PIEGE A LARVES ANTI-MOUSTIQUES AQUALAB

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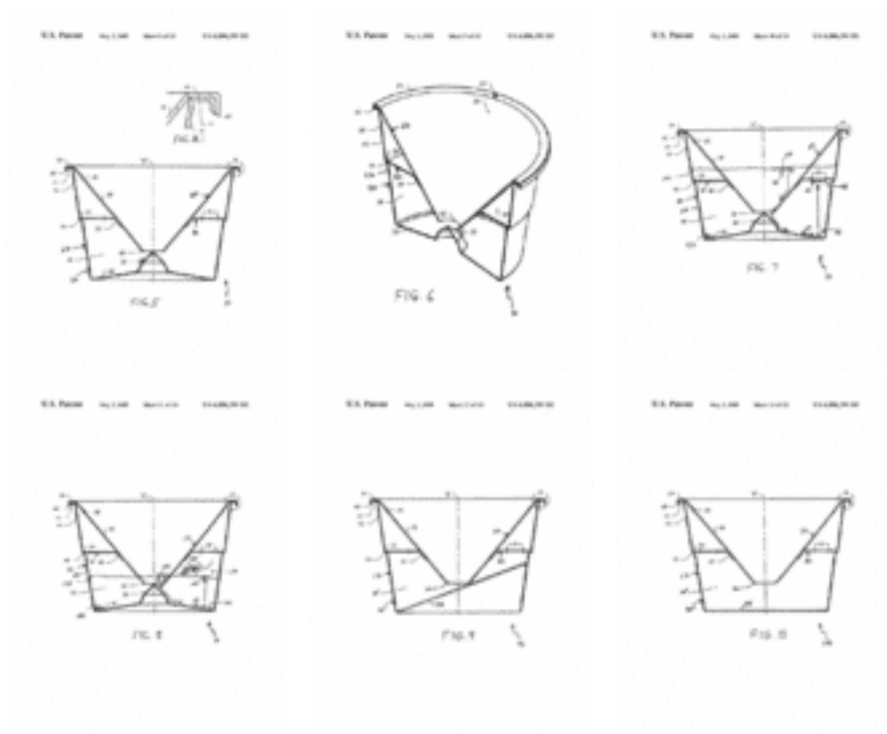
I. FICHE TECHNIQUE PIEGE A LARVES ANTI-MOUSTIQUES AQUALAB BREVETS
1 : PATENT 6886293: PAGES2-18

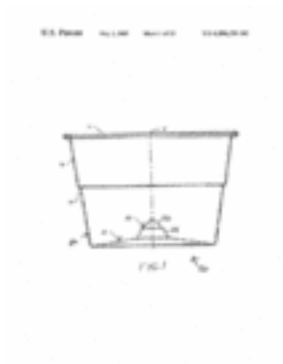
United States Patent	**6,886,293**
Forehand	**May 3, 2005**

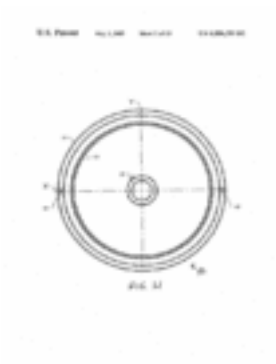
Method and apparatus for killing insects by trapping larvae

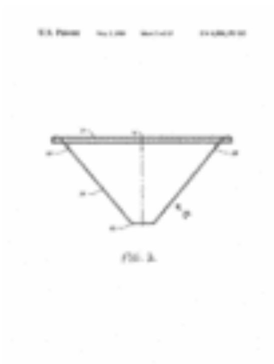
6886293 **Method and apparatus for killing insects by trapping larvae**

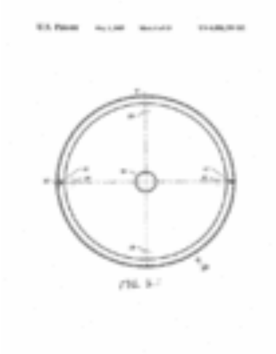
Patent Drawings:











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Foreign Patent Documents:	2 505 140; WO 00/74475
Other References:	
Abstract	A method and apparatus provide for the killing of insects by trapping the larvae, which either prevents development into adults or traps the adults developed from the larvae to prevent further reproduction and harm. In one preferred embodiment, the apparatus includes a container with an inverted cone or other protrusion and a second non-horizontal surface, such as a funnel, positioned

:	above the inverted cone. The funnel defines an opening above the inverted cone. A barrier may also be included that abuts the underside of the funnel. A liquid such as water is placed in the container at a level at least above the opening such that eggs laid in the water become larvae that swim downward and are directed through the opening by the funnel and are directed away from the opening by the inverted cone. The larvae either drown, if the water level is above the barrier, or else become trapped adult mosquitoes that cannot escape from the container. It is noted that this abstract is provided to comply with the rules requiring an abstract that will allow a searcher or other reader to ascertain quickly the subject matter of the technical disclosure and is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims.
Claim:	What is claimed is: 1. A method of killing insects with a container that includes a sidewall, a bottom that has at least a portion that is sloped relative to the horizontal when the container isupright, and a directing member positioned above the bottom that has at least a portion that is non-horizontal and that defines an opening above the sloped portion of the bottom, wherein the bottom, directing member, and sidewall define a chamber thattraps insect larvae, the method comprising: placing liquid in the container until its surface level is above the opening and at least partially fills the chamber; positioning the container such that insect eggs are laid on the liquid surface and theinsect eggs hatch into larvae; guiding the larvae to drop from the liquid surface down along the directing member and out of its opening; and after the larvae pass through the opening, guiding the larvae to further move along the sloped portion of thebottom away from the opening and into the chamber. 2. The method of killing insects of claim 1, wherein upon guiding the larvae to move along the sloped portion and into the chamber, the larvae mature into adult insects, and the method further comprises: trapping the adult insects on the surfaceof the water within the chamber. 3. The method of killing insects of claim 1, wherein the container further includes a barrier located within the container that abuts an underside of the directing member above its opening and abuts the container to further define the chamber,and wherein placing water in the container further comprises filling the container with liquid until the liquid level is at least above the barrier to completely fill the chamber. 4. The method of killing insects of claim 1, wherein upon guiding the larvae to move along the slope and into the chamber, blocking the larvae from returning to a surface of the liquid with the barrier.
Description:	TECHNICAL FIELD This invention relates in general to insect control, and in particular to the capture and killing of insects such as mosquito larvae before they become adult biting mosquitoes. BACKGROUND Mosquitoes are more than just an annoying problem. From the 1800s when British Army Doctor Donald Ross proved malaria was transmitted by mosquitoes, to the present United States outbreak of the mosquito borne West Nile virus, mosquitoes haveproven to be a serious problem for both man and animals. Some other diseases transmitted by mosquitoes are dengue, yellow fever, and encephalitis varieties such as Eastern Equine encephalitis, Western Equine encephalitis, La Crosse encephalitis, St. Louis encephalitis, and Japanese encephalitis. The quest to prevent mosquito transmitted diseases and the general annoyance of being bitten while engaged in outdoor activities has been long and generally unsuccessful. Primary methods of control have been directed at large scale sprayings ofindiscriminate poisonous chemicals, attractant traps directed at killing adult mosquitoes, draining of breeding areas such as wetlands, or the application of larvicide chemicals in bodies of water. Many poisonous chemicals not only kill mosquitoes, but also destroy beneficial insects as well as having detrimental effects on other wildlife such as birds. DDT is still a cause of ecological damage after over thirty years of non-use in theUnited States. Draining of wetlands has been recognized as destructive to the overall health of our environment and the use of larvicide chemicals in these areas is expensive, requires repeated applications during the breeding season, and could havelong term side effects as yet undetermined. Various types of traps have been introduced that attract adult mosquitoes by the use of light, emissions of chemical attractants, carbon dioxide releases, and even vibrating membranes that mimic animal skin. The killing mechanisms used by these traps tend to be electrocuting devices, vacuuming insects into holding bags, introducing the insects to poisonous chemicals, or providing a sticky surface on which the insects become trapped. Many of these traps areexpensive to produce and require extensive maintenance for their operation. All of the above trapping methods result in the unintended destruction of beneficial insects. Current studies indicate existing commercially available traps such as the light attractant and carbon dioxide emitting varieties tend to attractdisproportionately greater numbers of mosquitoes to an area than they actually kill. This action creates a negative impact on the intended result of mosquito elimination from a particular location. It has also been shown that the ratio of beneficialinsects killed versus mosquitoes by many of these devices is sufficiently high that quite a few of these traps are actually regressive to the environment.

