

## **Planting Tray**

### **Cross Reference to Related Applications**

This application claims priority from Singapore Patent Application No 5 201007419-3 filed on 11 October 2010 entitled "Planting tray" and from Singapore Patent Application No. 201102277-9 filed on 30 March 2011 also entitled "Planting tray", the entire contents of which are incorporated herein by reference.

### **Field of the Invention**

10 This invention relates to a planting tray particularly for use on roofs.

### **Background of the Invention**

Cities tend to be much warmer than surrounding rural land due to the build up of heat in the buildings that make up the city. It is known to "green" building roofs, 15 particularly high rise buildings, by covering them in growing plants/gardens to provide amenities for occupants of the buildings, to reduce reflected heat, and to improve the environment generally by absorbing *inter alia* rainwater and carbon dioxide.

Existing green roofs may be grown *in situ* in planting medium supported on various layers including waterproofing, a root guard layer and a drainage layer.

20 Such systems do not work with all type of roofs. For example in Singapore, public residential buildings have a particular type of roofing system in which ferro-cement slabs are supported above the main concrete roof of the building. These have the advantage of insulating the main roof of the building with an air gap. However, the slabs themselves get very hot and can exceed temperatures of 55°C or more on hot 25 days. The ferro-cement roof reflects much heat to surrounding buildings. The roofs typically carry electrical and mechanical services which makes it difficult to use traditional greening methods.

In order to address such issues it is known to provide planting trays which sit on top of the cement slabs. WO2007/050042 discloses one such system, as does 30 PCT/US01/22799. However these systems tend to be expensive and complicated to install. With the system of WO2007/050042 in particular, once installed, as all the trays are inter-engaged, it is difficult to simply remove one tray which may contain dead or dying plants for replacement with another as all the trays are interconnected, and need to be pushed apart to remove or add a tray.

A second problem with systems of the type described in WO2007/050042 is that the sealing between the pipes linking the trays together is not always reliable and can lead to water leaking onto the roof.

A further issue with existing systems relates to the effective transfer of water to  
5 the trays and from reservoirs in the trays to the growing medium and plants themselves.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the  
10 field relevant to the present invention as it existed before the priority date of each claim of this application.

### **Summary of the Invention**

In a first broad aspect of the invention, there is provided a planting tray for use  
15 on roofs or the like, including a tray or reservoir for retaining water, a structure supported above the reservoir and one or more wicks supported by the structure and depending into the reservoir for wicking water from the reservoir and means for interconnecting the tray with a like tray.

Typically, the wicks will include a first portion which depends into the reservoir  
20 and a second portion which extends on the structure perpendicular to the first portion.

The second portion may be covered by a fabric layer, such as a geo-textile and a layer of planting media.

The use of wicks is particularly advantageous with young plants whose roots may not be extensive and may not reach the reservoir.

25 The planting tray may define a reservoir having a base and side and end walls and a ledge extending around the internal perimeter of the reservoir. The lower part of the reservoir may be divided into cells by internal walls. One or more outlets/exits may be define at a height above the base which is approximately at or slightly lower than the height of the ledge above the base.

30 A perforated plate may rest on the ledge and or internal walls, on which the geo-textile layer rests in use. The plate may define, typically cruciform perforations for drainage of water as well as apertures for the wicks to pass through. The part of the plate which covers the exits may be solid and unperforated and higher, in use, relative to the rest of the plate.

35 The exits/outlets may be in fluid communication with sockets defined on the underside of the tray for receiving spigots in fluid communication with a network of

pipes, thus allowing drainage of water to the network of pipes. The connection between the spigots and the sockets may be non-permanent allowing removal and replacement of trays.

5 Elongated recesses or tunnels may be defined on the underside of the tray for receiving pipes in use.

The means for interconnecting the trays may include an external flange extending round the upper part of the tray. The tray is typically generally square in plan. The flange may define a series of holes for receiving a pin for receiving a locking pin. The flanges on two adjacent sides of the tray may be at a slightly lower height  
10 than the two opposite sides so that one flange overlaps another when the trays are placed side by side in the correct orientation with a higher flange overlying a lower flange. When the flanges are correctly overlying, the holes are aligned and a locking pin may be used to fix the flanges together.

Thus in a second aspect of the present invention, there is provided green roof  
15 system for use on roofs or the like, including:-

an array of interconnected pipes arranged on a substrate such as a roof, the array defining a plurality of upwardly extending spigots; and

a plurality of trays or reservoirs for retaining water, the trays having a base and walls and wherein the base is configured to locate over and receive the pipes and  
20 defines a socket for connection with the spigot for transfer of fluid such as water from the tray to the array of pipes and wherein the trays are located side by side and interconnected.

