮萍100～200kg，18°C～31°C培养7～18天收割浮萍，剩余浮萍密度控制在覆盖水面的25～50%；投放浮萍后每隔7～18天追加肥料；

[n0038]

The additional fertilizer is urea and phosphate fertilizer.

所述追加肥料为追加尿素和磷肥。

[n0039]

The inventors of this invention have discovered in practice that, in order to maintain high quality while continuously and rapidly reproducing duckweed, the appropriate combination of duckweed density, fertilization amount and cultivation conditions is crucial.

本发明的发明人在实践中发现，要实现浮萍保持高品质的同时持续快速繁殖，合适的浮萍密度、施肥量和培养条件之间的配合很关键。

In this invention, by controlling the amount of duckweed released (100-200 kg/mu), cultivating it at 18°C-31°C for 7-18 days, and selecting well-rotted manure as the base fertilizer and urea and phosphate fertilizer as the top-dressing fertilizer, all steps and parameters are coordinated as a whole to finally achieve an artificial cultivation method for duckweed that can achieve continuous and rapid reproduction and has excellent quality.

本发明中，通过控制投放浮萍投放量100～200kg/亩，培养条件18°C～31°C培养7-18天，并选择腐熟肥用于基础肥，尿素和磷肥用于追加肥，所有步骤和参数整体配合，最终实现了一种能实现持续快速繁殖，并且浮萍品质优良的浮萍的人工种植方法。

[n0040]

Preferably, in step (2), duckweed is harvested after being cultured at 18°C～31°C for 7-12 days.

优选地，所述步骤(2)中，18°C～31°C培养7-12天收割浮萍。

The method of this invention allows for the rapid propagation of duckweed, yielding high-quality duckweed in just 7-12 days.

本发明方法繁殖浮萍速度快，培养7-12天即可获得品质良好的浮萍。

Under otherwise unchanged conditions, temperatures below 18°C or above 31°C will slow down the growth of duckweed, reduce its quality, make the duckweed leaves more yellow, and decrease the chlorophyll content.

在其他条件不变的情况下，温度低于18°C或高于31°C均会导致浮萍生长变缓，以及品质下降，浮萍叶更黄，叶绿素含量降低。

[n0041]

Preferably, the additional fertilizer in step (2) is 0.5-2 kg of urea and 0.4-1 kg of phosphate fertilizer per mu.

优选地，步骤(2)所述追加肥料为每亩追加0.5～2kg尿素和0.4～1kg磷肥。

More preferably, the additional fertilizer in step (2) is 1-1.5 kg of urea and 0.4-0.7 kg of phosphate fertilizer per mu. This amount of fertilizer, combined with other steps, results in better quality duckweed with green leaves that do not turn yellow.

进一步优选地，步骤(2)所述追加肥料为每亩追加1～1.5kg尿素和0.4～0.7kg磷肥，此施肥量配合其他步骤，所得浮萍的品质更好，叶子翠绿不泛黄。

In conjunction with step (1), the decomposed manure was selected and the amount of decomposed manure used per mu of pond was 100kg to 300kg. Using decomposed manure as base fertilizer and urea and phosphate fertilizer as supplementary fertilizer, it was found that the reproduction speed of duckweed cultivation was better.

同时结合步骤(1)中，选择腐熟肥为人畜粪且每亩池塘用腐熟肥的量为100kg～300kg；以腐熟肥作为基肥配合尿素和磷肥作为追加肥，发现浮萍培育的繁殖速度更优。

In contrast, the reproduction rate of duckweed is affected by using only well-rotted manure, or only urea and phosphate fertilizer, or by adjusting the order of fertilization, and the reproduction rate of duckweed is unstable between different batches.

相比之下，如果全部使用腐熟肥或全部使用尿素和磷肥或调整施肥的顺序，浮萍繁殖速度有所影响，并且不同批次浮萍的繁殖速度不稳定。

[n0042]

Preferably, when harvesting duckweed, the density of the remaining duckweed is controlled to be 30-45% covering the water surface.

优选地，所述收割浮萍时，剩余浮萍密度控制在覆盖水面的30～45%。

Within this range, the duckweed density can better promote the duckweed to maintain a high reproduction rate. If the density is too high, the competition for oxygen and light on the water surface will be fierce, increasing the competition among species and causing the duckweed growth rate to be greatly reduced.

