

MULTI-LEVEL CONCURRENT DISPENSING SYSTEM

Field of the Invention

This invention relates to a system and method of growing larvae and pupae in a consistent manner. More particularly, this invention relates to a system and method of high volume feeding of larvae and pupae in a consistent manner.

Prior Art

The mosquito life cycle consists of the eggs, larvae, pupae, before final emerging as an adult mosquito. A large numbers of eggs, in the hundreds of thousands, are laid and collected. These eggs are counted and separated into different trays to await hatching into larvae. In the whole process of rearing mosquitoes, an important consideration is to maintain the consistency in the growth of the larvae and pupae. This is mainly because the key means of separation between the male and female species is attributed to this phase which is the size difference between the sexes, with the female being of a large size. Achieving a clear distinction in size between the sexes will allow very good separation being achieved. If the consistency in growth is not met, a large overlap in sizes will occur between the male and female larvae and pupae, resulting in contamination when sorting the sexes by sizes.

The variation in growth of the larvae can be a result of several factors. Subtle variation in temperature during their growth is one of them. In order to save space, the trays containing the larvae are often stacked vertically, typically at 10-50 trays per rack. Temperature variation can occur due to the height difference between the top trays to the bottom trays, resulting in different growth rates. Another factor can be uneven feeding of the larvae. Sizes of the trays can range between 0.3 – 2 m. Dispensing of the food to the larvae evenly becomes an important consideration in ensuring all the larvae in each tray is

fed as equally as possible. Several methods of feeding include capsules and spraying feed into the trays. A capsule is a concentrated feed that dissolves and spreads over the water in each tray, feeding the larvae in the tray. It is then understandable that the larvae furthest from the capsules may not be able to feed well, thus resulting in slower growth rates.

5 Another way of feeding is to spray feed into the trays through a nozzle, thus distributing the feed over the tray's water surface better. Current methods however still require a person to spray each tray individually. At the same time, the volume of feed sprayed into each tray may not be consistent.

Therefore, those skilled in the art are striving to provide an improved system and
10 method of growing larvae and pupae in a consistent manner.

Summary of the Invention

The above and other problems are solved and an advance in the art is made by a system and method in accordance with this disclosure. A first advantage of a system and
15 method in accordance with this disclosure is that the system and method allows feeding high volumes of larvae and pupae in a controlled manner so that the larvae and pupae are fed in a consistent manner. A second advantage of a system and method in accordance with this disclosure is that the system and method increases the throughput of the process of rearing insect such as mosquitoes using the smallest footprint.

20 A first aspect of the disclosure describes a feeding system specifically for dispensing feed to a plurality of trays in a rack. The feeding system comprises a base unit adapted to be movable and having an upright; and a dispensing unit having a dispensing arm with an inlet, dispensing nozzles and a fluid path defined within the dispensing arm and running from the inlet to the dispensing nozzles and a flow controller provided to
25 regulate a flow of feed flowing through the fluid path, wherein the dispensing arm is adapted to be coupled to the upright of the base unit.

In accordance with an embodiment of the first aspect of the disclosure, the base unit further comprises: a movable platform and wheels provided on a bottom surface of the movable platform, wherein the upright extends from a top surface of the movable platform.

5 In accordance with an embodiment of the first aspect of the disclosure, the dispensing arm is movably mounted to the upright.

In accordance with an embodiment of the first aspect of the disclosure, the feeding system further comprises a feed mixing container having a stirrer to stir the feed.

10 In accordance with an embodiment of the first aspect of the disclosure, the feeding system further comprises a number of dispensing units, each dispensing unit is movably mounted to the upright to allow adjustment of the dispensing arm to accommodate the different spacing between the trays on the rack.

15 In accordance with an embodiment of the first aspect of the disclosure, the feeding system further comprising a feed mixing container having a stirrer, wherein the feed mixing container is provided on the movable platform and the inlet of each dispensing unit is connected to a connecting pipe. In accordance with an embodiment of this embodiment the feeding system further comprises a number the connecting pipes, each connecting pipe is fluidly connected to the inlet of one of the plurality of dispensing unit.