The spigots may be defined by pipe joiners connecting lengths of pipe together. The joins between the pipes and pipe joiners may be covered in a flexible seal.

25 The sockets are preferably defined at one side of the tray.

Typically each tray defines two sockets and interconnects with two parallel pipes.

Each tray may define a flange for use in connecting the trays together.

The trays may be pre-planted with the desired vegetation in a nursery  
30 environment prior to installing on top of the pipe network to achieve instant greening of the rooftop. Alternatively, the trays may be planted in-situ and installed on top of the pipe network immediately.

The planters provide a number of advantages including immediate realisation of extensive greens roofs, reducing heat transmission, lowering ambient temperature and  
35 mitigating the heat island effect as well as improving air quality, aesthetics and reducing rainwater run off.

For in-situ planting, the ability to install individual trays on the pipe network only after each tray is planted also does away with the need to install the whole green roof system before planting commences. This prevents rainwater retention in empty pre-planted trays and green roof systems, and the consequent breeding of mosquitoes.

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### **Brief Description of the Drawings**

A specific embodiment of the present invention will now be described by way of example only and with reference to the accompanying drawings in which:-

Figure 1 is an isometric view of a planter embodying the present invention  
10 attached to pipes of a drainage system;

Figure 2 is an end view of the planter of Figure 1;

Figure 3 is a side view of the planter and pipe of Figure 1;

Figure 4 is an isometric view of the tray of the planter of Figure 1 showing some components removed to illustrate otherwise hidden features of the planter;

15 Figure 5 is a similar view to Figure 4 but including a mesh root guard;

Figure 6 is a similar view to Figure 5 but further including a geo-textile layer;

Figure 7 is a similar view to Figure 5 but further including a intersecting erosion guards;

Figure 8 is a view of the underside of the planter of Figure 4;

20 Figure 9 is a similar view to Figure 8 but further including pipe joiners;

Figure 10 is a similar view to Figure 9 but further including pipes and seals;

Figure 11 is an isometric view from the front and underside of the planter illustrating the pipe joiners in particular; and

Figure 12 is an isometric view of the mesh root guard only.

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### **Detailed Description of a Preferred Embodiment**

Referring to the drawings, Figures 1 to 3 illustrate a planter 10 embodying aspects of the present invention. The planter is shown attached to two pipes 12 of a pre-laid drainage system or grid into which the planter 10 may be plugged.

30 The planter comprises an open tray or reservoir 14 having a generally square contoured base 16, side walls 18, 20 and end walls 22, 24. An external flange 26 extends around the top of the side and end walls. The flange defines holes for receiving joining pegs 28, described in more detail below, for connecting adjacent planters to one another. The flange 26 is lower on two adjacent walls 26a and higher on the opposite  
35 two walls 26b and the higher part sits over the lower part of an adjacent tray when two trays are placed side by side. The planter also defines rodent barriers 30 which extend

from each corner at 135 degrees to each of the side/end walls. These act as a barrier to rodents passing between adjacent trays and infesting the spaces between the trays. The rodent barriers 30 snap fit between two elongate protrusions 31 defined at each corner of the tray (refer to Figure 4), and are optional features, as they are not required for all  
5 planters.

Figures 4 to 8 illustrate the planter in more detail omitting some components in order to show those components and features which are normally hidden in use.

Figure 4 shows the basic moulded tray 14 but also shows three continuous strips of geotextile 46 which define a series of linked depending wicks 47 and which are not  
10 part of the moulded tray and which, in use, are supported by a mesh plate not shown in Figure 4. As can best be seen in Figure 8, the base 16 defines two parallel spaced apart tunnels or recesses 33, 34 which extend from one end 22 of the tray 14 to the opposite end 24. Most of tunnel 33 is obscured by one of the strips of geotextile in Figure 4, however it is identical to tunnel 34. In use, as is described in more detail below, the  
15 recesses arch over and receive the pipes 12 of the drainage grid. At one end 24 of the tray there are two exit holes or outlets, 35, 36 through which water may flow into or out of the tray 14. The exit holes 35, 36 are at a height of just under half the height of the wall 24 and when the water level in the tray reaches that height the water flows out of the tray via the exit holes 35, 36.