此范围浮萍密度可以更好地促进浮萍保持高繁殖速率，密度太多，水面氧气和光照竞争激烈，增大种群竞争，致使浮萍生长速率大大降低。

[n0043]

Preferably, in step (1), washing the duckweed with a sodium hypochlorite aqueous solution includes washing the duckweed with a sodium hypochlorite aqueous solution with a concentration of 1wt% to 3wt% for 3 to 5 minutes.

优选地，所述步骤(1)中，所述采用次氯酸钠水溶液洗涤浮萍包括：采用浓度为1wt%～3wt%的次氯酸钠水溶液洗涤浮萍3～5min。

It can ensure the health of duckweed.

其可以保证浮萍健康。

Preferably, in step (2), the concentrations of the 20-20-20 liquid fertilizer, sucrose, and uniconazole in the water tank are 2g/L to 5g/L, 5g/L to 10g/L, and 0.6g/L to 1g/L, respectively.

优选地，所述步骤(2)中，所述20-20-20液体肥、蔗糖和烯效唑在水池中的浓度依次分别为2g/L～5g/L、5g/L～10g/L和0.6g/L～1g/L。

It is beneficial to quickly provide high-quality duckweed seedlings for later field planting.

其有利于为后期田间种植快速地提供品质良好的浮萍苗。

To ensure rapid and high-quality duckweed propagation, thorough preparation is necessary before releasing the duckweed. By optimizing the selection of duckweed species, treatment of varieties, and propagation as described in this invention, a large number of healthy duckweed resources can be obtained quickly, significantly reducing the time required for later release. Furthermore, healthy duckweed seedlings provide quality assurance for later field planting.

要更好地保证快速、高品质的实现浮萍繁殖，投放浮萍前还需要做好充分的准备工作，通过对前期浮萍种类的选择、品种的处理、品种的扩繁等进行本发明所述整体优化，可以快速获取大量健康浮萍资源，为后期投放浮萍上缩减大量时间，并且健康的浮萍苗对后期田间投放种植提供品质保障。

[n0044]

Preferably, the water-drying process includes: filling a pond with water to a depth of 1.0 to 1.5 m, and then exposing it to the sun for 3 to 5 days.

优选地，所述晒水包括：在池塘中注入水至1.0～1.5m深，然后暴晒3～5天。

Sunlight exposure to water can help remove chlorine ions and pathogenic microorganisms.

通过晒水，可以促进去除水中氯离子和病原微生物。

[n0045]

Preferably, in step (1), the cleaning includes cleaning with 0.05wt% to 0.5wt% sodium hypochlorite, and the amount of 0.05wt% to 0.5wt% sodium hypochlorite used per mu of pond is 0.005L/m³ to 0.05L/m³.

优选地，步骤(1)中，所述清洁包括：用0.05wt%～0.5wt%次氯酸钠进行清洁，每亩池塘用0.05wt%～0.5wt%次氯酸钠的量为0.005L/m³～0.05L/m³。

[n0046]

This invention establishes a technical system for the artificial cultivation of duckweed, which can help farmers in temperate and subtropical regions to cultivate duckweed artificially. It can continuously and quickly harvest high-quality duckweed for use as fish bait and animal feed, greatly reducing farmers' feed costs and closely integrating planting and breeding industries to solve farmers' practical production problems.

本发明建立一种浮萍人工种植的技术体系，能够帮助温带和亚热带地区农户开展人工种植浮萍，可以持续快速的收获高品质浮萍用于鱼饵、动物饲料，大大减轻了农户的饲料成本，使种植业和养殖业紧密结合，以解决农民实际生产问题。

[n0047]

The present invention will be further described in detail below with reference to specific embodiments.

以下结合具体实施例对本发明作进一步详细的说明。

[n0048]

Example 1

实施例1

[n0049]

(1) Selection of duckweed species: Select common and widely distributed duckweed (Lemna minor) and duckweed (Spirodela polyrrhiza) in nature, and wash them with low concentration sodium hypochlorite (1wt% to 3wt%) for 3 to 5 minutes to remove microalgae attached to the surface of the duckweed.

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(1)浮萍选种：选取自然界常见且分布较广的青萍(Lemna minor)和紫萍(Spirodela polyrrhiza)，采用低浓度次氯酸钠1wt%～3wt%洗涤3～5min洗涤以清除浮萍表面附着的微藻；

[n0050]

(2) Duckweed cultivation: A simple pond was built in the greenhouse, and 3.5g/L 20-20-20 liquid fertilizer, 7.5g/L sucrose and 0.8g/L plant growth regulator tebuconazole were added to rapidly propagate duckweed;

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(2)浮萍培育：在温室大棚内修建简易水池，添加浓度为3.5g/L 20-20-20液体肥、7.5g/L蔗糖和0.8g/L植物调节剂烯效唑对浮萍进行快速扩繁；

[n0051]

(3) Selecting or building ponds: Existing ponds, fish ponds, reservoirs, etc., or artificial ponds can be used for planting.