20 In accordance with an embodiment of the first aspect of the disclosure, the feeding system further comprises a feed mixing container having a stirrer, wherein the feed mixing container is provided above the top most dispensing unit and the inlet of each dispensing unit is connected to a connecting pipe. In accordance with an embodiment of this embodiment, the feeding system further comprises a number of the connecting pipes, each connecting pipe is fluidly connected to the inlet of one of the plurality of dispensing unit.

25 In accordance with an embodiment of the first aspect of the disclosure, the feeding system further comprises a number of feed mixing containers, each feed mixing container

having a stirrer and each of the plurality of feed mixing containers is fluidly connected to the inlet of one of the plurality of dispensing unit.

In accordance with an embodiment of the first aspect of the disclosure, the upright includes a track to allow moving of the dispensing arm along a length of the upright.

5 In accordance with an embodiment of the first aspect of the disclosure, the flow controller is an adjustable valve to regulate the flow of feed.

In accordance with an embodiment of the first aspect of the disclosure, the feeding system further comprises a processing unit communicatively connected to the flow controller to control the flow of feed and to document an amount of feed being fed to the
10 relevant trays.

In accordance with an embodiment of the first aspect of the disclosure, the feeding system further comprises a processing unit communicatively connected to the stirrer to adjust a speed of the stirrer.

In accordance with an embodiment of the first aspect of the disclosure, the flow
15 controller has an angled path such that the feeds are guided to the fluid path in the dispensing arm such that only one solid feed is inserted into the fluid path and the dispensing unit further comprises a pushing bar and a dispensing actuator configured to actuate the pushing bar to push the solid feed inside the fluid path towards the dispensing nozzle until the feed falls out from the dispensing nozzle and into the tray.

20 A second aspect of the disclosure describes a dispensing system specifically for dispensing items such as feed, larvae, pupae, eggs and water to a plurality of trays in a rack. The dispensing system comprises: a base unit adapted to be movable and having an upright; and a plurality of the dispensing units, each dispensing unit having a dispensing arm with an inlet, dispensing nozzles and a fluid path defined within the dispensing arm
25 and running from the inlet to the dispensing nozzles and a flow controller provided to regulate a flow of feed flowing through the fluid path, wherein each dispensing unit is

movably mounted to the upright to allow adjustment of the dispensing arm to accommodate the different spacing between the trays on the rack to allow simultaneous dispensing of items into the trays.

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Brief Description of the Drawings

The above and other features and advantages in accordance with this invention are described in the following detailed description and are shown in the following drawings:

Figure 1 illustrating a first embodiment of a feeder system in accordance with this disclosure;

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Figure 2 illustrating a second embodiment of a feeder system in accordance with this disclosure;

Figure 3 illustrating the feed system of the second embodiment with mixing containers in accordance with this disclosure;

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Figure 4 illustrating a third embodiment of a feeder system in accordance with this disclosure;

Figure 5 illustrating the feed system of the second embodiment with one mixing container in a first configuration in accordance with this disclosure;

Figure 6 illustrating the feed system of the second embodiment with one mixing container in a second configuration in accordance with this disclosure;

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Figure 7 illustrating the feed system of the second embodiment with one mixing container in a third configuration in accordance with this disclosure;

Figure 8 illustrating the feed system of the second embodiment with one mixing container in a fourth configuration in accordance with this disclosure; and

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Figure 9 illustrating a block diagram of a system controlling the feeding system in accordance with an embodiment of this disclosure.

Detailed Description

This invention relates to a system and method of growing larvae and pupae in a consistent manner. More particularly, this invention relates to a system and method of high volume feeding of larvae and pupae in a consistent manner.

