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A means for the generation of feed comprising a tray (17) comprising a base defining a substantially horizontal growth bed (41) surrounded by an upstanding side wall (19, 21, 23), a circulation means (25) connected to the tray for the delivery of an aqueous nutrient solution into the growth bed, wherein a portion of the side wall (23) is adapted to enable the plant material resulting from germination and growth of seed deposited onto the growth bed to be withdrawn from the tray over the portion of the side wall.
"Means and Method of Generating Feed"

Field of the Invention

This invention relates to a means and method of generating feed for livestock.

Background Art

The feed lotting of livestock is seen to provide an advantageous means of animal husbandry to ensure controlled and rapid growth of the livestock however, one of the difficulties of feed lotting relates to the significant costs that arise when compared to raising livestock by open grazing. One of the factors relating to the increased costs of feed lotting relates to the production and management of the feed which is provided to the livestock.

One proposed means of generating feed for livestock has comprised generation of feed using hydroponic systems whereby grass grain in the form of wheat, barley or the like is germinated and allowed to initially grow and provide grass which is then collected and fed to the livestock. The systems which have been proposed in the past have comprised growing the plant material in individual trays in a suitable environment and then removing the trays manually from their location in the environment and removing the plant material from the trays. Whilst the generation of fresh feed by utilisation of hydroponics can provide an advantage in relation to the nature of the feed which can be fed to livestock there is a significant cost factor in relation to the generation of such feed due to the extent of labour that is required in the production of the feed.

The preceding discussion of the background to the invention is intended only to facilitate an understanding of the present invention. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was part of the common general knowledge in Australia as at the priority date of the application.
Disclosure of the Invention

Accordingly the invention resides in a means for the generation of feed comprising a tray comprising a base defining a substantially horizontal growth bed surrounded by an upstanding side wall, a portion of the side wall is adapted to enable the plant material resulting from germination and growth of seed deposited onto the growth bed to be withdrawn from the tray over the portion of the side wall, a circulation means connected to the tray for the delivery of an aqueous nutrient solution into the growth bed, the circulation means having an inlet in the tray adapted to connect the interior of the tray to a source of nutrient solution, an outlet and a control means adapted to periodically admit a sufficient volume of the aqueous nutrient solution into the tray through the inlet to flood the growth bed and after a period of time to cause the aqueous nutrient solution to be drained from the growth bed through the outlet.

According to a preferred feature of the invention a plurality of trays are supported in vertically spaced relation above each other. According to a preferred feature of the invention the trays are supported on a rack. According to a preferred feature of the invention the rack is intended to be accommodated within an enclosure in which an environment is provided to promote germination and growth of plant material from the seed. According to one embodiment of the invention the rack is adapted to be movable from the enclosure to facilitate reseeding of the trays. According to one embodiment of the invention the rack is fixed and is associated with a conveyor having an outlet which is capable of being located above the tray and movable along the tray to facilitate reseeding of the trays.

According to a preferred feature of the invention the circulation means is adapted to periodically admit a sufficient volume of the aqueous nutrient solution to flood the growth bed to facilitate the growth of the plant material and after a period of time to cause the aqueous nutrient solution to be drained from the growth bed. According to a preferred feature of the invention the circulation means comprises an inlet provided in the tray, said inlet being adapted to be connected to a source
of aqueous nutrient solution. According to a preferred feature of the invention a reservoir is provided in the tray, said reservoir comprising a space separate from the growth bed, a flow path provided between the reservoir and the growth bed and said inlet opening into the reservoir. According to a preferred feature of the
the invention the upper level of the reservoir is substantially coplanar with the upper level of the growth bed.

According to a preferred feature of the invention wherein each tray has an elongate configuration wherein the side wall is provided by a pair of opposed side walls and a pair of opposed end walls and the portion comprises one end wall. According to a preferred feature of the invention the reservoir is located proximate the other end wall. According to a preferred feature of the invention a weir is provided adjacent each opposed side wall in spaced relation thereto and wherein the growth bed is defined between the weirs and the space between each weir and the most proximate side wall comprises the flow path.

According to a preferred feature of the invention the surface of the growth bed is inclined transversely. According to a preferred feature of the invention the growth bed is cambered transversely.

According to a preferred feature of the invention wherein the surface of the growth bed is substantially smooth.

According to a preferred feature of the invention wherein the portion of the side wall is formed at least in part as an upwardly and outwardly inclined lip.