Mosquito populations grow exponentially with one adult female laying from a few to over one hundred eggs every third day of her breeding life. Obviously, the attracting and killing of individual mosquitoes using existing art is, at best, acheck-stop measure as the existing art fails to kill mosquitoes in large numbers and break the cycle that allows the exponential growth of the population.

SUMMARY

Embodiments of the present invention address these issues and others by providing a method and apparatus that captures mosquito larvae to prevent them from developing into adult mosquitoes that are otherwise free to continue to reproduce andcause harm. Embodiments provide an attractive location for mosquitoes and other harmful insects to lay eggs while trapping and killing the larvae developing from these eggs and/or trapping and killing adult mosquitoes that have developed from thetrapped larvae.

One embodiment is an apparatus for killing insects. One preferred design of the apparatus includes a container and a protrusion within the container, in which at least a portion of the protrusion is preferably sloped relative to horizontal. Theapparatus also includes a directing member within the container that is positioned above the protrusion and having at least a portion that is non-horizontal. The directing member defines an opening that is located above the protrusion. The protrusion,directing member, and container define a chamber that for containing insect larvae and prevent those larvae from maturing into insects or, if they mature, from exiting the container.

Another embodiment is a method of killing insects with a container, such as the one described above. The method involves placing liquid in the container so that the liquid level is above the opening of the directing member and partially fillsthe chamber. The container is positioned such that insect eggs are laid on the liquid surface and the insect eggs hatch into larvae. The method further involves directing or guiding the larvae to drop from the liquid surface along the directing memberand out of its opening. After the larvae pass through the opening, the method preferably further involves directing the larvae to further drop or otherwise move into the chamber. When the larvae reach this location, they have little chance of survivingand exiting the chamber alive.

Another preferred embodiment of the present invention includes a container and an inverted cone member within the container. A funnel-shaped member is located within the container above the inverted cone and defines an opening above the invertedcone. The embodiment further includes a barrier that has a first edge that abuts the underside of the funnel-shaped member and has a second edge that abuts the container. At least the barrier, the funnel-shaped member, and the container define achamber.

Additional embodiments of the present invention include a container and a floor within the container, and the floor may include at least a portion that is sloped relative to the horizontal. A directing member is positioned above the floor andhas at least a portion that is non-horizontal. The directing member defines an opening above the floor. The floor, directing member, and container define a chamber that traps the insect larvae. The container may be translucent while the directingmember may be opaque such that the larvae are drawn away from the opening and further into the chamber toward the sidewall regardless of whether the bottom is sloped or flat.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of an illustrative container of one embodiment showing a concave bottom and a protrusion centered on the container bottom.

FIG. 1.1 is a top plan or birds-eye view of the container of FIG. 1 showing center alignment of the protrusion.

FIG. 2 is a front view of an illustrative funneling device of one embodiment that fits into the container of FIG. 1.

FIG. 2.1 is a top plan view of the funneling device of FIG. 2 showing center alignment of its lower opening.

FIG. 3 is a top plan view of an illustrative ascension barrier of one embodiment.

FIG. 3.1 is a front view of the ascension barrier of FIG. 3.

FIG. 4 is an exploded front view of one embodiment of the present invention showing the assembly process.

FIG. 5 is a front cross-sectional view of the assembled embodiment shown in FIG. 4.

FIG. 5.1 is a cut away cross-sectional view of an illustrative snap-on lid portion of the funnel of FIG. 2 connected to the container of FIG. 1.

FIG. 6 is an isometric cross-sectional view of FIG. 5.

FIG. 7 is an alternative cross-sectional view of FIG. 5 after water has been placed into the container to a level adequate to drown the larvae

FIG. 8 is an alternative cross-sectional view of FIG. 7 after water has been placed into the container to a level adequate to trap adult mosquitoes that have developed from the trapped larvae.

FIG. 9 is a front cross-sectional view of one assembled alternative embodiment that has a sloped bottom within the container.

FIG. 10 is a front cross-sectional view of one assembled alternative embodiment that has a flat bottom within the container.

DETAILED DESCRIPTION

The present invention is more particularly described in the following examples that are intended as illustrative only since numerous modifications and variations therein will be apparent to those skilled in the art. As used in the specificationand in the claims, "a," "an," or "the" can mean one or more, depending upon the context in which it is used. The preferred embodiment is now described with reference to the figures, in which like numbers indicate like parts throughout the figures.

The present invention provides a trap for insect larvae, in particular mosquito larvae, and a method of using such a trap. The larvae are contained so that they either drown or develop into adult mosquitoes that are unable to exit and eventuallystarve, depending upon the particular embodiment of the present invention and the corresponding level of liquid being used. The present invention, accordingly, assists in breaking the cycle of the exponential increase in mosquito populations.