5 It is envisioned that a system and method in accordance with embodiments of this disclosure aims to increasing the throughput of the process of rearing insect such as mosquitoes using the smallest footprint. Increasing the number of trays 190 per rack 180 helps in reducing the space footprint in rearing the mosquitoes. At the same time, it is also desirable to put as many larvae into each tray as possible. For example, for one million
10 larvae capacity, if each tray is allowed to contain 10,000 larvae, a hundred trays will be needed. If each rack has capacity of 10 trays, 10 racks will be needed. However, if each tray can put 50,000 larvae, and each rack is allowed 20 trays, a single rack space is sufficient. Considering that a large quantity of mosquitoes is needed to be bred, saving the amount of space is an important consideration. Therefore, there is tremendous desire to
15 put as many larvae into one tray and stack as many trays into a single rack as possible. Both of these actions lead to increased difficulty in maintaining consistent growth rates for all the larvae.

At higher volumes of larvae rearing, in the tens of millions, multiple racks still have to be used. Manually dispensing feed into each of the trays one by one is a labour-intensive
20 process. Without some means of double-checking the feeding process, human errors can still occur, resulting in different dispensing amounts or maybe even accidentally missing feeding a few trays altogether. Hence, it is desirable to provide an improved feeding system and method for feeding high volumes of larvae and pupae in a controlled manner so that the larvae and pupae are fed in a consistent manner.

25 A semi-automatic larvae and/or pupae feeding system is intended to resolve all the issues highlighted above. Multiple dispensing arms extend out from the feeding system,

one for each tray. The height of each dispensing arm is configurable to accommodate the different spacing between the trays. At the end of each arm, consists of multiple nozzle ends and piping lines. Details of the feeding system and method will be described as follows.

Figure 1 shows a first embodiment of a feeding system 100 in accordance with this disclosure. The feeding system 100 includes a base unit 110 and a dispensing unit 120.

The base unit 110 includes a movable platform 111, wheels 112 provided on a bottom surface of the movable platform 111, and an upright 113 extending from a top surface of the movable platform 111.

The dispensing unit 120 includes a flow controller 122 and a dispensing arm 123 having an inlet 121 and dispensing nozzles 124. A fluid path is defined within the dispensing arm 123 and running from the inlet 121 to the dispensing nozzles 124. The feed is inserted to the inlet 121 and dispensed via the dispensing nozzles 124 onto the tray 190.

The dispensing arm 123 is movably mounted to the upright 113. This allows the dispensing arm 123 to be secured at various heights along the upright 113 to accommodate the different spacing between the trays 190 on the rack 180. The dispensing arm 123 may be mounted on the upright via securing means such as screws or bolt and nuts. The upright 113 may include a track to allow moving of the dispensing arm 123 along the length of the upright.

The dispensing arm 123 has a fluid path to allow fluid to flow between the inlet 121 and the dispensing nozzles 124. A flow controller 122 is provided on the dispensing arm 123 and between the inlet 121 and the dispensing nozzles 124 to regulate flow of the feed from the inlet 121 to the dispensing nozzles. The flow controller 122 may be an adjustable valve to regulate the flow of the feed.

The feeding system 100 allows a central feed mixing container 140 to maintain a consistent density throughout the feeding process. This helps to maintain the density of the feed as the amount within the container changes as the feed is dispensed. One only has

to push the feeding system 100 into the larvae rearing racks 180. The dispensing arm 123 from the feeding system 100 slots into gaps within the racks 180, one above each tray 190. A user can dispense feeds to all the trays in the rack one after another by adjusting the dispensing arm 123 along the upright 113. Alternatively, multiple dispensing units 120 may be provided as shown in figure 2 where the dispensing units 120 are evenly distributed along the upright 113. Similarly, the dispensing arm 123 of each dispensing unit 120 is movably mounted to the upright 113 to allow adjustment of the dispensing arm 123 to accommodate the different spacing between the trays 190 on the rack 180. In this embodiment, a user can dispense feeds to all the trays in the rack simultaneously.

In figure 2, the rack 180 and trays 190 are omitted for brevity. Further, the rack 180 and trays 190 in figure 1 illustrate only one possible configuration of the rack 180 and trays 190 which is not meant to be exhaustive. Other rack 180 and trays 190 configurations may be provided without departing from this disclosure.

