Title: LIGHT TRAP FOR MANAGING INSECTS

Abstract: Light trap for managing insects can be used for monitoring or mass trapping of harmful insect pests in the crops and on the other hand it is safe to most of the beneficial insects (particularly parasites). It will prove an important tool of eco-friendly integrated pest management strategy.

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

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— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(b))

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"LIGHT TRAP FOR MANAGING INSECTS"

Field of the Invention

The present invention relates to a light trap for managing insects, and more particularly, to the monitoring or mass trapping of harmful insect pests and safe for beneficial insects. The invention can be used for the management of the population of insect pests damaging the crops and the system alike.

Description of the Related Art

Insect pests of various kinds are taking a heavy toll of crops and forest trees e.g., army worm, different kinds of borers, hairy caterpillars, leaf rollers, cut worms and others. Pest management for the crops and forest eco-system needs to be eco-friendly and not detrimental to the flora and fauna. The indiscriminate use of chemical pesticides had disturbed the balanced eco-system; as a result the beneficial insects (egg, larval, egg-larval parasitoids and predators) which are the strong biotic check upon insect pests since long has been slowly eliminating from our ecosystem. This is one of the important reasons that population of insect pests is increasing much above economic threshold level season after season and causing economical losses to the crops under field conditions. Sole dependence on the application of synthetic chemical pesticides has led to residues of the pesticides in foodgrains, fruits, vegetables, fish, milk, water and soil (Dhaliwal and Kalra, 1977; Kalra and Chawla, 1981). The philosophy of insect control has also undergone a radical change in the limitations of chemical pesticides, their environmental hazards and other devastating side effects. In order to minimize these problems, application of eco-friendly integrated insect pest management techniques (use of insect pest resistance varieties, botanical pesticides, insect trapping systems, use of parasitoids, predators and pathogens for management of insect pests etc) are assuming significance as important components of pest management because of their eco-friendly nature. The various insect trapping and killing systems has been evolved over the time and are in use for specific conditions. For
example, sex pheromone traps are used for those insect species for which the sex pheromones are available. Unfortunately, pheromones for only a very limited number of species are known. Rotary insect traps and suction insect traps are other types of traps used for trapping the insect pest population. Among the different insect trapping tools, light traps are the most widely used visual traps for the agricultural insect pests, and have been particularly important in surveillance programme and monitoring of the seasonal appearance of many insect pests (Javeri, 1921; Chopra, 1928).

Light trap is one of the effective tools of management of the insect pests as it mass-traps both the sexes of insect pests and also substantially reduces the carryover pest population. Since long, the researchers and farmers are using ordinary light trap to mass trap and sample insect pests of crops. Light traps are also used to determine seasonal patterns of insects' density in the cropped areas. It also provides information related to insect distribution, abundance, flight patterns and helps to decide the timing of the application of chemical pesticides, biopesticides or the release of biocontrol agents. The key insect pests of cereal crops (rice, maize, sorghum), pulse crops (chickpea, pigeonpea, lentil, greengram), vegetable crops (okra, cauliflower, cabbage, tomato, brinjal), horticultural crops (mango, ber, litchi, pomegranate) can be mass trapped by using the light trap. The major insect pests that are attracted towards light trap include the rice leaf folder, rice stem borer, corn borer, hoppers, codling moth, cabbage looper, cutworms, armyworms, diamondback moth, webworm moths, leaf roller moths, tobacco caterpillar, potato leafhopper, bark beetles, red hairy caterpillar, white grubs, groundnut leaf minor, hoppers etc.

