

PRE-GROWN VEGETATED MAT

FIELD OF THE INVENTION

5 This invention relates to a pre-grown vegetated mat. More particularly, the invention relates to a pre-grown vegetated mat comprising a first layer made of impermeable material, a second layer made of burlap material and a top dressing spreading over the second layer.

10 BACKGROUND

Pre-vegetated mats with plant cuttings are typically grown off-site at production facilities before the mats and the plants are transferred to the site to be installed. Many of the pre-grown vegetated mats are made of non-degradable materials, such as interwoven
15 nylon or polymeric mesh. Such mats may pose health and environmental issues.

Some of the pre-growing processes known in the art use cococoir/oil palm fibrous mats or non-degradable polymeric mesh to pre-grow the plants before the mats and the plants are placed on site. The non-degradable polymeric mesh is heat welded onto a 2-
20 dimensional non-woven polymeric surface. These methods of pre-growing the plants are relatively slow as the mats essentially do not contain much water within their fibrous or polymeric materials. Regular watering of the plants will be required throughout the day in order to sustain adequate water within the mats for normal growth of the plants. Such processes are laborious and involved relatively higher production costs. The use
25 of polymeric mesh in the mats also results in relatively higher production costs as compared to using mats fabricated from non-synthetic fibres.

Some methods known in the art uses soil to support the growth of the plants on the mats. Pre-grown vegetated mat with plant cuttings grown in soil has a number of
30 limitations and disadvantages. These include limitations on the exportation of the pre-grown vegetated mat with plant cuttings to other countries as many countries impose restrictions on the importation of soil into the country. Soil that contains contaminants may be classified hazardous waste and therefore it is often subject to restrictions in transportation. Pre-grown vegetated mat with plant cuttings grown in soil is also
35 extremely heavy and is therefore difficult to transport, handle and apply.

It is therefore desirable to provide a pre-grown vegetated mat and a process of producing the same that seek to address at least one of the problems described hereinabove, or at least to provide alternatives.

5 SUMMARY OF INVENTION

In accordance with a first aspect of this invention, a pre-grown vegetated mat is provided. The pre-grown vegetated mat comprises a first layer made of impermeable material, a second layer made of burlap material extending over the first layer, wherein
10 the second layer having perforated surface configured to receive plant cuttings; and a top dressing spreading over the second layer opposite the first layer, the top dressing comprises one or more substances selected from the group consisting of peat moss, coco peat, black loose soil and a combination thereof.

15 In accordance with a second aspect of this invention, a method of producing a pre-grown vegetated mat with plant cuttings is provided. The method comprises providing a first layer made of impermeable material, laying a second layer made of burlap material over the first layer, wherein the second layer having perforated surface configured to receive plant cuttings; spreading species of plant cuttings over the second layer;
20 optionally adding compost and/or fertilizers over the second layer; applying a top dressing over the second layer opposite the first layer; and allowing the species of plant cuttings to grow on the perforated surface of the second layer such that the roots of the plant cuttings extend through the perforated surface of the second layer and intertwine around the perforations of the second layer.

25 In accordance with one embodiment of this invention, the impermeable material is a polymeric plastic material.

In accordance with one embodiment of this invention, the first layer has a thickness of 1
30 to 10 mm. In accordance with another embodiment of this invention, the second layer has a thickness of 5 to 10 mm.

In accordance with an embodiment of this invention, the second layer is provided in the form of a strip. In accordance with another embodiment of this invention, the vegetated
35 mat is provided in the form of a strip.

In accordance with an embodiment of this invention, the plant cuttings having roots extending through the perforated surface of the second layer and intertwine around the perforations of the perforated surface of the second layer.

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BRIEF DESCRIPTION OF THE DRAWINGS

The above advantages and features of a method and apparatus in accordance with this invention are described in the following detailed description and are shown in the drawings:

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Figure 1 is cross-sectional view of the pre-grown vegetated mat according to the present invention.

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Figure 2 is an image showing that plant cuttings growing on coconut fibre mat tend to dry out relatively faster.