Figure 3 illustrates the second embodiment of the feed system 100 with mixing containers 140. The mixing containers 140 are fluidly connected to the inlet 121 of the dispensing units 120. The mixing containers 140 is arranged above the inlet 121 such that feeds flows from mixing containers 140 to the inlet 121 of the dispensing units 120. The feed flows from the mixing containers 140 to respective dispensing arms 123 and dispense from the dispensing nozzles 124. The feed is dispensed evenly throughout each tray by regulating the flow controller 122. Once dispensed, the feeding system 100 can be pushed out of the rack and push into another rack. This then allows a fast, efficient and consistent feeding system.

The mixing container 140 includes a stirrer 141 and feed 143. The feed 143 may be liquid solution or a mixture of liquid with solid. The stirrer 141 is provided at the bottom of the mixing container 140 to stir the feed in a controlled manner to maintain a consistent density throughout the feeding process.

Figure 4 illustrates a third embodiment of a feeding system 100 configured for feeding solid feed 490. The flow controller 122 in accordance with this embodiment has an angled path such that the solid feeds 490 are guided to the fluid path in the dispensing arm 123 such that only one solid feed 490 is inserted into the fluid path. The pushing bar 410 is actuated by a dispensing actuator 420. Specifically, the dispensing actuator 420 will actuate the pushing bar 410 in the direction shown by arrow 411 to push the solid feed 490 inside the fluid path towards the dispensing nozzle 124 until the solid feed 490 falls out from the dispensing nozzle 124 and into the tray 190.

Figure 5 illustrates the feed system 100 of the second embodiment with one mixing container in a first configuration in accordance with this disclosure. Accordingly, a central feed mixing container 140 is provided on the movable platform 111 to maintain a consistent density of feed throughout the feeding process. In this feeding system 100, the inlet 121 of each dispensing unit 120 is connected to respective connecting pipes 510. Specifically, a connecting pipe 510 is fluidly connected to one inlet of a dispensing unit. This means that the number of connecting pipe 510 corresponds to the number of dispensing units 120.

Figure 6 illustrates the feed system 100 of the second embodiment with one mixing container in a second configuration in accordance with this disclosure. Similar to the feeding system 100 in the first configuration, a central feed mixing container 140 is provided on the movable platform 111 to maintain a consistent density of feed throughout the feeding process. However, in this feeding system 100, only one connecting pipe 510 is provided to fluidly connect the inlets 121 to each dispensing unit 120.

Figure 7 illustrates the feed system 100 of the second embodiment with one mixing container in a third configuration in accordance with this disclosure. Accordingly, a central feed mixing container 140 is provided above the upper dispensing unit 120 to maintain a consistent density of feed throughout the feeding process. In this feeding system 100, the inlet 121 of each dispensing unit 120 is connected to respective connecting pipes 510.

Specifically, a connecting pipe 510 is fluidly connected to one inlet of a dispensing unit. This means that the number of connecting pipe 510 corresponds to the number of dispensing units 120. Further, in this configuration, a pump is not required to drive the feed to the inlet 121 of each dispensing unit 120 as the feed are directed to the inlet 121 based on gravitational force and the flow is adjustable by the flow controller.

Figure 8 the feed system 100 of the second embodiment with one mixing container in a fourth configuration in accordance with this disclosure. Similar to the feeding system 100 in the third configuration, a central feed mixing container 140 is provided above the upper dispensing unit 120 to maintain a consistent density of feed throughout the feeding process. In this feeding system 100, only one connecting pipe 510 is provided that is fluidly connected to the inlets 121 of each dispensing unit 120.

The feeding system 100 allows a central feed mixing container to maintain a consistent density throughout the feeding process. This helps to maintain the density of the feed as the amount within the container changes as the feed is dispensed. One only has to push the feeding system into the larvae rearing racks where the dispensing arms from the feeding system slots into gaps within the racks, one above each tray. A user can dispense feeds to all the trays in the rack simultaneously. The feed flows from the central mixing container to each of the dispensing arms and out of the nozzle. The feed is then dispensed evenly throughout each tray. Once dispensed, the feeding system can be pushed out of the rack and push into another rack. This allows a fast, efficient and consistent feeding system.