20 A ledge 37 extends around the perimeter of the interior of the tray 14 at a height just above that of the exit holes 35, 36. The lower part of the tray below the ledge 37 is divided into a series of discrete cells by a series of four internal dividing walls 38 which extend from one side wall 18 to the other 20 and, four internal dividing walls 40 which extend from one end wall 22 to the other 24. The dividing walls 38 define small  
25 notches 42 over which water may flow from one cell to another. The small notches allow water to flow down the slope (from one end to the other) from one cell to the next, and the walls keep the level of water higher in each cell without making the growing medium waterlogged. All roofs, even "flat roofs" slope, if only gently, to allow drainage of water. If there were no side to side dividing walls 38 the water level  
30 would be much lower at the higher end of the tray and consequently the volume of water stored would be less. Also the water level would be further away from the growing medium which would make the wicks 47 less effective. The dividing walls 40 define generally deeper notches 44, except where the depth is constrained by the tunnels/recesses 33, 34. This allows water in the tray to flow more easily from one side  
35 to the other which reduces the number of wicks required, as the cells joined by the deeper notches effectively function as a single cell.

Figure 5 shows the tray of Figure 4 but including a mesh root guard or grid 48 in the form of a perforated plastic plate which is supported on the top of the dividing walls 38, 40 and ledge 37. The root guard 48 which is separately shown in Figure 12 defines an array of cruciform holes 50, as well as a number of elongate slits 52 through which the wicks 47 extend. The slits 52 define a number of opposed teeth 54. There are three rows of 52a, 52b, 52c of five parallel slits 52 spaced across the plate. In use, a long continuous strip of geotextile 46 is placed along each row of slits and a loop 47 of geotextile is pushed down into each slit 52 in turn using a suitable tool. The teeth flex and grip the wicks. the depending loops 47 form the wicks and in use wick water up from the reservoir.

The mesh root guard is solid and unperforated raised where the guard covers the outlets 32, 34 at 48a. Importantly the guard 48 substantially extends to the walls of the tray on all sides. This provides a solid barrier and an air gap between the planting medium above the guard and the outlets 32, 34 which inhibits roots from blocking and accessing the exits 35, 36.

Figure 6 shows the mesh guard 48 covered in a layer of geo-textile 60. This is typically a non-woven needle staple fibre ("SF") polyester geo-textile.

Figure 7 shows erosion guards in the form of three parallel spaced dividing walls 61 which extend from one side wall 18 to the other 20 and three spaced dividing walls 62 which extend from one end wall 22 to the other 24 and which divide the planter into sixteen generally square cells. The dividing walls define pegs 66 at their ends which mount in annular columns located adjacent the sides and end walls of the tray for attachment of the walls to the reservoir 14.

The erosion guards 61, 62 help prevent the planting material moving during transport of the tray and/or due to wind and other environmental effects when installed.

Figures 8 to 10 illustrate the underside of the tray and the attachment of the tray to pipes. The underside of the tray defines outlets 70 which are in fluid communication with the exit holes 35, 36. The outlets 70 define coaxial circular portions with an annular gap 71 between them which act as a socket for receiving a spigot of a pipe joiner.

Figure 9 illustrates a pipe joiner 72 attached to the sockets 60 on the underside of the tray. Each pipe joiner 72 defines two parallel short lengths of pipe 74 which in use connect to the pipes 12, linked by a connecting piece 75 which also defines an annular shroud 76a which receives a connector peg, in use. A spigot 76, not shown in Figure 9, but partly visible in Figure 11, extends up from each pipe 74 and locates in one of the sockets 71. Figures 10 and 11 illustrate pipes 12 attached to the pipe joiner

72 and watertight seals 78 extending around the joints between the pipe joiners 72 and the pipes 12.

When installing a green roof using the planting trays 10 the pipes 12 are first laid out on the roof linked together with pipe joiners 72 and seals. Each pipe joiner  
5 defines two upwardly extending spigots 76 which can be inserted into the sockets defined on the underside of the planters 10. The planters are then simply placed on top of the pipe joiners and plugged into the pipe network. The roof will typically have a small degree of slope to allow for drainage and when correctly positioned, the outlets of each tray are at the lowermost end of the tray and the pipes 12 follow the slope of the  
10 roof. The planters are then inter-engaged using the joining pegs 28 which provide reliable bayonet type connections. When two trays are placed side by side, the higher flange 26b is placed over the lower flange 26a of the adjacent tray and pegs are inserted into the aligned holes 27 and rotated through 90 degrees to lock the trays together. This also prevents the trays being incorrectly assembled and ensures the outlets are always  
15 on the same side of the trays. The interconnected trays 14 serve as a storage reservoir for water during wet periods which can be used by the plants in dry periods thus reducing the amount of watering/maintenance needed for the planters.

For high wind areas where there is a risk of typhoons a longer peg is used in the hole 27a between the exits and this connects the tray 14 to the pipe network which may  
20 be fixed to the roof by means of screws or bolts passing through holes in the pipe joiners. Rodent barriers 30 are typically used on the planters which form the perimeter of the installation to form an external barrier wall denying access to the interior of the installation to rodents.