One preferred embodiment of the present invention comprises a container, a protrusion or inverted cone member, a directing member or funnel, and, optionally, a barrier. FIG. 1 is a front view of an exemplary container 50 according to oneembodiment, in which a vertical axis V bisects the center of the container 50 and is used for reference throughout the drawings. In this embodiment, the container 50 is shown as being round in shape, but other shapes including polygons of variousnumbers of sides are also applicable. The container 50 may be made from various materials such as plastic or metal. However, translucent plastic allows the inside of the container 50 to be viewed by an observer to verify the functioning of theapparatus and also allows light to enter the container to further draw the larvae toward the light, as discussed below.

The container 50 includes various attributes. A sidewall 62 of the container 50 may optionally include a ledge 18 for an optional ascension barrier, discussed below, to rest on with the ledge 18 so as to separate an upper sidewall region 16 fromthe remainder of the sidewall 62. In this embodiment, a bottom surface 20 of the container 50 is concave to have a slight inward taper or slope forming a raised base.

Still referring to FIG. 1, a modified conical structure 22, which is an inverted cone, is positioned on the apex of the bottom 20. The conical structure 22 of this embodiment has a first sloped region 52 and second sloped region 54, with the topsloped region 52 having less slope. The taper of the bottom surface 20 of the container 50 has an even lesser slope extending between the conical structure 22 and the sidewall 62. As one skilled in the art will appreciate, if an object falls or driftsinto the center of the container bottom 20, the conical structure 22 and concave design of the bottom direct that object toward the sidewall 62 of the container 20. Other manners of obtaining this same effect with the bottom 20 is to have a paraboliccross-section between the sidewall 62 and center or to have a consistent slope extending from the apex to the sidewall 62. As discussed below in relation to FIG. 9, other formations for the bottom of the container are applicable as well, such as havinga substantially planar bottom of the container that is either flat or sloped relative to the horizontal and spans the diameter of the round bottom of the container 50.

FIG. 1.1 is a top plan view of the container 50 depicting a `y` axis Y and the perpendicular `x` axis X in center alignment along with the top rim 14, which is also shown in FIG. 1. The optional ledge 18 is also shown, on which the optionalascension barrier may rest. The modified conical structure 22 of this particular embodiment is also shown. Optional holes 42 allow a simple bent wire handle (not shown) to be connected to the container 50 to facilitate carrying it.

The present invention also preferably comprises a non-horizontal top surface to assist in directing or guiding larvae downwardly, and FIG. 2 shows a funnel 60 that is one exemplary embodiment. The funnel mounts within the container 50 and has afunnel sidewall 26, funnel top opening rim 24, funnel bottom opening rim 30, and optional funnel vent holes 28, which allow air trapped during the filling process to escape when the apparatus is filled with liquid after being assembled. Such vent holes28 are not necessary when ventilation is not required, such as when the container 50 is filled with liquid prior to the additional components such as funnel 60 being inserted into the interior of the container 50. The top opening rim 24 preferablyattaches onto the top rim 14 of the container 50 by interlocking together, which is shown in FIG. 5.1.

As discussed in more detail below, the sloped sidewall 26 of the funnel 60 directs larvae to the bottom rim, which defines an opening 30 therethrough. In use, the sinking or downwardly moving larvae pass through the opening to the bottom surface20, where they are directed toward the sidewall 62 of the container 50 and away from the opening 30. Thus, the slope of the sidewall 26 of the funnel 60 directs the larvae to its opening, and then once through, the slope of the bottom surface directsthe larvae away from the opening to decrease the likelihood of reentry into the interior of the funnel 60. As discussed above, the conical structure 22 further assists in directing the larvae to the sidewall of the container and impedes the larvae fromreentering into the interior of the funnel 60.

The sidewall 26 of the funnel 60 may be constructed of various materials such as plastic or metal. However, a dark, visible light-absorbing coloring provides the most attractive location for eggs to be laid by the harmful insects, such as bitingmosquitoes. A black non-horizontal top surface is especially attractive to mosquitoes. Having an opaque funnel also prevents light from entering the container near the opening 30 such that larvae are not attracted back toward the opening after thelarvae have already passed through it.

One skilled in the art will appreciate that the slope of the sidewall 26 of the funnel 60 can vary. One consideration is that the opening 30 is sufficiently small so that the larvae cannot easily reenter the interior of the funnel after exitingit. The slope is also a function of the dimensions of the container, i.e., a shorter container with a wide top opening will use a different slope that a taller container with a narrow top opening. One contemplated embodiment of the funnel 60 has a topopening rim 24 having a diameter of 7.25 inches inside the rim and 8 inches outside of the rim; a bottom opening 30 with a diameter of one inch, a vertical height between the top and bottom openings of 4 inches, and an included angle of 77 degreesrelative to horizontal to define the slope. It should be noted that these dimensions are provided only for purposes of illustration of one embodiment and that various other dimensions are also applicable. Accordingly, these dimensions are not intendedto limit the scope or meaning of the claims.

While the funnel 60 provides a suitable non-horizontal top surface for the illustrated embodiment, various other non-horizontal top surfaces may also be used. For example, an inverted cone could be utilized in which the inverted cone provides aslope leading to one or more openings along the outer rim rather than providing an opening in the center, such that the larvae are directed downward and toward the outer portion of the cone and through openings at the outer portion. However, where suchan inverted cone is utilized to provide a top slope, the bottom surface of the container is provided a reversed slope, which leads from the sidewall 62 downward to a center location to direct the larvae to the center of the bottom surface, which is awayfrom the openings of the top surface. Other examples of a non-horizontal top surface include having a consistent slope leading across the diameter of the container 50 with an opening defined by the surface in proximity to the sidewall 62 or having avertical surface extending downward but terminating above the sloped bottom surface to define an opening.

FIG. 2.1 shows the funnel bottom opening rim 30, optional funnel vent holes 28, and the optional alignment holes 42 for handle insertion.

Referring now to FIG. 3, the optional ascension barrier 80 is shown having optional vent holes 32, an outer rim 34, and an ascension barrier-locking ring 36. The barrier 80 rests on the ledge 18 of the container 50 and the barrier-locking ring36 defines a hole in the center into which the funnel 60 is received such that the opening 30 of the funnel 60 is located below the ledge 18 and ascension barrier 80. The barrier-locking ring 36 complementarily receives and contacts the underside of thefunnel 60 to create a barrier between the funnel 60 and sidewall 62 of the container 50. The ascension barrier 80 may be constructed of various materials such as plastic or metal. As noted above for the funnel 60, the vent holes 32 of the ascensionbarrier are optional and are not necessary when the apparatus is assembled after the liquid has already been poured into the container 50. The vent holes 32 are preferably of a dimension such that the larvae cannot easily pass through them, if at all.