The feed is poured into a mixing container 140 that is consistently mixed to ensure the even density of the feed throughout the feeding process. In order to maintain consistent flow rates throughout the feeding process, the feed flow of each dispensing unit 120 is separately controlled, either pump or flow controller 122.

In another embodiment, two mixing containers 140 may be provided, one provided on the movable platform 111 and another above the upper dispensing unit 120. This is suitable where the racks are tall and having two mixing containers 140 in this configuration would allow the feed to be directed to the trays more efficiently. Further, this allow different stages of the larvae and pupae to be reared in the same rack. This also allows segregating of different batches of larvae of pupae in the same rack and monitoring the batches according to the feed. Specifically, different stages of the larvae and pupae may require different types of feed and having two mixing containers provide the flexibility to rear different stages of the larvae and pupae in the same rack. For example, trays in the upper half of the rack are for larvae while the trays in the lower half of the rack are for pupae.

The flow controller 122 or pump, track of the upright 113, stirrer 141 may be communicatively connected to a processing unit 900. This allows a user to easily control the feeding system 100 and to document the amount of feeds being fed to the relevant trays. Figure 9 illustrates the block diagram of the processing unit 900. The processing unit 900 can receive and transmit data, execute software applications. The processing unit 900 comprises a processor 910, memory 920, transceiver 930, and input/output ports 940.

The processor 910 is a processor, microprocessor, microcontroller, application specific integrated circuit, digital signal processor (DSP), programmable logic circuit, or other data processing device that executes instructions to perform the processes in accordance with the present invention. The processor 910 has the capability to execute various applications that are stored in the memory 920.

The memory 920 may include read-only memory (ROM), random-access memory (RAM), electrically erasable programmable ROM (EEPROM), flash cards, or any memory commonly used for computers. The memory 920 stores instructions which are executable by the processor 910 to perform processes in accordance with the method and system of this disclosure.

Transceiver 930 connects processor 910 to a network for transmission of data to and from other processing systems such as a mobile device, tablet or computer that allows a user to communicate with the processing unit 900. Transceiver 930 has long range wireless communication capability such as 3G/4G/5G telecommunication network protocols and/or short and/or medium range wireless capability such as Wireless Fidelity (Wi-Fi), Bluetooth, infrared, Zigbee, etc.

One or more input/output (I/O) ports 940 can be configured to allow the processor 910 to communicate with and control from various I/O devices. Peripheral devices that may be connected to processing unit 900 via the I/O ports 940 include the flow controller 122, stirrer 141, track 960 of the upright, pump 950, a display, keypad, a USB storage device, an SD card or other storage device for transmitting information to or receiving information from the processing unit 900. In addition to updating applications stored on memory 920 or installing new applications onto the memory via the transceiver 930, a user may alternatively install new applications or update applications on the memory 920 through a user interface such as a USB via the I/O ports 940.

One skilled in the art will recognize that other features may be included in the processing unit 900. Further, the components in processing unit 900 may be replaced by other components that perform similar functions. In brief, the processing unit 900 as shown in figure 9 is considered merely illustrative and non-limiting.

The processing unit 900 is communicatively connected to a mobile device such as a tablet to allow a user to control the processing unit 900. The user is able to adjust the height of the dispensing arm by instructing the processing unit 900 to control the track of the upright. In this configuration, the dispensing arms 123 are evenly distributed and secured along the track. The speed of the stirrer 141 can be controlled via the processing unit 900. The flow of the feed can be controlled via the processing unit 900 by adjusting the flow controller 122 or the pump 950 provided in the mixing container. In this manner, the data such as amount of feed can be stored in a database for future reference.