The light trap has progressed fast from its simple beginning as an electric bulb or a kerosene lamp kept in front of a cloth sheet or water container. The ordinary light trap consists of an electric bulb as attractant, a funnel to direct lured insects into a container or bag. Several research workers viz., Bowden, 1982; Easton, 1987; Rogers and Smith, 1977; Siddorn and Brown, 1971; Skovmand and Mourier, 1986; Taylor and Brown, 1972 had worked on various aspects of light traps viz., light source producing shorter wave
lengths and longer wave lengths to increase the luring and trapping efficiency of the light traps. Light weight, portable, battery-operated, remote and timer operated light traps had also been designed and developed. Various types of insect collecting systems *i.e.*, adhesive boards, glue boards, water containers etc. had also been developed. These traps have many drawbacks as the trapped insect specimens do not remain in good condition and insect identification can't be done properly. The light trap made up of stainless steel, plastic, aluminum, polyethylene, magnesium or related alloys, different types of wood products, reinforced thermoplastics or thermosetting, paper board, pressed paper board, corrugated paper board, gunny bags, cloth bags etc. had also been developed and validated. For indoor homes, several types of electrocuted light traps are available in the market. In these traps, ultraviolet energy (black light) with an electrically charged grid to kill insects is in use. High electricity energy is required for killing insects on the grid. In these ordinary light traps, the phototropic insects like moths, hoppers, flies, beetles (harmful insects) as well as beneficial insects like parasitoids, predators, pollinators get trapped and all these trapped insects are killed by using insecticides or other means. Khan (1983) reported eight beneficial species of the family Braconidae trapped in the light trap. The beneficial insects are also killed along with harmful insects because there are no provisions to separate them from harmful insect pests.

Due to this reason, the light trap is not being recommended for use on a larger scale for controlling the insect pests. The conventional light trap attracts both the insect pest as well as natural enemies and is therefore contra indicator of the integrated pest management approach. There is urgent need to conserve and enhance the population of the beneficial insects so that they can keep a check upon the population of harmful insects in the eco-systems.

Some attempts had been made to put insect sorting screens or porous wire mesh in the insect trapping bag to separate specific insects. For separating different size insects, the requisite specific sorting screen is required. Depending upon the size of the insects, different sorting screen or porous materials are required during different growth periods of the crop. The crops are attacked by an array of insects (moths, beetles, hoppers,
grasshoppers, flies) during different crop growth periods and all these insects have
different body sizes. The beneficial insects (parasitoids) have small body size in
comparison to their respective host insects. However, some of the non-host insect pests
have also small body size, therefore, they can also escape from the sorting screen of the
light trap along with the beneficial insects. In a crop season, the different types of insect
sorting screens are required based upon the insect pest complex of the targeted crop. The
insect pest complex varies from crop to crop, therefore, a large number of insect sorting
screen are required which is time consuming and costly process.

Thus, in the view of above prior art there is a need for an innovative light trap that
can also be used for the management of insect pests in all the crops and cropping systems
and side by side safe to most of beneficial insects like parasitoids (egg, larval, pupal, egg-
larval, parasitoids) and predators so that these can also remain available in the crop fields
and can act as a natural biotic force to further manage the insect pests on the crops in an
integrated manner.

**Objects of the Invention**

Having in mind the drawbacks of the prior art, it is an object of the present
invention is to provide light trap for managing insects is to mass trap the harmful insect
pests and on the other hand it is safe to the population of beneficial insects *i.e.*, insect
parasitoids.

Another object of the present invention is to safeguard beneficial insects
particularly insect parasitoids from unnecessary trapping in the light trap as these are
needed for the suppression of the population of insect pests damaging the crops.

Still another object of the present invention is to provide the light trap suitable for
all seasons of the year and during whole of the crop season.
Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

Summary of the Invention

Accordingly, the present invention is directed to a light trap for managing insects, which substantially obviate one or more problems due to limitations and disadvantages of the related art. The light trap for managing insects, the mass trapping of both the sexes of harmful insect pests are required for the suppression of the population of insect pests damaging the crops; the safety of beneficial insects particularly insect parasitoids are also needed in the crop fields as they suppress the population of harmful insect pests which are damaging the crops in a natural manner.