According to a preferred feature of the invention no substrate is provided in the growth bed.

According to an alternative preferred feature of the invention a substrate is provided in the growth bed. According to an embodiment of the invention a substrate is provided in the tray to support the plant material in its germination and growth and wherein said substrate is able to be consumed by livestock without substantial injurious effects thereon.

Accordingly the invention also resides in a method of producing feed utilising a means as described above comprising introducing seed onto a growth bed provided by the tray, periodically introducing an aqueous nutrient solution to the
growth bed, providing an environment to promote germination and growth of the plants from the seed and extracting the resultant plant material from one side of the tray.

According to a preferred feature of the invention the introduction of the aqueous nutrient solution to the growth bed is effected by periodically flooding the growth bed from an inlet provided in the tray which is connected to a source of aqueous nutrient solution, said method further comprising draining the aqueous nutrient solution from the tray a period of time subsequent to each flooding.

According to a preferred feature of the invention the aqueous nutrient solution is introduced into the tray at a location separate from the growth bed.

According to a preferred feature of the invention the extraction of the plant material is effected by engaging the portion of the plant material in the vicinity of the one side and withdrawing the portion of the plant material with the balance of the plant material laterally from the tray. According to an alternative feature of the invention the extraction of the plant material is effected by engaging a platform like element between the base of the growth bed and the plant material and lifting the platform with the plant material from the tray.

According to a preferred feature of the invention the tray is rectangular and the one side comprises one end.

The invention will be more fully understood in the light of the following description of several specific embodiments.

Brief Description of the Drawings

The description is made with reference to the accompanying drawings, of which:

Figure 1 is a schematic side elevation of a means for generating feed according to the first embodiment;
Figure 2 is an end elevation of the first embodiment as shown in Figure 1 from the end remote from the circulation means;

Figure 3 is an end elevation of the first embodiment as shown in Figure 1 from the end proximate to the circulation means;

Figure 4 is a cross-sectional elevation of a tray according to the first embodiment;

Figure 5 is a part sectional side elevation of a tray according to the first embodiment; and

Figure 6 is a schematic partial side elevation of the first embodiment illustrating the removal of plant material from the lowermost tray.

**Description of Specific Embodiments**

The first embodiment as shown in the accompanying drawings relates to a means for generating feed by utilisation of a hydroponic growth system.

The arrangement according to the first embodiment utilises an enclosure (not shown) which is intended to provide an environment to promote hydroponic growth. The enclosure is adapted to accommodate a plurality of racks 11 of the form as shown in the accompanying drawings whereby the racks are supported in a side-by-side relationship on a suitable track system. The temperature and humidity within enclosure is controlled to promote plant growth and appropriate light sources are located between the racks. Each rack 11 is supported by a set of feet 13 which support the rack from the ground and each rack comprises a set of vertically spaced platforms 15. Each platform 15 supports a growth tray 17 which has a generally elongate rectangular form which is defined by a pair of opposed side walls 19 and a pair of opposed end walls 21 and 23. The end of the tray which is associated with the one end wall 21 is provided with a reservoir 25 which is provided with an inlet 29 for the introduction of an aqueous nutrient solution into the reservoir 25 and drain outlets 27 and 30. Each inlet is
associated with upstanding delivery conduit 35 which is supported from the side of the rack 11 and is provided at its lower end with a coupling 37 which enables connection of the delivery conduit to a delivery line 39. Similarly the drain 27 of each tray is connected to an upstanding drain conduit 28 supported from the side of the rack 11 which is provided at its lower end with a coupling 31 to enable the drain conduit to be connected to a drain 33. Each drain 30 of each tray is associated with delivery conduit 35.

The tray 17 defines between its side walls a growth bed 41 which is terminated at the one end of the tray by a barrier 43 which defines a side wall of the reservoir 25 and which is in opposed relation to the one end wall 21 of the tray. The barrier terminates short of each opposed side wall of the tray to provide a space between each end of the barrier and the respective side wall of the tray. The growth bed 41 is terminated at its other end by the other end wall 23 which is formed as an upwardly and outwardly inclined lip. In addition the interior of the tray is provided with a weir 45 located parallel and adjacent to each side wall 19 to extend from the respective end of the barrier 41. The growth bed 41 is further defined between the weirs 45. The space between each of the weirs 45 and the respective side wall 19 opens into the reservoir 25. The surface of the growth bed 41 is cambered transversely such as to provide a substantial upwardly convex surface between the weirs 45 and otherwise the surface of the growth bed is substantially smooth.