One skilled in the art will recognise that the feed system 100 may be use to dispense items other than feed 143. For example, larvae, pupae, eggs and water may be dispensed

to the trays using the feed system 100. Generally, the feed system 100 may be a dispensing system for dispensing items such as feed 143, larvae, pupae, eggs and water to multiple trays in a rack. This helps to simultaneously dispense the required amount of items to multiple trays in a rack for growing insects such as mosquitoes.

- 5 The above is a description of exemplary embodiments of a system and method of feeding inserts in accordance with this disclosure. It is foreseeable that those skilled in the art can and will design alternative systems based on this disclosure that infringe upon this invention as set forth in the following claims.

Claims:

1. A feeding system for dispensing a feed to a plurality of trays provided one above another in a rack with a space above each of the plurality of trays, the dispensing system comprising:
 - 5 a base unit adapted to be movable and having an upright; and
 - a dispensing unit having a dispensing arm with an inlet, a plurality of dispensing nozzles and a fluid path defined within the dispensing arm and running from the inlet to the plurality of dispensing nozzles and a flow controller provided to regulate a flow of the feed flowing through the fluid path,
 - 10 wherein the dispensing arm is adapted to be coupled to the upright of the base unit such that plurality of dispensing nozzles is positionable within the space above one of the plurality of trays to evenly distribute the feed throughout the one of the plurality of trays that is under the plurality of dispensing nozzles.
- 15 2. The feeding system according to claim 1 wherein the base unit further comprises:
 - a movable platform and wheels provided on a bottom surface of the movable platform,
 - wherein the upright extends from a top surface of the movable platform.
3. The feeding system according to claim 2 wherein the dispensing arm is movably
20 mounted to the upright.
4. The feeding system according to claim 2 further comprising:
 - a feed mixing container fluidly connected to the inlet, the feed mixing container having a stirrer.
- 25 5. The feeding system according to claim 2 further comprising:
 - a plurality of the dispensing units, each dispensing unit is movably mounted to the upright to allow adjustment of the dispensing arm to accommodate the spacings between the plurality of trays on the rack.

6. The feeding system according to claim 5 further comprising a feed mixing container having a stirrer, wherein the feed mixing container is provided on the movable platform and the inlet of each dispensing unit is connected to a connecting pipe that fluidly connects the plurality of dispensing units to the feed mixing container.

7. The feeding system according to claim 6 further comprising a plurality of the connecting pipes, each connecting pipe fluidly connects the inlet of one of the plurality of dispensing unit to the feed mixing container.

8. The feeding system according to claim 5 further comprising a feed mixing container having a stirrer, wherein the feed mixing container is provided above a top most of the plurality of dispensing units and the inlet of each dispensing unit is connected to a connecting pipe that fluidly connects the dispensing unit to the feed mixing container.

9. The feeding system according to claim 8 further comprising a plurality of the connecting pipes, each connecting pipe fluidly connects the inlet of one of the plurality of dispensing unit to the feed mixing container.

10. The feeding system according to claim 5 further comprising a plurality of feed mixing containers, each feed mixing container having a stirrer and each of the plurality of feed mixing containers is fluidly connected to the inlet of one of the plurality of dispensing unit.

11. The feeding system according to claim 1 wherein the upright includes a track to allow moving of the dispensing arm along a length of the upright.

12. The feeding system according to claim 1 wherein the flow controller is an adjustable valve to regulate the flow of feed.

13. The feeding system according to any one of claims 1-12 further comprising:
a processing unit communicatively connected to the flow controller to control the flow of feed and to document an amount of feed being fed to the relevant trays.
- 5 14. The feeding system according to any one of claims 4 and 6-10 further comprising:
a processing unit communicatively connected to the stirrer to adjust a speed of the stirrer.
- 10 15. The feeding system of any one of claims 5 to 10, wherein the plurality of dispensing units is adapted to dispense the feed to the plurality of trays simultaneously.
16. Use of the feeding system of any one of claim 1 to 14 in dispensing food, larvae, pupae, eggs or water to the plurality of trays.
- 15 17. Use of the feeding system of any one of the preceding claims in rearing insects.
18. The use of claim 17, wherein the insects comprise mosquitoes.