Figures 3 and 4 are images showing the slow establishment of plant cuttings on coconut fibre mat.

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Figure 5 is an image showing that plant cuttings grown on a coconut fibre mat began to rot after several days.

Figure 6 is an image showing that the coverage of the plants grown on a coconut fibre mat is less than 100%.

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Figure 7 is an image showing that the coverage of the plants grown on the pre-grown vegetated mat of the present invention is about 100%.

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Figure 8 is an image illustrating another example wherein plant cuttings are pre-grown on mat comprising oil palm fibre.

Figure 9 and 10 are images illustrating another example wherein plant cuttings are grown on mat comprising polymeric mesh. The images show that plant cuttings grown on polymeric mesh tend to have weeds rampantly growing on the mat.

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DETAILED DESCRIPTION

The present invention relates to a pre-grown vegetated mat.

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Referring to Figure 1, the pre-grown vegetated mat (10) comprises a first layer (12) made of impermeable material, a second layer (14) made of burlap material and extending over the first layer (12), wherein the second layer having perforated surface configured to receive plant cuttings. The pre-grown vegetated mat (10) is further
10 provided with a top dressing (16) spreading over the second layer opposite the first layer, wherein the top dressing (16) comprises one or more substances selected from the group consisting of peat moss, coco peat, black loose soil and a combination thereof.

15 Any suitable impermeable material can be used as the first layer as long as the impermeable material does not allow water to sip through the material. The material also should not allow the roots of the plant cuttings to penetrate through. This is to facilitate the growing of the roots around the perforations of the perforated surface of the second layer such that the roots will grow and intertwine with one another and/or
20 around the perforations. This helps to secure the plant cuttings in position and to the mat. In one embodiment, the impermeable material is a polymeric plastic material.

The burlap material forming the second layer is formed from jute, hemp, or other natural fibres. Jute is a long, soft, shiny vegetable fibre that can be spun into coarse, strong threads. Jute is produced primarily from plants in the genus *Corchorus*. The
25 fibres of the jute are used to weave into the material forming the second layer. The jute is first dried and the dried fibres from the jute are then processed to form a regular, loosely woven perforated material for forming the second layer of the pre-grown vegetated mat. The perforated surface of the second layer helps to secure the plant
30 cuttings in position when the plant cuttings are spread onto the second layer. As the plant cuttings grow on the second layer, the roots of the plant cuttings may penetrate through the perforations of the second layer and intertwine with one another and/or with the perforations of the second layer. This helps to secure the plant cuttings more firmly to the mat and this in turn, facilitates transportation of the vegetated mat. The
35 perforations can be of any suitable shapes, sizes and layout. In one embodiment, the

perforations are substantially circular in shape and having an average diameter of 0.1 to 8.0 mm, preferably 0.5 to 3.0 mm. In other embodiments, the perforations have an average aperture dimension of 15 to 25 mm in length and 15 to 25 mm in width.

- 5 The second layer made of burlap material has good water retention. The material helps to retain water and the impermeable first layer further facilitates the retention of the water within the mat. This reduces the need to water the plants on a regular basis. Any suitable grade of burlap material may be used as long as it is able to retain water by up to 50 to 70% or able to maintain the pre-grown vegetated mat in a rolled up position for
10 12 hours to 2.5 days without compromising the quality of the plant cuttings.

In one embodiment, the top dressing spreading over the second layer covers a predominant surface area of the second layer opposite the first layer, ranging from 50% to 100% of the surface area of the second layer. The top dressing is applied over the
15 second layer to provide additional nutrients to the plant cuttings.