FIG. 3.1 is a front view of the ascension barrier 80 showing the outer rim of ascension barrier 34 and funnel-locking ring 36. From this view, it can be appreciated that once installed, the outer rim 34 contacts the ledge 18 of the containerwhile the funnel-locking ring 36 contacts the funnel 60 such that a barrier is created. This barrier 80 may be included in the apparatus where the liquid is filled above the barrier 80 so that larvae cannot reach the surface of the water due to thebarrier and drown. Including the barrier 80 allows this mode of operation to occur without requiring that the liquid be filled all of the way to the top rim 14 of the container. However, other modes of operation will also serve to kill the harmfulinsects, as discussed below.

FIG. 4 provides an exploded view of one illustrative embodiment of the apparatus 10 of the present invention, in which the funnel 60, the optional ascension barrier 80, and the container 50 are correctly aligned for assembly. Thus, for thisembodiment, the optional barrier 80 is first placed into the container 50 and is seated on the ledge 18. Then the funnel 60 is placed into the container 50 where it is seated within the locking ring 36 of the barrier 80 and fits onto the top rim 14 ofthe container 50.

FIG. 5 shows the assembled apparatus 10. A detailed view of a funnel-locking ring 40, which is snapped into place over the top rim 14 of the container 50, is shown in FIG. 5.1. As noted above, the funnel sidewall 26, directs the larvae in adownward direction toward and out of its opening 30, where they are further directed away from this opening by the conical structure 22 and further encouraged to move away from this area by the concave bottom 20 of the container 50. At this point, thelarvae are in an entrapment chamber 38, which is defined by the bottom 20 of the container 50, sidewall 62 of the container 50, sidewall 26 of the funnel 60, the conical structure 22, and the barrier 80 if present.

Referring now to FIG. 6, the apparatus 10 is shown in cross-section, in which the funnel 60 is connected to the container 50 by the funnel-locking ring 36 at the ledge 18 of the container 50. The sidewall 26 of the funnel 60, with optional ventholes 28, slopes to the bottom rim 30 of the funnel 60 which opens into the entrapment chamber 38 by passing around the conical structure 22, which is a molded part of the concave bottom 20 of this embodiment but could be a separate component installedwithin the container 50. Larvae attempting to get to the surface of the liquid to breathe while in the entrapment chamber 38, are blocked by the barrier 80, which is held in place below the surface of the liquid by both the ascension barrier collar 36and ledge 18, and the larvae drown.

In operation the assembled structure 10 is filled to a particular level with liquid. Such liquid may be water from any source, utilizing anything from a stagnant pool to fresh tap water. The water is filled to at least a level above the bottomopening 30 of the funnel 60. As discussed above, the apparatus 10 may be assembled prior to filling with water. In that case, ventilation holes in the ascension barrier 80, if the barrier 80 is present, and in the funnel 60, allow air to escape as thewater displaces it. In addition to water, oviposition material 120 as shown in FIGS. 7 and 8 may be placed in the apparatus 10 to advance the stagnation of the water so as to draw mosquitoes more quickly. That is, the oviposition material depletesoxygen from the water, which also accelerates the drowning of the trapped larvae. Examples of such oviposition material include non-animal fat materials such as pot-bellied pig chow, oatmeal, alfalfa, rice hulls, and brewer's yeast. While ovipositionmaterial containing animal fat such as rabbit pellets may be used to further stagnate the water, a layer of grease may form on the water surface thereby lessening the attraction of mosquitoes to use the apparatus 10.

The apparatus 10 is placed in a location where it is likely that mosquitoes will be present to lay eggs. For example, the apparatus may be placed in a shaded area preferably in grassy locations or near bushes. As shown in FIGS. 7 and 8,mosquitoes are attracted to the still water 100 (FIG. 7), 100' (FIG. 8) present atop the funnel 60 and lay their eggs 102 within it.

The eggs 102 float on top of the water 100, 100' until they hatch into larvae 104 approximately twenty-four to forty-eight hours later. The larvae 104 breathe at the surface of the water 100, 100' instead of ingesting oxygen from the wateritself, and drift or swim to the bottom to hide. The funnel sidewall 26 directs the larvae 104 down and toward the center where they emerge from the bottom opening 30 of the funnel 60, and are directed into the entrapment chamber 38, and away from thebottom rim 30 of the funnel 60 by the conical structure 22, and also by the light entering through the container 50, if translucent. Once within the entrapment chamber 38, the concave bottom 20 of the container 50 encourages further movement away fromthe bottom opening 30 of the funnel 60 toward an outer region 106.

As shown in FIG. 7, when the need for oxygen causes the larvae 104 to swim toward the surface of the water 100, they are blocked by the ascension barrier 80, and drown at a region 108 since the water 100 has been filled to a level above thebarrier 80. In trials, an occasional larva 104 found its way out of the entrapment chamber 38 and back through the bottom rim 30 of the funnel 60. However, if that occurs, the process starts again by that larva 104 again swimming downwardly back in theentrapment chamber 38, where it will drown.

The method of killing the insects as shown in FIG. 7 may also work without the ascension barrier 80 present if the water 100 is filled all the way to the rim 24 of the funnel 60. Thus, once the larvae 104 enter the entrapment chamber 38 andbegin to swim upward toward the surface, the larvae encounter the underside of the funnel 60 and drown.

FIG. 8 shows the water level in the apparatus 10 below the ascension barrier 80 but above the bottom rim 30 of the funnel 60. The apparatus 10 continues to work but uses a different method. In this situation, larva confined to the entrapmentchamber 38 can reach the surface of the water 100' to breathe and eventually mature into adult mosquitoes 112. However, because adult mosquitoes 112 cannot swim underwater, they remain trapped in the entrapment chamber 38 and quickly die of starvation. In this scenario, the ascension barrier 80 continues to be optional because once the adult mosquito 112 develops, the underside of the funnel 60 traps the mosquito 60 if the barrier 80 is not present.

The converse of this scenario of a low water level is too much rain, which overflows the apparatus 10. Since the apparatus is designed to work at full water depths as noted above, either with or without the ascension barrier, heavy rains do noharm with the excess simply spilling over the side. Any eggs 102 or larvae 104 that spill over onto the ground with the excess water quickly die of dehydration since they must be in water to survive.