No support substrate is provided in the growth bed.

Within the reservoir 25 the inlet of one drain outlet 27 of each tray is located at a position spaced above the germination bed a distance corresponding to the desired depth of the nutrient solution in the growth bed under growth conditions whilst the inlet to the other drain outlet 30 of each tray is located at a level below that of the growth bed 41. Each of the other drain outlets 30 is controlled by a one-way control valve.

In use, the apparatus of the first embodiment is used for the growth of feed. This is initiated by the introduction of a layer of seed onto the growth bed 41 of each
of the trays 17. This can be affected whilst the rack is out of the enclosure in which growth is to take place. On the completion of the filling of each of the growth beds with the desired amount of seed, the rack 11 is then reinstalled in position within the enclosure.

Once the rack is in position and the delivery conduit 35 is connected to the delivery line 39 and the drain conduit 28 is connected to the drain 33 a nutrient solution is then introduced into each of the reservoirs 25 through the inlet 29. The one-way control valve of each of the other drain outlets 30 is closed by the pressure within delivery conduit carrying the nutrient solution which allows each of the reservoirs to be filled to the level of the inlet of the one drain outlet 27. As a result the growth bed 41 is flooded in order to saturate the seeds accommodated in the growth bed. After a period of time, the supply of nutrient solution to the delivery line 39 is stopped. As a result the one-way control valve at each of the other drain outlets is opened due to the absence of pressure in the delivery conduit whereby the nutrient solution in each of the reservoirs is drained from the growth bed 41 through the one-way control valve provided with each of the other drain outlets 30 and into the delivery conduit 35 and delivery line 39. This action is repeated periodically and consequently the growth bed is periodically flooded and drained and the frequency of the cycles of flooding and draining can be varied according to the parameters of the environment provided within the enclosure to maximise the germination and growth of plant material from the seeds contained by the growth bed.

On the plant material having reached the desired maturity, the plant material is extracted from each of the trays across the other end wall 23. This can be effected by locating a platform under the other end wall pulling the end of the mass of plant material located adjacent the second end 23 across and over the end wall 23 onto the platform which is then withdrawn and as a result of the matting of the root systems of each plant with its neighbours and other plants in the vicinity the remainder of the plant material will move with the platform at material. This movement is enhanced by the smooth nature of the growth bed. The resultant plant material is then deposited into a suitable conveyor or
conveyancing means for use as feed for livestock. An alternative method of removal can comprise location of a platform having the configuration of a laminar member, under within the tray between the growth bed and the plant material and removing the platform from the tray.

The trays on the rack are then reseeded. The introduction of seed into the growth bed for each growing program can be effected manually or through mechanical delivery means for controllably delivering seed into the growth bed.

The first embodiment provides a means of generating feed for livestock which has the advantages of hydroponic systems and which reduces the degree of labour involved in the production of such feed when compared to other forms of hydroponic generation of feed.

According to a second embodiment of the invention a substrate is used in the growth bed to support the plant material during its germination and growth whereby that substrate is removed with the plant material on its removal from the trays. The substrate is of a form such that it can be consumed and digested by livestock without any significant deleterious effects.

Throughout the specification, unless the context requires otherwise, the word “comprise” or variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

It should be appreciated that the scope of the present invention need not be limited to the particular scope of the embodiment described above. In particular the invention need not be limited to the particular form of hydroponic system as described in relation to the embodiment for the delivery of nutrient solution to the plants.
Claims

The claims defining the invention are as follows:

1. (amended) A means for the generation of feed comprising a tray comprising a base defining a substantially horizontal growth bed surrounded by an upstanding side wall, a portion of the side wall is adapted to enable the plant material resulting from germination and growth of seed deposited onto the growth bed to be withdrawn from the tray over the portion of the side wall, a circulation means connected to the tray for the delivery of an aqueous nutrient solution into the growth bed, the circulation means having an inlet in the tray adapted to connect the interior of the tray to a source of nutrient solution, an outlet and a control means adapted to periodically admit a sufficient volume of the aqueous nutrient solution into the tray through the inlet to flood the growth bed and after a period of time to cause the aqueous nutrient solution to be drained from the growth bed through the outlet.