One important advantage of the invention is that it is relatively easy to remove  
25 one tray from an array of trays without having to remove adjacent trays and dismantling any part of the drainage pipe network. Trays may be required to be removed from time to time for replacement, for example, if the plants in the tray are diseased or dying or for access to the roof below the trays for maintenance.

The use of wicks to provide water to the planting medium and the air gap  
30 provided over the outlets 35, 36 reduces the tendency for the roots of the plants to move to the lower part of the tray to seek water, potentially blocking the outlets. The wicks also keep the planting medium wetter than other systems where evaporation of water or direct access to the water by plant roots is the medium of transfer of water to the planting medium.

The planter may be moulded in any suitable material, particularly plastics materials, however to provide a lightweight robust planter, high-strength UV-stabilised polypropylene the preferred material. The total weight of the tray and components saturated planting media, maximum stored water and plants is less than 30kg.

- 5 It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

## CLAIMS:

1. A planting tray for use on roofs or the like, including a reservoir for retaining water, a structure supported above the reservoir and one or more wicks supported by the structure and depending into the reservoir for wicking water from the reservoir and including means for engaging and interlocking the tray with an adjacent tray.
2. A planting tray as claimed in claim 1 wherein the wicks include at least a first portion which depends into the reservoir and a second portion which extends on the structure perpendicular to the first portion.
3. A planting tray as claimed in claim 1 or claim 2 wherein the second portion is covered by a water permeable fabric layer, such as a geo-textile, and a layer of planting media.
4. A planting tray as claimed in any one of claims 1 to 3 wherein the reservoir is in the form of a tray having a base and side and end walls and a ledge extends around the internal perimeter of the reservoir which supports the structure.
5. A planting tray as claimed in claim 4 wherein the lower part of the reservoir is divided into cells by internal walls and wherein one or more reservoir outlets are defined at a height above the base, said height being approximately at or slightly lower than the height of the ledge above the base.
6. A planting tray as claimed in any one of claims 1 to 5 wherein the support structure includes a perforated plate which defines apertures for drainage of water and slots for the wick or wicks to pass through.
7. A planting tray as claimed in claim 6 wherein the slots define teeth for engaging with and gripping the wick.
8. A planting tray as claimed in claim 6 when dependent on claim 4 wherein the perforated plate is supported by the ledge and a part of the plate which is located above the exits defines a continuous unperforated surface which is higher, in use, relative to the rest of the perforated plate.

9. A planting tray as claimed in any one of claims 5 to 8 wherein the outlets are in fluid communication with sockets defined on the underside of the tray, the sockets being configured to receiving spigots in fluid communication with a network of pipes, thus allowing drainage of water to the network of pipes and wherein the connection  
5 between the spigots and the sockets is non-permanent allowing removal and replacement of trays.

10. A planting tray as claimed in claim 9 wherein elongate recesses are defined on the underside of the tray for receiving pipes in use.

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11. A planting tray as claimed in any one of claims 1 to 10 wherein the means for interconnecting the trays include an external flange extending round the upper part of the tray which defines a series of holes for receiving a locking pin.

12. A planting tray as claimed in claim 11 wherein the base of the tray is generally square and the tray has four sides and wherein the flanges on two adjacent sides of the tray are at a slightly lower height than the two other sides so that one flange overlaps another when the trays are placed side by side in the correct orientation with a higher flange overlying a lower flange.

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13. A green roof system for use on roofs or the like, including:-  
an array of interconnected pipes arranged on a substrate such as a roof, the array defining a plurality of upwardly extending spigots; and  
a plurality of trays or reservoirs for retaining water, the trays having a base and  
25 walls and wherein the base is configured to locate over and receive the pipes and defines a socket for connection with the spigot for transfer of fluid such as water from the tray to the array of pipes.

14. A green roof system as claimed in claim 13 wherein the spigots are defined by  
30 pipe joiners connecting lengths of pipe together.

15. A green roof system as claimed in claim 13 or 14 wherein there are at least two sockets which are both located on one side of the tray and interconnect with two parallel pipes.

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16. A green roof system as claimed in any one of claims 14 to 15 wherein the joins between the pipes and pipe joiners are covered in a flexible seal.

17. A green roof system as claimed in any one of claims 13 to 16 wherein each tray  
5 defines a flange for use in connecting the trays together.

18. A green roof system as claimed in claim 17 wherein the flange is lower on two adjacent sides and higher on the opposite two sides so that and the higher part sits over the lower part of an adjacent tray when two trays are placed side by side and wherein  
10 the higher and lower flanges define overlapping apertures for receiving a pin for locking the flanges together.