FIG. 9 shows one of the various alternatives to the embodiment shown in FIGS. 1-8. The apparatus 90 of FIG. 9 includes a container 50' having a bottom 92 that forms a sloped surface relative to horizontal, as opposed to including a protrusionsuch as the conical structure 22 of FIGS. 1-8. The sloped surface of the bottom 92 directs the larvae toward the sidewall 62 upon the larvae passing through the opening 30 of the funnel 60. The larvae are then trapped within the entrapment chamber 38'defined by the bottom 92, sidewall 62 and funnel 60 where they drown or starve once an adult mosquito. As with the previous embodiment, the ascension barrier 80 may be included to further define the entrapment chamber 38'.

It will be appreciated that the bottom 92 of this embodiment may be substantially planar, parabolic, concave, or of other curvature that slopes away from the opening 30 and into the entrapment chamber 38'. Furthermore, it will be appreciatedthat the bottom 92 may also be augmented at the area below the opening 30 with a protrusion such as a conical structure as described above. Additionally, it will be appreciated that the funnel 60 may be opaque while the container 50 is translucent tofurther discourage the larvae from swimming toward the opening 30 while encouraging the larvae to swim toward the sidewall 62 and further into the entrapment chamber 38'.

FIG. 10 shows another of the various alternatives to the embodiments shown in FIGS. 1-9. The apparatus 150 of FIG. 10 includes a container 50" having a bottom 92' that is flat relative to the horizontal, as opposed to forming a sloped surfacerelative to horizontal and as opposed to including a protrusion such as the conical structure 22 of FIGS. 1-8. The flat surface of the bottom 92' may not direct the larvae toward the sidewall 62 upon the larvae passing through the opening 30 of thefunnel 60, but some larvae will swim toward the sidewall 62 without the direction from the bottom 92'. The larvae are then trapped within the entrapment chamber 38" defined by the bottom 92', sidewall 62 and funnel 60 where they drown or starve once anadult mosquito. As with the previous embodiments, the ascension barrier 80 may be included to further define the entrapment chamber 38". The level of the liquid that is used to fill the container is at least above the opening 30 but may either be aboveor below the ascension barrier 80.

It will be appreciated that the that the funnel 60 may be opaque while the container 50 is translucent to further discourage the larvae from swimming toward the opening 30 while encouraging the larvae to swim toward the sidewall 62 and furtherinto the entrapment chamber 38". Thus, while the bottom 92' may not provide direction to the larvae, the light entering through the translucent container 50" will provide the effect of drawing the larvae toward the sidewall 62 and further into theentrapment chamber 38".

The exemplary apparatus and designs illustrated and discussed above in relation to FIGS. 1-10 may include several individual components. These components may be individually formed and assembled to complete the apparatus or one or more of thesecomponents may be integral with another. It will be appreciated that whether to have the components separately formed and assembled or as integral components formed together at the time of manufacture is a matter of design choice. Additionally, itshould be noted that the non-horizontal directing member above the bottom 92 may be shaped in other ways. For example, the opening 30 may be defined at various locations other than in the center, such as in proximity to the sidewall 62 at a locationthat is near the upper intersection of the bottom 92 and the sidewall 62.

The various embodiments described above are provided by way of illustration only and should not be construed to limit the invention. Those skilled in the art will readily recognize various modifications and changes that may be made to thepresent invention without following the example embodiments and applications illustrated and described herein, and without departing from the true spirit and scope of the present invention, which is set forth in the following claims.

I. FICHE TECHNIQUE PIEGE A LARVES ANTI-MOUSTIQUES AQUALAB BREVETS 2 : PATENT 7134238: PAGES11-13

US7134238

Apparatus for killing insects by trapping larvae

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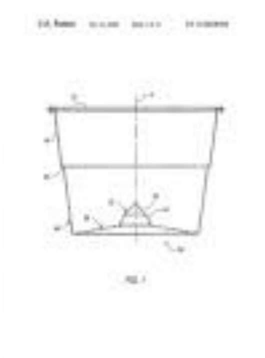

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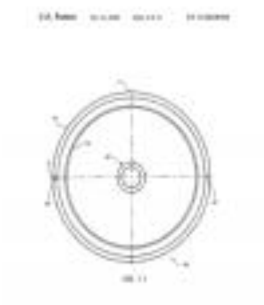

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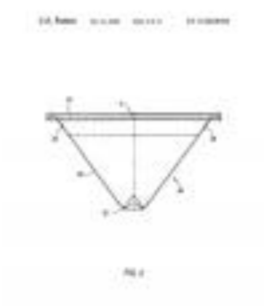

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US007134238B2

(12) United States Patent
Forehand

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(54) **APPARATUS FOR KILLING INSECTS BY TRAPPING LARVAE**

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A01M 1/10 (2006.01)
A01M 1/20 (2006.01)

(52) **U.S. Cl.** **43/122**; 43/107

(58) **Field of Classification Search** 43/107, 43/122, 121, 132.1, 133
See application file for complete search history.

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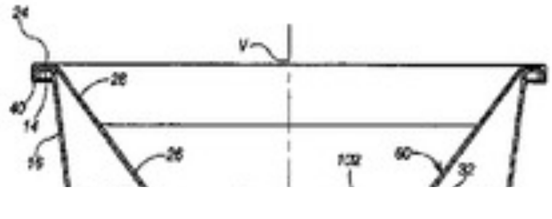
(57) **ABSTRACT**

An apparatus provides for the killing of insects by trappi the larvae. In one preferred embodiment, the apparat includes a container with a protrusion and a second no horizontal surface, such as a funnel, positioned above t protrusion. The funnel defines an opening above the protr sion. A barrier may also be included that abuts the unders of the funnel. A liquid is placed in the container at a level least above the opening such that eggs laid in the wat become larvae that swim downward and are direct through the opening by the funnel and are directed aw from the opening by the protrusion. The larvae either drow or become trapped adult mosquitoes. It is noted that th abstract is provided to comply with the rules requiring abstract that allows a searcher or reader to ascertain quick the subject matter of the technical disclosure and is subm ted with the understanding that it will not be used to interp or limit the scope or meaning of the claims.

17 Claims, 13 Drawing Sheets



II. ETUDE « MOSQUITOLARVAL TRAP TESTING CONDUCTED AT THE UNIVERSITY OF FLORIDA » : PAGE14-21

SIJMMARY SHEET OF MOSQ'IJITOLARVAL TRAP TESTING CONDUCTED AT THE UNIVERSITY OF FLORIDA

Background: Experiments were conducted during the months of August, September, and November, 2003, utilizing the original patented mosquito larva traps (U.S. Patent No. 6,886,293). Subsequenttotheseandothertests,revisionsweremadethatfurther enhanced the trapping abilities of the product (U.S. Patent No. 7,134,238).

Objectives: After determining the proper test procedures, the objectives of the testing were to:
1) Ascertain trap effectiveness. 2) Identify potential stimulants to further attrac,t gravid mosquitoes.