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(3)选池或造池：可用现有池沼、鱼塘、蓄水池等或人工造池进行种植。

Clean the pond: Fill the pond with water to a depth of about 5-10 cm, pour in 0.2 wt% sodium hypochlorite to remove weeds, algae and insects (0.025 L/m³), and then drain the water; Sun-dry the pond: Fill the pond with tap water to a depth of 1.0-1.5 m, and then expose it to the sun for 3-5 days to remove chloride ions and pathogenic microorganisms; Apply base fertilizer: Apply 100 kg-300 kg of well-rotted fertilizer per acre of water surface.

清洁池塘：对池塘注入约5～10cm深的水，倒入0.2wt%次氯酸钠对杂草、藻类和虫类进行清理(0.025L/m³)，之后将水排掉；池塘晒水：注入自来水至池塘1.0～1.5m深，然后暴晒3～5天以去除水中氯离子和病原微生物；施用基肥：每亩水面施腐熟肥100kg～300kg。

[n0052]

(4) Field management: 100-200 kg of duckweed obtained from step (2) is placed per mu.

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(4)田间管理：每亩投放步骤(2)扩繁得到的浮萍100～200kg。

The growth of duckweed is affected by factors such as ambient temperature, duckweed density, and water nutrients, and management should be carried out in combination with specific factors.

浮萍生长受到环境温度、浮萍密度和水体营养等因素影响，需结合具体因素进行管理。

[n0053]

Ambient temperature: When the water temperature is between 18°C and 31°C, it is the optimal growth temperature for duckweed. It can be harvested by a water plant harvester after 7 to 12 days of cultivation.

环境温度：当水温在18°C～31°C时，为浮萍最适生长温度，培养7～12天即可通过水草收割机进行收获。

[n0054]

Duckweed density: When harvesting duckweed, the remaining duckweed density should be controlled to cover 30-45% of the water surface;

浮萍密度：收获浮萍时，剩余的浮萍密度需控制在覆盖水面的30～45%；

[n0055]

Water nutrition: Apply 1-1.5 kg of urea and 0.4-0.7 kg of phosphate fertilizer per mu every 7-12 days.

水体营养：每隔7～12天每亩施用1～1.5kg尿素和0.4～0.7kg磷肥。

Meanwhile, topdressing should be carried out after the duckweed has been removed, and the amount should be applied according to the time when the duckweed was removed.

同时追肥应在打捞浮萍之后进行，并且根据浮萍打捞时间施用。

[n0056]

Example 2

实施例2

[n0057]

The difference between this embodiment and embodiment 1 is that step (4) is:

本实施例与实施例1的区别在于，步骤(4)为：

[n0058]

Plant 100-150 kg of duckweed per mu.

每亩投放浮萍100～150kg。

The growth of duckweed is affected by factors such as ambient temperature, duckweed density, and water nutrients, and management should be carried out in combination with specific factors.

浮萍生长受到环境温度、浮萍密度和水体营养等因素影响，需结合具体因素进行管理。

[n0059]

Ambient temperature: The water temperature should be above 31°C. Cultivate for 14 to 18 days before harvesting with a waterweed harvester.

环境温度：水温在31°C以上，培养14～18天再通过水草收割机进行收获。

[n0060]

Duckweed density: When harvesting duckweed, the remaining duckweed density should be controlled at 35-45% of the water surface to ensure that there is enough duckweed to reproduce rapidly at that temperature;

浮萍密度：收获浮萍时，剩余的浮萍密度需控制在覆盖水面的35～45%，以保留有足量的浮萍能够在该温度下快速繁殖；

[n0061]

Water nutrition: Apply 1-1.5 kg of urea and 0.4-0.7 kg of phosphate fertilizer per mu every 14-18 days.

水体营养：每隔14～18天每亩施用1～1.5kg尿素和0.4～0.7kg磷肥。

[n0062]

Example 3

实施例3

[n0063]

The difference between this embodiment and embodiment 1 is that step (4) is:

本实施例与实施例1的区别在于，步骤(4)为：

[n0064]

Plant 150-200 kg of duckweed per mu (unit of land area).