The second layer extending over the first layer can be of the same size and shape as the first layer or it can be of a different size and shape as the first layer. In one embodiment, the first layer is provided in a form of a sheet that when applied to a
20 terrain, it spreads across the terrain and the second layer is provided in the form of strips. In another embodiment, the first layer and the second layer are provided in the form of a strip. The configuration of the second layer or the first and second layers in strip form helps to facilitate the process of pre-growing the plant cuttings on the mat and transporting the mat with the plant cuttings to the site for installation. In one
25 embodiment, the strip has a width of 0.3 to 2.0 m, preferably 0.3 to 1.5 m, more preferably 0.3 to 1.2 m, even more preferably 0.3 to 1.0 m and most preferably 0.3 to 0.5 m. The strip can be of any suitable length. In one embodiment, the strip has a length of 4 to 12 m.

- 30 Preferably, the first layer of the pre-grown vegetated mat has a thickness of 1 to 10 mm, preferably 1 to 3 mm. The second layer has a thickness of 5 to 10 mm. The thickness of the layers will affect the costs and the weight of the pre-grown vegetated mat. These are some of the factors that the inventors consider when choosing the materials for fabricating the pre-grown vegetated mat.

In one embodiment, the pre-grown vegetated mat further comprises plant cuttings disposed on the second layer, between the top dressing and the second layer.

5 “Plant cuttings” as used herein refers to pieces of plants that are used in horticulture for vegetative propagation. The pieces may include the stem, root and/or leaves of a source plant.

Any suitable plant cuttings can be used. The species used for the plant cuttings can be of any suitable type as long as the plant cuttings are able to withstand the climate that they are grown in. In some exemplary embodiments, the species include, but are not limited to, *sedum sarmentosum*, *sedum mexicanum*, *portulaca oleracea*, *portulaca grandiflora*, *portulaca pilosa*, *axonopus compressus*, pearl grass, carpet grass, *callisia repens*, *plectranthus* species, *alternanthera* species, *wedelia trilobata*, *dissotis rotundifolia*, *piper sarmentosum*, *cyanotis cristata*, *cyanotis axillaris*, *cyanotis obtusa*,
10 *stenotaphrum secundatum* variegated and *stenotaphrum secundatum* green. The plant cuttings can be provided in any suitable forms, shapes and sizes.

In the embodiment described hereinabove, the overall thickness of the pre-grown vegetated mat comprising the first layer, the second layer, the top dressing and the plant cuttings ranges from 30 to 50 mm. This thickness is relatively thinner as
20 compared to some vegetated mats known in the state of the art (which may be around 50 to 75 mm). The reduced thickness reduces the overall weight of the pre-grown vegetated mat.

25 In another embodiment, the second layer may be an interwoven layer comprising two or more layers made of burlap material, wherein the two or more layers superimpose with one another to form a single integral layer. This embodiment enables one to fabricate a second layer according to the desired dimensions of the perforations using existing burlap materials, to cater to the different species of plant cuttings growing on
30 the mat. The overall thickness of the pre-grown vegetated mat of this configuration varies according to the number of layers of burlap material used to make the second layer.

In another aspect of the invention, a method of producing a pre-grown vegetated mat
35 with plant cuttings is provided. The method comprises providing a first layer made of

impermeable material. A second layer made of burlap material is then laid over the first layer, wherein the second layer having perforated surface configured to receive plant cutting. This is followed by spreading species of plant cuttings over the second layer. Optionally, compost and/or fertilizers may be added to the plant cuttings. Examples of
 5 compost that may be used include, but are not limited to, cococoir, tree bark, mulch and peat moss from raised bogs. Any suitable types of fertilizers may be used. The fertilizers are provided to kick start the growing process of the plant cuttings.

After the plant cuttings are spread over the second layer, a top dressing is applied over
 10 the second layer opposite the first layer. Preferably, the top dressing comprises one or more substances selected from the group consisting of peat moss, coco peat, black loose soil and a combination thereof.

The mat comprising the first layer, the second layer and the top dressing is irrigated
 15 with an aqueous solution to prevent the mat from drying out. In one embodiment, the mat is irrigated with an aqueous solution at least once a day. Any suitable type of aqueous solution may be used including, but is not limited to, water, recycled water from holding pond, water containing organic enzymes, etc.