Methodology: Each test consisted of the deployment of twenty traps in various locations around the Entomology building on campus. Although this deployment in a small area diminished the attractant abilities of any single trap due to competition Aom nearby units, the overall results of the tests in relation to total kills and best stimulants verses the control units containing water only remain valid.

The dedinitive test results are found in the second round of testing; the first round being utilized to refine the methods used in the second round. The results of this second testing are portrayed in graph form on page 15 of the attached report. The combined capture rate of the traps over a thirty-eight day period was estimated to be 17,400 mosquitoes or approximately 458 mosquitoes per day.

(116 egg rafts (page 15) x 150 eggs per raft (page **3)** = 17,400 mosquitoes)

Summary: Gravid (egg bearing) mosquitoes generally live their entire lives, (approximately 15 days as adults), in an area about the size of a football field (less than '/z acre) and lay eggs 3 - 5 times during their adult Iife. The ***Forehand's!*** traps collect and destroy the offspring of the adults, thus breaking the exponential cycle of mosquito infestation in a given area during the breeding months.

Field deployment of traps has proven the product to be highly effective in mosquito eradicationwhilebeingsafetousearoundchildrenandpets. Withthestimulantbeing rice based, the ***Forehand's!*** trap uses no poisons or harmful chemicals. Rather than electrocution or death by poison, the ***Forehand's!*** trapping action relies on the natural tendencies of the mosquito larva to dive for protection and rest.

Conclusion: This product is the only mosquito control system available today that is environmentally friendly, truly safe to use around children and pets, has been tested and proven effective in eliminating mosquito problems, and is inexpensive to deploy and maintain.

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Dear Jimmy The Forehand Mosquito Larval Trap report is enclosed.
J. F. But r, Professor Med. Vet. Entomology
December 2,2003

Fax (352) 3924190

SUBJECT: Test Forehand Mosquito Larval Traps.
PEST: Mosquitoes. **TITLE:**
Forehand Mosquito Larval Trap Evaluations Trial 1 and 2.
LEADER: Dr. J. F. Butler, Department of Entomology and Nematology, IFAS, University of Florida, Bld 970, Natural Area Drive Box 110620 Gainesville, Florida 326 11-0620. (352 392-1930-152) E-mail= jfl>@trnv.ifas.ufl.edu
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OBJECTIVES:
The objectives were: (1.) To develop testing procedures to evaluate mosquito traps. (2.) To determine the ef-fectivenessof the Forehand inverted cone mosquitolarvaltrap. (3.)Toaddpotentialegglayingstimulantstothetrapto improve egg and larval capture rate.
MATERIALS and METHODS:
Mosquito Larval Trap Trial 1: Forehand Mosquito LarvalJEgg Traps were evaluated with different types of media as an attractant for natural egg laying. Five treatments with four replications were used (20 traps). Traps were placed in four different areas near the Entomology and Nematology Building 970. Trap treatments were randomized with 4 replications per treatment. Traps were labeled with date, treatment number, and location with white tape placed on the trap side. A one by six cm strip of filter paper was placed in the cone for egg attachment.
Medias evaluated in Trap 1 are as follows:
Media 1: 2 Liters of water
2 grams of powdered Pot Bellied Pig Chow
0.5 gram of brewers yeast Media 2:
2 Liters of water 2 grams of powered Timothy Hay 0.5 gram of brewers yeast
Media **3:** 2 Liters of water
2 grams of powered Pure Rice Bran
0.5 gram of brewers yeast Media 4:
2 Liters of water 2 grams of powered Alfalfa Pellets 0.5 gram of brewers yeast
Media 5: 2 Liters of water
The traps with media were placed outside but protected from rain by a roof overhang. The windowsills of the inner courtyard and out side of building 970 wereused. Observationsweremadeafterthefirst7daystodetermineif mosquitoes had begun laying eggs. The number of egg rafts present on the water surface as well as individual eggs placed on small blotter paper strips at the side oftheconeleadingintothewaterwasmonitored. After5weekstheresiduein thetrapswasevaluatedformosquitolarvaeandotherarthropodspresent. Adult mosquitoes in the upper trap area were monitored on a weekly basis.
Mosquito Larval Trap Trial 2:
Forehand Mosquito Larval Traps were set up as in Trial 1. Five treatments with four replications were used. The traps with media were placed outside of the windowsills in four different areas of building 970 in the inner courtyard. Evaluation of egg rafts and egg deposition were the only data

monitored for Trial 2 as these criteria were found to be the most reliable data from Trial 1. The one by six cm strip of filter paper was placed in the cone for egg attachment and attractant placement. The strip was changed every 4 days. The following media were evaluated in Trial 2.
Media 1: 1 gram of powered Pure Rice Bran 1 gram of powered Alfalfa Pellets
2 Liters of water
0.5 gram of brewers yeast Media 2:
2 Liters of water 2 grams of powered Pure Rice Bran 0.5 gram of brewers yeast in
Media 3: 2 Liters of water
2 grams of powered Alfalfa Pellets
0.5 gram of brewers yeast Media 4:
1 gram of powered Pure Rice Bran 1 grams of powered Alfalfa Pellets 0.005 gram of attractant on the top of the attached iilter paper weekly 2 Liters of water 0.5 gram of brewers yeast
Media 5: 2 Liters of water
Observations were made as noted in the tables for the number of mosquito egg rafts present on the surface of the water and the individual eggs attached to the filter paper inserts. Previous counts of mosquito larvae and other insects present in Trial 1 were limited in value as the number of mosquitoes that died in the I" and 2nd instar stages could not be evaluated. The most valuable counts in Trial 1 were the number of egg rafts in the surface of the water and the number of individual eggs present on the attached paper strip. These gave a better evaluation of the potential mosquitoes exposed in the trap. A mosquitoe normally produces 2-3 egg rafts in her lifetime due to natural mortality rates. Therefore one egg raft or egg deposition represents about one third of their lifetime expected reproductive potential. A mosquito egg raft contains about 150 eggs. The observations of egg raft counts were timed to record the numbers prior to hatching and dispersal of 1"' instar larvae into the trap.
Observations as egg and egg rafts were made daily for 2 weeks to determine the number of mosquito eggs laid. Adult mosquitoes surviving in the upper trap area were monitored on a weekly basis.

RESULTS and DISCISSION:

There were three objectives: (1.) To develop testing procedures to evaluate mosquito traps. (2.) To determine the effectiveness of the Forehand inverted cone mosquitolarvaltrap. (3.)Toevaluateanegglayingstimulantsaddedtothetrap.