In a preferred embodiment of the present invention, light trap for managing insects comprises light source(s) as attractant, funnel(s) below the light source to direct attracted insects into the insect collecting chamber which has body preferably semi porous. The insect collecting chamber accommodates anther porous chamber(s) required for adjusting the size of pores of the body of insect collecting chamber. The insect collecting chamber accommodates a lid preferably at the bottom to open or close the chamber. The insect collecting chamber also accommodates the light source(s) on its outer side. The insect collecting chamber is covered by a protective covering. The light trap attracts the insects particularly which are responding to the light source such as moths, flies, beetles, hoppers, wasps etc. towards it. These insects fall down in the funnel kept below it and get trapped into the insect collecting chamber. In the influence of the light source(s) which has been provided inside the protective covering, the porous body of the insect collecting chamber facilitates automatic sieving and grading of insects. As per requirement, the pore size of the insect collecting chamber can be adjusted according to the size of the insect pest complex
of the crop or cropping system with the help of another porous structures(s) provided in the insect collecting chamber. This helps in the separation of beneficial insects (such as parasitoids) which are smaller in size in comparison to harmful insects which are particularly large-sized insects such as moths, crickets, beetles, flies etc. The harmful insects trapped inside the insect collecting chamber can be easily removed from there. Mass trapping of adults of both sexes of insect pests by light trap will help in minimizing their infestation in the crop fields. On the other side, the escape of beneficial insects from the insect collecting chamber of the light trap is a desirable characteristic. It will prove an important tool of eco-friendly integrated pest management strategies against crop pests.

In an embodiment of the present invention, is provided that this light trap can be installed in the crop fields or can be hanged on the trees or alike systems. It can be used for mass trapping of harmful insect pests in the fields.

In another embodiment of the present invention, the light trap is provided in the field to trap different category of insect pests during whole crop season by just adjusting the pore size of the insect collecting chamber.

In yet another embodiment of the present invention, the insect parasitoids which are naturally occurring in the crop fields will automatically escape from the porous body of the insect collecting chamber and the harmful insect pests can't escape from this trap due to their bigger body size and they remain trapped inside the light trap.

In still another embodiment of the present invention, the action of parasitic wasps escaped from the trap is that these will search the insect pests attacking on the crops and parasitizes them and they will further multiply in numbers while destroying the insect pests damaging the crops.

In yet another embodiment of the present invention, the light trap can be used during different crop growth periods or during the different periods of the year for mass
trapping of harmful insect pests and side by side safe to the beneficial insects by just adjusting the pore size of the insect collecting chamber as per requirement.

**Brief Description of the Accompanying Drawing**

A light trap for managing insects according to a preferred embodiment is herein described and illustrated in the accompanying drawings wherein;

FIG. 1 illustrates a light trap for managing insects in accordance with a preferred embodiment of the present invention.

**Detailed Description of the Invention**

Reference will now be made in detail to the preferred embodiment of the present invention, examples of which are illustrated in the accompanying drawing.

Referring to FIG. 1, light trap for managing insects comprises of: light source(s) as attractant 1, protective roof 2 over the light source(s), funnel(s) 3 to direct lured insects into the insect collecting chamber(s) 4.

The protective roof accommodates the light source(s). The light source contains a timer 5 and provisions for having electric wires to get electricity current supply from the energy source. The funnel consists of baffles 6. The baffles support the protective roof. At the top, the protective roof contains a structure preferably hook shaped 7 required to install the whole unit in the crop fields. The delivery end of the funnel accommodates insect collecting chamber having body preferably semi porous and circular in shape. The insect collecting chamber also contains a lid 8 preferably in the bottom required to open or close the chamber.
The insect collecting chamber accommodates structure(s) 9 preferably curved in shape having porous mean(s) in it. These curved structure(s) preferably remain inside the insect collecting chamber and have provisions to accommodate the ball bearings 10 near their top and bottom portions inside the insect collecting chamber for their easy rotation. This is required to adjust the size of the pores of the insect collecting chamber as per the specific requirements. These curved structures accommodate the regulator (s) 11 which helps in regulating their rotation inside the insect collecting chamber. The slits are provided in the wall of the insect collecting chamber to insert the regulators. The regulators consist of indicators. The numberings are marked preferably on the insect collecting chamber for rotating of the curved structures in the definite precision manner.

The insect collecting chamber has provisions to accommodate the rods on the outer side of its body which consist of light sources 12. The light sources exist in front of the porous means of the insect collecting chamber. The light source accommodates a timer 13 and provisions for having electric wires to get energy from the source.

The funnel at the rear end also accommodates a frame which supports a protective covering 14 which covers the insect collecting chamber from all sides except the bottom. At the bottom portion, it accommodates a hollow structure 15 preferably circular in shape which facilitates the expansion of the protective covering.