20 The species of plant cuttings are then allowed to grow on the perforated surface of the second layer. The plant cuttings grow in such a way that the roots of the plant cuttings extend through the perforated surface of the second layer and intertwine around the perforations of the second layer. Due to the impermeable nature of the first layer, the roots of the plant cuttings are not able to penetrate through the first layer. As a result,
 25 the roots of the plant cuttings grow and extend horizontally within the space between the first layer and the second layer. As the roots of the plant cuttings grow longer, the roots intertwine with one another, with some roots latching themselves onto the perforated surface of the second layer. This firmly secures the plant cuttings to the second layer and holds the plant cuttings in place. The plant cuttings may be secured
 30 to the second layer in uniformly spaced locations or in a random manner.

When the plants are ready to be harvested, the pre-grown vegetated mat is rolled up. In the embodiment wherein the first layer and the second layer are provided in the form of a strip, the first layer, the second layer together with the top dressing are rolled up
 35 together. In the embodiment wherein the second layer is provided in the form of a strip,

the second layer together with the top dressing is rolled up, without the first layer. Providing the mat in strip form eliminates the need to cut the mat to size before rolling up the mat. This makes the process of harvesting relatively faster and easier, and less labour intensive. The typical weight for each strip of the mat ranges from 1 to 5 kg/m², depending on the moisture content of the second layer. This is significantly lighter than those known in the art, which are typically in the range of 10 to 15 kg/m² (for mat made of, for example, coconut fiber), and 25 to 35 kg/m² (for mat made of, for example, polymeric mesh).

Providing the mat in strip form also allows the mat to be changed with relatively ease when the need arises, particularly when the vegetation on the mat withered or needed to be replaced with another type of vegetation. This allows different types of species to grow on a single terrain. This method is useful when there is a need to provide different species for beautifying the terrain or any other purposes.

In general, the pre-grown vegetated mat of the present invention can be used for a variety of purposes. For example, it can be laid on terrains with soil or on surfaces without soil, for example, on roof top. In the embodiment wherein the mat is laid on terrains with soil, the mat is first unrolled and the first layer made of impermeable layer is removed before the mat is laid on the terrain. Further plant cuttings and soil may be spread over the second layer such that the section of the terrain is quickly vegetated. As the plants continue to grow, the roots of the plants will grow into the soil of the terrain and thereby securing the mat with the plants more firmly to the terrain. In the embodiment in which the mat is laid on surfaces without soil, the mat is simply unrolled and laid onto the surfaces without the need to remove the first layer made of impermeable layer.

In another aspect of the present invention, a method of producing a plurality of pre-grown vegetated mats with plant cuttings is provided. The method comprises providing a first layer made of impermeable material and laying a first batch of two or more strips of second layer made of burlap material over the first layer in a spaced-apart manner, wherein each of the strips of the second layer having perforated surface configured to receive plant cutting. This is followed by spreading species of plant cuttings over each of the strips of the second layer. Optionally, compost and/or fertilizers may be added to the plant cuttings.

After the plant cuttings are spread over the strips of second layer, a top dressing is applied over each strip of the second layer opposite the first layer. Each mat comprising the first layer, the second layer and the top dressing is irrigated with an aqueous solution to prevent the mat from drying out.

The species of plant cuttings are then allowed to grow on the perforated surface of each strip of the second layer in the same manner as described hereinabove.

Before the plants are harvested, a second batch of two or more strips of second layer made of burlap material are laid over the first layer, with each strip of the second batch placed between two adjacent strips from the first batch. This allows the species of plant cuttings from the first batch of the second layer to grow over to the second batch of strips of second layer. Once the plant cuttings from the first batch of second layer are ready to be harvested, the first batch of second layer is rolled up and a new batch of two or more strips of second layer is provided to take its place. This makes the process of harvesting relatively faster and more cost effective as less plant cuttings are required for each new batch of second layer.

The method of the present invention provides a simplified way of pre-growing vegetation on a mat before the vegetation is transported to a desired location. The method is less labour-intensive as compared to traditional method of growing vegetation as the plant cuttings in the present invention are able to grow on the mat with minimal supervision and intervention. The method requires fewer steps in growing vegetation on the mat.