每亩投放浮萍150～200kg。

The growth of duckweed is affected by factors such as ambient temperature, duckweed density, and water nutrients, and management should be carried out in combination with specific factors.

浮萍生长受到环境温度、浮萍密度和水体营养等因素影响，需结合具体因素进行管理。

[n0065]

Ambient temperature: The water temperature should be below 18°C. Cultivate for 14 to 18 days before harvesting with a waterweed harvester.

环境温度：水温在18°C以下，培养14～18天再通过水草收割机进行收获。

[n0066]

Duckweed density: When harvesting duckweed, the remaining duckweed density should be controlled at 35-45% of the water surface to ensure that there is enough duckweed to reproduce rapidly at that temperature;

浮萍密度：收获浮萍时，剩余的浮萍密度需控制在覆盖水面的35～45%，以保留有足量的浮萍能够在该温度下快速繁殖；

[n0067]

Water nutrition: Apply 1-1.5 kg of urea and 0.4-0.7 kg of phosphate fertilizer per mu every 14-18 days.

水体营养：每隔14～18天每亩施用1～1.5kg尿素和0.4～0.7kg磷肥。

[n0068]

Example 4

实施例4

[n0069]

The difference between this embodiment and embodiment 1 is that step (4) is:

本实施例与实施例1的区别在于，步骤(4)为：

[n0070]

Plant 150-200 kg of duckweed per mu (unit of land area).

每亩投放浮萍150～200kg。

The growth of duckweed is affected by factors such as ambient temperature, duckweed density, and water nutrients, and management should be carried out in combination with specific factors.

浮萍生长受到环境温度、浮萍密度和水体营养等因素影响，需结合具体因素进行管理。

[n0071]

Ambient temperature: The water temperature should be below 18°C. Cultivate for 7-12 days and then harvest using a waterweed harvester.

环境温度：水温在18°C以下，培养7～12天再通过水草收割机进行收获。

[n0072]

Duckweed density: When harvesting duckweed, the remaining duckweed density should be controlled at 35-45% of the water surface to ensure that there is enough duckweed to reproduce rapidly at that temperature;

浮萍密度：收获浮萍时，剩余的浮萍密度需控制在覆盖水面的35～45%，以保留有足量的浮萍能够在该温度下快速繁殖；

[n0073]

Water nutrition: Apply 1-1.5 kg of urea and 0.4-0.7 kg of phosphate fertilizer per mu every 7-12 days.

水体营养：每隔7～12天每亩施用1～1.5kg尿素和0.4～0.7kg磷肥。

[n0074]

Example 5

实施例5

[n0075]

The difference between this embodiment and embodiment 1 is that step (4) is:

本实施例与实施例1的区别在于，步骤(4)为：

[n0076]

Plant 150-200 kg of duckweed per mu (unit of land area).

每亩投放浮萍150～200kg。

The growth of duckweed is affected by factors such as ambient temperature, duckweed density, and water nutrients, and management should be carried out in combination with specific factors.

浮萍生长受到环境温度、浮萍密度和水体营养等因素影响，需结合具体因素进行管理。

[n0077]

Ambient temperature: The water temperature should be above 31°C. Cultivate for 7-12 days and then harvest using a waterweed harvester.

环境温度：水温在31°C以上，培养7～12天再通过水草收割机进行收获。

[n0078]

Duckweed density: When harvesting duckweed, the remaining duckweed density should be controlled at 35-45% of the water surface to ensure that there is enough duckweed to reproduce rapidly at that temperature;

浮萍密度：收获浮萍时，剩余的浮萍密度需控制在覆盖水面的35～45%，以保留有足量的浮萍能够在该温度下快速繁殖；

[n0079]

Water nutrition: Apply 1-1.5 kg of urea and 0.4-0.7 kg of phosphate fertilizer per mu every 7-12 days.

水体营养：每隔7～12天每亩施用1～1.5kg尿素和0.4～0.7kg磷肥。

[n0080]

Example 6

实施例6

[n0081]

The difference between this embodiment and embodiment 1 is that in step 4, 5-10 kg of urea and 3-5 kg of phosphate fertilizer are applied per mu every 7-12 days.