Trial 1 was a developmental step to determine how data could be collected forthisnewtypeoftrapandtomeasurepotentialcollectionrates. Asmosquitoes visiting and laying eggs in the trap could not be counted the egg rafts or individual eggs were counted within a time interval and summed over time for evaluation. As the media matured with fermentation the mosquito egg laying attractiongenerallyincreased(Figure5). Whentheeggshatchedthesmalllarvae generally migrated beneath the black funnel to the lighter area beneath and were trapped and drown A few first instar larvae were able to migrate through the small holes in the retention ring where they continued development to adults.

As the media became older or about 2 weeks there was a debris buildup allowing some of the larvae to stay in the black funnel. We were not able to assess the numbers of larvae that were trapped and drown. The total number of mosquitoes present was estimated by the number of egg rafts, which were on the surface. An egg raft would result in 150 larvae for *Clulex quuinyuqfu,~c~utuAse.des ulhopictus*femaleslayeggssingularlyatorabovethewaterline. Thesewere assessed by placing 1 cm strips of blotter paper from the top of the trap into the water at the center. Success considered for *A e h* sp. was limited, as the number ofeggscollectedseemedlow.

Ithinkthatthesurfaceoftheshinyblackfunnel should be rough or non-glossy allowing for some moistening of the plasticlwater interface.

Data collected for Trial 1 are presented in Tables 1-5. Results of Trial 1 are best shown in Figures 1-3. There were no significant differences in Trial 1 (Table **4,5)** due to the placement of the replications on the outer windowsills of building 970. The mosquito populations on the outside of the building were not comparable with the inner courtyard. We were able to develop assay methods for the trapping system however, with egg rafts on the surface of the water and eggs placed upon the filter paper used to determine the number of potential mosquitoes developing. The presence and number of trapped insects were varied (Table 1).It was difficult to evaluate survivingldead insect numbers from those remaining and decaying in the trap so the number of eggs and egg rafts were adopted as a measure of potential mosquitoes exposed. Some adult mortality was seen in those insects trapped above the retention ring of the trap.

The suitability of media in the traps was also observed. Table 1 gives the general observations on trap conditions and catches rates for traps during August 2003. In Trial 1the condition and odor produced by the media was noted with the powered Pot Bellied Pig Chow and brewers yeast being particularly rank. This mediawouldnotbeacceptabletothegeneralpublic. Thismediaisalsonoton theGRASlist. Theothermediaweremoreacceptableandtheingredientsareon the list.

The media collectingthe most *C'ule,rquinqu~f~~sciu*wtu*as* the Powered Pure Rice Bran and brewers yeast (Figure 2). This material could easily be packaged with the traps. Aedes eggs were highest for Powered Timothy hay and brewers yeast Figure I). Powered Timothy hay is not on the GRAS list. The fermenting pig chow also attracted many other small Diptera maggots as demonstrated in Figure 3 and Table 1. Statistical dif'ferences could not be demonstrated in Trial 1 due to high variance in the replications presented between to outer windowsill and inner courtyard placement of traps.

Trial 2 was more statistically reliable with replication placement allowing data collected to be analyzed. It also gave a measure of suitable media and augmentation of trap catch rates with potential attractants. Table 6-8 and Figures 4-6 presents these results. In this Trial powdered Rice Hulls and brewers yeast media were compared with powered Alfalfa Pellets and brewers yeast as well as their mixtures (Figure 5). The powdered Rice Hulls was significantly more attractive than Rice + Alfalfa + Dibutyl succinate which was significantly better than Alfalfa alone (Tables 6-8). The mixture of powdered Rice Hulls + powered Alfalfa Pellets were not significantly different than the water control. The mixtures of Rice Hulls + powered Alfalfa Pellets and Rice Hulls + powered Alfalfa Pellets + Dibutyl Succinate cannot be directly compared to the other treatments as the amount of each in the mixture was less than the other treatments. This was to maintain the same total 2 g amount of dry media at one gram of each inthemixturetested. ThesignificantdifferenceseenbetweentheRiceHulls+ Alfalfa Pellets and Rice Hulls + Alfalfa Pellets + Dibutyl Succinate demonstrated that Dibutyl Succinate increased the catch rates for the traps. When Dibutyl

Succinate was added to the filter paper on the top of the trap (0.005 g) the number of *C'ulexyuinyu~firsc~utu*e.*s*gg rafts were doubled indicating that this material is a good attractant for stimulation of egg laying (Figure 5).

Media conditioning and longevity is noted in Figure 5. A delay of 12 days was noted before mosquitoes were attracted to the traps. By day 29 the media had lost its major attractiveness. Traps will need to be serviced about once per month, cleaning out the debris and adding new water and media.

SUMMARY:

The powdered rice hulls at 2 grams + 0.5 g brewers yeast, in 2 Liters of water was the best both in numbers of eggs laid and suitability of product odor. One loading of a trap is good for about 30 days and then productivity goes to near 0. Our best data collection was a count of mosquito egg rafts (150 eggsiraft), as larval mortality could not be reliably estimated. W e had some survival of mosquitolarvaetoadultsduringthetest. Thetrapsmayneedtobemodifiedand or disturbed to assure trapping of all the larvae. I think that 6 small 2 cm no return cones with 3mm holes placed in the positioning ring (the ring just under the black funnel) would allow larvae to move into this area to breath air but be unable to return to the center exit of the trap. Larva in this region of the trap would survive to adult and then die allowing a precise trapping measure of numbers and species. This would also be a visible demonstration of adult mosquitoes being trapped and
killed for the consumer. The water levels in the traps will also need to be maintained to keep traps effective.

The trap that included Dibutyl Succinate as an attractant demonstrated doublethecatchrateofonegrameachofRiceHullsandAlfalfa. Iassumethatit would also work for rice hulls alone. The mosquitoes, which are the vectors of West Nile Virus *(Culex yuinquqfiscicrtus),*were the majority those trapped. Aedes mosquitoes were not attracted to laying eggs on the slick black surface and only laid a few eggs on the filter paper installed for the purpose. The shiny black surface should be converted to a mat or brushed surface to one centimeter above the water line, which may increase the egg laying for these mosquitoes.

Table 1: Forehand Mosquito Larval cjeneral observations of Insects Collected and Media Conditions in T r a ~ s .