The pre-grown vegetated mat of the present invention can be easily rolled up for storage and/or for transportation. One of the factors contributing to this advantage is that the roots of the plant cuttings do not penetrate through the impermeable first layer and this allows easy removal of the mat from the site at which the mat is placed to pre-grow the plant cuttings. Another factor contributing to this advantage is that the mat is relatively thinner and lighter due to the materials used to form the various layers of the mat. The burlap material used to produce the mat is relatively lighter as compared to conventional mats formed from 3-dimensional polymeric mesh which is heat welded onto a 2-dimensional non-woven polymeric layer.

The second layer of the mat has a higher water retention capability due to the burlap material used to form the second layer. This allows the mat to be rolled up, stored and transported without having to compromise the quality of the plants. The mat can be
5 rolled up in this manner for as long as 12 hours to 2.5 days without compromising the quality of the plants.

Comparing a mat made from burlap material to a coir mat or other organic mat material, the mat of the present invention has a better water retention capacity and can allow the
10 plant cuttings to grow 2 to 3 times faster and at a higher survival rate to form the mat. The mat of the present invention only requires a very thin layer of the top dressing as compared to one using coir mat or other forms of net, wherein multiple times of thick and heavy top layer is applied onto. This has implications on the costs in the form of material and labour costs. Due to the nature of dependence on labour for forming a top
15 layer that is even and thick, in the event that the top layer for coir mat is not done properly, the vegetated mat will not have a 100% coverage, maybe only 70-80% coverage within a given standard period of time. This is because the area of the coir mat that does not have the top dressing will be too dry. This will not allow any form of roots to grow there.

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The pre-grown vegetated mat of the present invention is soilless. The mats are easy to transport, store and handle. The perforated surface of the second layer facilitates the growing of the plant cuttings on the second layer and this in turn allows the mat to be transported easily without running into the risk of having the vegetation falling out from
25 the mat. The mat has greatly improved storage characteristics. Due to the relatively higher water retention capability, it reduces the frequency of watering of the plant cuttings. This reduces labour costs, increases efficiency and reliability.

The following examples illustrate various embodiments of this invention. One skilled in
30 the art will recognize that the examples set out below are not an exhaustive list of the embodiments of this invention.

EXAMPLE

35 Example 1

Pre-grown vegetated mat made of coconut fibre (or cocomat) is prepared and allowed to grow under the same condition as the pre-grown vegetated mat of the present invention. The results obtained after 40 days of growth are shown in Figures 2 to 6.

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Figure 2 shows that after 7 days, the plant cuttings grew on the coconut fibre mat dried out (201) relatively faster as compared to the mat of the present invention. Due to its inability to retain sufficient water on the mat, the growth of the plants is relatively slower as compared to the mat of the present invention even though the same species of plant cuttings are used and grew under the same conditions. Figures 3 and 4 show the slow establishment (301, 401) of the plants on coconut fibre mat. Figure 5 shows that the plants grown on the coconut fibre mat began to rot (501) after 7 days.

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The results also show that the coverage of the plants grown on the coconut fibre mat is not 100%, as can be seen in Figure 6 (601). Conversely, in the present invention, the coverage of the plants grown on the mat of the present invention is about 100%. This is clearly shown in Figure 7.

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The pre-grown vegetated mat fabricated from coconut fibres tend to be quite hard and does not decompose well. The mat of this nature is able to last 3-10 years, making it relatively harder to sustain when installed on green roof.

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Example 2

Figure 8 shows another example wherein plant cuttings are pre-grown on mat comprising oil palm fibre. The growth of the plants on such mat is not uniform (801) as some areas of the mat may become drier than other areas, resulting in a slower establishment of the plants.

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Example 3

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Figures 9 and 10 each shows an example wherein plant cuttings are grown on mat comprising polymeric mesh. The images show that plant cuttings grown on polymeric mesh tend to have weeds (901, 101) rampantly growing on the mat.