本实施例与实施例1的区别在于：步骤4中每隔7～12天每亩施用5～10kg尿素和3～5kg磷肥。

[n0082]

Example 7

实施例7

[n0083]

The difference between this embodiment and embodiment 1 is that in step 4, 0.1-0.5 kg of urea and 0.1-0.3 kg of phosphate fertilizer are applied per mu every 7-12 days.

本实施例与实施例1的区别在于：步骤4中每隔7～12天每亩施用0.1～0.5kg尿素和0.1～0.3kg磷肥。

[n0084]

Example 8

实施例8

[n0085]

The difference between this embodiment and embodiment 1 is that the density of duckweed in step 2 needs to be controlled to cover 50-60% of the water surface.

本实施例与实施例1的区别在于：步骤2中浮萍密度需控制在覆盖水面的50～60%。

[n0086]

Example 9

实施例9

[n0087]

The difference between this embodiment and embodiment 1 is that the density of duckweed in step 2 needs to be controlled to cover 20-30% of the water surface.

本实施例与实施例1的区别在于：步骤2中浮萍密度需控制在覆盖水面的20～30%。

[n0088]

The morphology and chlorophyll content of duckweed collected in Examples 1-5 are shown in Figure 1 and Figure 2.

实施例1-5采集后的浮萍形态和叶绿素含量如图1和图2所示。

The duckweed in Example 1 grows rapidly and has a high chlorophyll content, resulting in good quality duckweed, as shown in Figure 1A.

实施例1的浮萍生长速度快，并且浮萍叶绿素含量高，浮萍品质好，如图1A。

The duckweed in Example 2 grows at a temperature above 31°C, which slows down its growth rate. It takes 14 to 18 days to harvest, and the chlorophyll content of the duckweed is lower than that in Example 1, as shown in Figure 1B.

实施例2的浮萍生长温度在31°C以上，生长速度放缓，延长时间追肥，需要14～18天才能收获，且所得浮萍叶绿素含量低于实施例1，如图1B。

The duckweed in Example 3 grows at a temperature below 18°C, which slows down its growth rate. It takes 14 to 18 days to harvest, and the chlorophyll content of the duckweed is lower than that in Examples 1 and 2, as shown in Figure 1C.

实施例3的浮萍生长温度在18°C以下，生长速度放缓，延长时间追肥，需要14～18天才能收获，并且所得浮萍的叶绿素含量低于实施例1和实施例2，如图1C。

In Example 4, the duckweed grew at a temperature below 18°C, its growth rate slowed down, and it was fertilized every 7-12 days. The duckweed turned yellow and its chlorophyll content was significantly lower than that of Examples 1-3, as shown in Figure 1D.

实施例4的浮萍的生长温度在18°C以下，生长速度放缓，7-12天追肥，浮萍颜色变黄，叶绿素含量相比实施例1-3明显降低，如图1D。

In Example 5, the duckweed was grown at a temperature above 31°C. After fertilization every 7-12 days, the duckweed turned yellow and the chlorophyll content was significantly lower than that in Examples 1-3, as shown in Figure 1E.

实施例5的的浮萍的生长温度在31°C以上，7-12天追肥，浮萍颜色变黄，叶绿素含量相比实施例1-3明显降低，如图1E。

[n0089]

Figure 3 shows the morphology of duckweed collected under different fertilizer concentrations in Examples 1 and 6-7.

实施例1、6-7不同施肥浓度下采集浮萍形态如图3所示。

The dark green duckweed in Figure B is the duckweed obtained in Example 1.

中间B图的深绿色浮萍为实施例1所得浮萍。

The duckweed with a yellowish tint in Figure A on the left and Figure C on the right are the duckweed obtained in Example 7 and Example 6, respectively.

左侧的A图和右侧的C图浮萍颜色偏黄的分别为实施例7和实施例6的所得浮萍。

[n0090]

Figure 4 shows the growth of duckweed under different harvest densities in Examples 1, 8, and 9.

实施例1、8、9不同收获密度下的浮萍生长如图4所示。

As shown in Figure 4, the growth rate of Example 1 is optimal.

由图4可知，以实施例1的生长速率最佳。

[n0091]

The technical features of the above embodiments can be combined in any way. For the sake of brevity, not all possible combinations of the technical features in the above embodiments are described. However, as long as there is no contradiction in the combination of these technical features, they should be considered to be within the scope of this specification.

以上所述实施例的各技术特征可以进行任意的组合，为使描述简洁，未对上述实施例中的各个技术特征所有可能的组合都进行描述，然而，只要这些技术特征的组合不存在矛盾，都应当认为是本说明书记载的范围。