2. A means for the generation of feed as claimed at claim 1 wherein, a plurality of trays are supported in vertically spaced relation above each other.

3. A means for the generation of feed as claimed at claim 2 wherein the trays are supported on a rack.

4. A means for the generation of feed as claimed at claim 3 wherein the rack is intended to be accommodated within an enclosure in which an environment is provided to promote germination and growth of plant material from the seed.

5. A means for the generation of feed as claimed at claim 4 wherein the rack is adapted to be movable from the enclosure to facilitate reseeding of the trays.
6. A means for the generation of feed as claimed at claim 4 wherein the rack is fixed.

7. A means for the generation of feed as claimed at claim 5 or 6 wherein the rack is associated with a conveyor having an outlet which is capable of being located above the tray and movable along the tray to facilitate reseeding of the trays.

8. (cancelled)

9. (cancelled)

10. (amended) A means for the generation of feed as claimed at any one of the preceding claims wherein a reservoir is provided in the tray, said reservoir comprising a space separate from the growth bed, a flow path provided between the reservoir and the growth bed and said inlet opening into the reservoir.

11. (amended) A means for the generation of feed as claimed at claim 10 wherein the drain is provided in the reservoir.

12. A means for the generation of feed as claimed at claim 10 or 11 wherein the upper level of the reservoir is substantially coplanar with the upper level of the growth bed.

13. (amended) A means for the generation of feed as claimed at any one of the preceding claims wherein each tray has an elongate configuration wherein the side wall is provided by a pair of opposed side walls and a pair of opposed end walls.

14. (amended) A means for the generation of feed as claimed at claim 13 as dependant from any one of claims 10 to 12 wherein the reservoir is located proximate one end wall.
15. A means for the generation of feed as claimed at claim 14 wherein a weir is provided adjacent each opposed side wall in spaced relation thereto and wherein the growth bed is defined between the weirs and the space between each weir and the most proximate side wall comprises the flow path.

16. A means for the generation of feed as claimed at any one of the preceding claims the surface of the growth bed is inclined transversely.

17. A means for the generation of feed as claimed at claim 16 wherein the growth bed is cambered transversely.

18. A means for the generation of feed as claimed at any one of the preceding claims wherein the surface of the growth bed is substantially smooth.

19. A means for the generation of feed as claimed at any one of the preceding claims wherein the portion of the side wall is formed at least in part as an upwardly and outwardly inclined lip.

20. A means for the generation of feed as claimed at any one of the preceding claims wherein no substrate is provided in the growth bed.

21. A means for the generation of feed as claimed at any one of claims 1 to 19 wherein a substrate is provided in the growth bed.

22. A means for the generation of feed as claimed at any one of claims 1 to 19 wherein a substrate is provided in the tray to support the plant material in its germination and growth and wherein said substrate is able to be consumed by livestock without substantial injurious effects thereon.

23. A means for the generation of feed substantially as herein described.
24. A method of producing feed utilising a means as claimed at any one of the preceding claims comprising introducing seed onto a growth bed provided by the tray, periodically introducing an aqueous nutrient solution to the growth bed, providing an environment to promote germination and growth of the plants from the seed and extracting the resultant plant material from one side of the tray.

25. A method of producing feed as claimed at claim 24 wherein the introduction of the aqueous nutrient solution to the growth bed is effected by periodically flooding the growth bed from an inlet provided in the tray which is connected to a source of aqueous nutrient solution, said method further comprising draining the aqueous nutrient solution from the tray a period of time subsequent to each flooding.

26. A method of producing feed as claimed at claim 24 or 25 wherein the aqueous nutrient solution is introduced into the tray at a location separate from the growth bed.

27. A method of producing feed as claimed at claim 24 or 25 or 26 wherein the extraction of the plant material is effected by engaging the portion of the plant material in the vicinity of the one side and withdrawing the portion of the plant material with the balance of the plant material laterally from the tray.

28. A method of producing feed as claimed at claim 24 or 25 or 26 wherein the extraction of the plant material is effected by engaging a platform like element between the base of the growth bed and the plant material and lifting the platform with the plant material from the tray.

29. A method of producing feed as claimed at claim 24 or 25 or 26 or 27 or 28 wherein the tray is rectangular and the one side comprises one end.

30. (cancelled)
31. (amended) A means for the generation of feed as claimed at any one of claims 1 to 29 wherein the portion comprises one end wall.

32. (new) A method of producing feed substantially as herein described.