Site 1 - inner courtyard, west Site 2 - inner courtyard, east Site3-outercourtyard,west Site 4 - outer courtyard, east

a - alfalfa p - Pot Bellied Pig Chow r- poweredPureRiceBran t - Timothy hay W- water (control)

l a (translucent green, neutral smell) I egg raft 9- 10 each 2-3rd instars larvae (dead) 1 each 4th instar mosquito Larva (dead)

Ip (nearputrid)

1eggraft 1adult***Culexyuinyuef~~rc~at***a*u*d*s*ult female

1 Pupa 25 dead adult **C'x** y***uinyztejusciatus***.

4 each 4th instar **C'x.** ***yurnquefa.scratus*** larvae 2 each 3rd instar larvae Estimated 65 2nd instar larvae

1r (putrid,brownmilkycolor) 40 each 2-3rd instar mosq larvae

1 sewer fly, Psychodidae 1 fruit fly, Drosophilidae

2 adult *O* ***.yuinquefasciutus*** females, 1 male 1t (notputrid,translucentbrown)

1w (clearwater)

2p (brownputrid) 2r (brownputrid)

1egg raft 9 Chironomid larvae

1 Psychodidae adult (dead) 3Culicidlarvae 4 Chironomidaelarvae 2 each 4th instar **(:x.** ***yuinquefu.~cratus*** 2a (brownish-green,slightmuskysmell) 80 each 2-3rd instar mosquito

larvae
1pupalcastskinmosq 84 each Chironomid cases on clear plastic part of trap 9 each Chironomid cases on black lip 2adultfemale**Ck. *yuinyuefusciutus,*** Imale *1* egg raft 2 each 4th instar mosquito larvae
10 each 2-3rd instar mosquito larvae 2 Chironomid larvae (bloodworms)
2t (brown,slightnon-putridodor) Collembola; about 10 each dead on water
2w nothing
1 Psychodidae adult dead 1 Psychodidae larva
3a (heavily green, lots of algae) 1 each 1st instar mosquito larva
1adult female *Clx. qurnyuefr.~ciatus* 3p (green water, nasty putrid)
I each 2nd instar mosquito larva (dead) 3r (greenwater,slightodor)
98 each 2-4th instar mosquito larvae (dead) 3t (green, slight odor)
nothing 3w (somealgae,veryslight)
nothing 4a (brown, moderate stink)
4p (putrid brown)
1 each adult Culex (escaped) 3 each 4th instar larvae
15 pupae 75 each 4th instar *C'x. quinyucfr.vcrutus*
1mosquito pupa Approximately 100 Chironomid larval cases
4r (putrid brown, orange fjlm on bottom of trap) 26 each 3-4th instar mosquito larvae *Cx. quingu~f~~~crutus*.
4t (brown, some odor)
Several dead Collembola
105 each mosquito larvae, 2-4th instar *C'x. yuinqu~fuscnrtus* 50 immature cyclorraphids
4w 15 mosq larvae, 2-4th instar, C'x. *Qurnyu~fuscrutus*
Table 2: Forehand Mosquito Larval Traps Trial 1 Mosauito Larvae Present in Traps
Media tested S1 Alfalfa
Culex rafts Alfalfa
S2
S3
80 1 3
Sum 19 112 76 178 26 180
105 105
Pig Rice Timothy Water
14 98 0 0 0 0
15 Table 3: Forehand Mosquito Larval Trap Culex Eqq Rafts Trial 1
S1
S4
20 S2 S3 S4 Raft Total
I
11 98 42
0 5
2
10 3 C 0 7 3 C 0 1C
Pig Rice Timothy 21C 0 ba Water 00C 0 C
285C 2 3E 61

I

Table 4 stat. Forehand Mosquito Larval Trap Cuiex Egg Rafts Trial 1 ANOVA: Single Factor

SUMMARY

Alfalfa

Groups *Count* *Sum* *Average* *Variance*

4 13 3.25 22.25 4 10 2.5 11 **4** 35 8.76 168.9167 4 3 0.75 0.916667

Pig Rice Timothy Water 400C

ANOVA

Source of Variation *SS* ***df*** *MS* *F* *P-value* *F crit*

Between Groups Within Groups

189.7 609.25

4 15

47.425 1.167624 40.61667

0.364112

3.055568

Total 798.95 19

Table 5 stat. Forehand Mosquito Larval Trap Aedes Egg Counts Trial 1 ANOVA: Single Factor

SUMMARY

Alfalfa

Groups *Count* *Sum* *Average* *Variance*

400C

4

Pig Rice 4

Timothy 4

10.75 358.25 *8.75* 106.25

43 35 93 23.25 956.9167

Source of Variation *SS* *df* *MS* *F* *P-value* *F crif*

3 Total 5367.43E 15

1103.18E

367.7292 1.034824

Between Groups Within Groups 4264.2: 12 355.3542

0.412102

3.4903

Table 6: Forehand Mosquito Larval Trap Aedes **Eag** Counts Trial 1 S1 S2 S3 S4 Raft Total

Alfalfa 00C *0* **c**

Pig

Rice Timothy Water

4 0 C 39 42 20 0 **1E** 0 3E

26 I

c *66* 92 1 0 1 11 12 1**84**

Table 7: Forehand Cone T r a T~rial 2 ***Culex cyuinquefuscic~fx****es*gg raft@)

Treatment Material Used 1Rice + Alfalfa

2Rice 2Alfalfa

Rice + Alfalfa

+ Dibutyl 4succinate ZWater-Control

Table 8 stat. Forehand Cone Trap Trial 2 ***Culex** auinqu~fascinttr*e.~ua raft(s) ANOVA: Single Factor

2

7 7 *7*
14
4C
22
SUMMARY
Site Site Site Site Trt llrep 2lrep 31rep 41rep total
c 2 **9** **3 s** 18 **9** **4**
Groups *CountSumAverage Variance*
Rice + Alfalfa Rice Alfalfa Rice + Atfatfa + Dibutyl succinate Water-Control
ANOVA
414 440
3.5 15 10 34 5.75 6.25 8 7.333333
1.752.916667
4 4 4
23 32 7
Sourceof Variation SS ***df*** *MS F P-value F crif* Between Groups 176.7 **4** 44.175
3.372137 0.037048 3.055568 Within Groups 196.5 15 13.1
Total 373.2 19 ANOVA: Single Factor SUMMARY
Groups *Count Sum Average Variance*
Rice+Alfalfa+Dibutylsuccinate Water-Control
4 32 87.333333 **4**7 1.752.916667
ANOVA Source of Variation SS df MS F P-value F crit
Between Groups Within Groups
78.125 30.75
1 6
78.125 5.125
15.2435 0.0079445.987374
108.87 Total 5 7
ANOVA: Single Factor
SUMMARY
Groups Count Sum Average Variance 4 7 1.75 2.916667 Rice+Alfalfa 4 14 3.5
15
ANOVA Sourceof Variation *SS* ***dY*** MS F P-value ***F***crit
Water-Control
BetweenGroups Within Groups
6.125 1 6.125 0.6837210.4399465.987374 53.75 68.958333
Total 59.875 7