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The above is a description of the subject matter the inventors regard as the invention and is believed that those skilled in the art can and will design alternative embodiments that include of this invention as set forth in the following claims.

Claims:

1. A pre-grown vegetated mat comprising:
 - a first layer made of impermeable material;
 - 5 a second layer made of burlap material extending over the first layer, wherein the second layer having perforated surface configured to receive plant cuttings; and
 - a top dressing spreading over the second layer opposite the first layer, the top dressing comprises one or more substances selected from the group consisting of peat moss, coco peat, black loose soil and a combination thereof.
- 10 2. The pre-grown vegetated mat according to claim 1, wherein the impermeable material is polymeric plastic material.
3. The pre-grown vegetated mat according to claim 1, wherein the second layer
- 15 having a thickness of 5 to 10 mm.
4. The pre-grown vegetated mat according to claim 1, wherein the first layer having a thickness of 1 to 10 mm, preferably 1 to 3 mm.
- 20 5. The pre-grown vegetated mat according to claim 1, wherein the second layer is provided in the form of a strip.
6. The pre-grown vegetated mat according to claim 1, wherein the pre-grown vegetated mat is in the form of a strip.
- 25 7. The pre-grown vegetated mat according to claim 1 or 6, wherein the pre-grown vegetated mat having a length of 4 to 12 m.
8. The pre-grown vegetated mat according to claim 6 or 7, wherein the pre-grown
- 30 vegetated mat having a width of 0.3 to 2.0 m.
9. The pre-grown vegetated mat according to claim 6, wherein the strip has a weight of 1 to 5 kg/m².

10. The pre-grown vegetated mat according to claim 1, wherein the vegetated mat further comprises plant cuttings disposed on the second layer, between the top dressing and the second layer.

5 11. The pre-grown vegetated mat according to claim 1, wherein the plant cuttings having roots extending through the perforated surface of the second layer and intertwine around the perforations of the perforated surface of the second layer.

12. The pre-grown vegetated mat according to claim 10, wherein the pre-grown
10 vegetated mat having an overall thickness of 30 to 50 mm.

13 The pre-grown vegetated mat according to claim 1, wherein the second layer comprises two or more layers made of burlap material, the two or more layers superimpose with one another to form a single integral layer disposed between the first
15 layer and the top dressing.

14. A method of producing a pre-grown vegetated mat with plant cuttings, the method comprising:

providing a first layer made of impermeable material;
20 laying a second layer made of burlap material over the first layer, wherein the second layer having perforated surface configured to receive plant cuttings;
spreading species of plant cuttings over the second layer;
optionally adding compost and/or fertilizers over the second layer;
applying a top dressing over the second layer opposite the first layer; and
25 allowing the species of plant cuttings to grow on the perforated surface of the second layer such that the roots of the plant cuttings extend through the perforated surface of the second layer and intertwine around the perforations of the second layer.

15. The method according to claim 14, wherein the top dressing comprises one or
30 more substances selected from the group consisting of peat moss, coco peat, black loose soil and a combination thereof.

16. The method according to claim 14, wherein the impermeable material is polymeric plastic material.

17. The method according to claim 14, wherein the second layer having a thickness of 5 to 10 mm.

5 18. The method according to claim 14, wherein the first layer having a thickness of 1 to 10 mm, preferably 1 to 3 mm.

19. The method according to claim 14, wherein the pre-grown vegetated mat having an overall thickness of 30 to 50 mm.

10 20. The method according to claim 14, wherein the second layer is provided in the form of a strip.

21. The method according to claim 14, wherein the first layer and the second layer are each provided in the form a strip.

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22. The method according to claim 14, wherein the pre-grown vegetated mat having a length of 4 to 12 m.

20 23. The method according to claim 14 or 22, wherein the pre-grown vegetated mat having a width of 0.3 to 2.0 m.

24. The method according to claim 14, further comprising laying a fourth layer made of burlap material over the second layer before applying the top dressing over the second layer.