The light trap for managing insects can be installed in the crop field or hanged on the trees or alike structures wherever one would like to control the insect pests. The height of the light trap can be kept as per the required height of crop. The light trap for managing insects can be used for sampling purpose, insect monitoring, mass trapping of harmful insect pests etc. in the crop fields. The light trap starts attracting the insects particularly which are responding to the light source such as moths, flies, beetles, hoppers, wasps etc. towards it. These insects fall down in the funnel kept below it and get trapped into the insect collecting chamber. In the influence of the light source(s) which has been provided inside the protective covering, the porous means of the insect collecting chamber facilitates
sieving and grading of insects into different categories. This helps in the separation of beneficial insects (such as parasitoids) which are smaller in size in comparison to harmful insects which are particularly large-sized insects such as moths, crickets, beetles, flies etc. The harmful insects trapped inside the insect collecting chamber can be easily removed from there. Mass trapping of adults of both sexes of insect pests by light trap will help in minimizing their attack in the crop fields. On the other side, the escape of beneficial insects from the insect collecting chamber of the light trap is a desirable characteristic. These parasitic insects will search the insect pests attacking on the crops and may parasitize them. Thus they will further multiply in numbers while killing the insect pests damaging the crops. The multiplication of the parasitoid wasps while destroying the insect pests in the crop fields will be dynamic process. In this way, the insect pests attacking the crops can be suppressed effectively and timely.

As per requirement, the size of the pores of the insect collecting chamber can be regulated (opening-closing or increasing-decreasing of the size of pores) with the help of the regulators. The regulators govern the rotation of the curved structure(s) inside the insect collecting chamber which in turn governs the opening-closing or increasing-decreasing of the size of pores of the insect collecting chamber. Depending upon the size of the insect pest complex of the targeted crop(s), the desired pore size of the insect collecting chamber can be maintained with the help of the regulators. The light trap can be used during different crop growth periods or during the different periods of the year for trapping of harmful insects. It will prove an important tool of eco-friendly integrated pest management strategies against crop insect pests.

EXAMPLES:

Insect traps were set in triplicate in three different fields in the Kharif season in the year 2010 i.e. Paddy, Sugarcane and Cauliflower. DVPP swab was placed in an umbrella bag to make the insects unconscious and the insects that escaped from the trap were counted next morning. The traps were left overnight and the collected / escaped insects were assessed next morning.
Pore size of insect light trap (in the filter chamber)

<table>
<thead>
<tr>
<th>Most preferred pore size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Range of pore size</th>
</tr>
</thead>
<tbody>
<tr>
<td>pore size (mm)</td>
</tr>
<tr>
<td>1 mm to 21 mm</td>
</tr>
</tbody>
</table>

Table: Major Insects belonging to order found escaped from the filter chamber pores (5mm size) of light trap

<table>
<thead>
<tr>
<th>S.no</th>
<th>Order</th>
<th>Insect Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hymenoptera</td>
<td>Ichnemonidae</td>
</tr>
<tr>
<td>2</td>
<td>Coleoptera</td>
<td>Braconidae</td>
</tr>
<tr>
<td>3</td>
<td>Dermaptera</td>
<td>Formicidae</td>
</tr>
<tr>
<td>4</td>
<td>Diptera</td>
<td>Identified parasitic wasps of Hymenoptera</td>
</tr>
</tbody>
</table>

Table: Insect families/order of parasitoids/predators/beneficial/non-targeted insects escaped from pores (5mm size) of the filter chamber of the light trap in different crops during 2010

<table>
<thead>
<tr>
<th>Insect Order</th>
<th>Insect Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hymenoptera</td>
<td>Ichnemonidae</td>
</tr>
<tr>
<td></td>
<td>Braconidae</td>
</tr>
<tr>
<td></td>
<td>Formicidae</td>
</tr>
<tr>
<td></td>
<td>Identified parasitic wasps of Hymenoptera</td>
</tr>
<tr>
<td>Diptera</td>
<td>Ephyridae</td>
</tr>
<tr>
<td>Dermaptera</td>
<td>Forficulidae</td>
</tr>
<tr>
<td>Coleoptera</td>
<td>Staphylinidae</td>
</tr>
</tbody>
</table>

Table: Major insects trapped by light trap in different crops during 2010

<table>
<thead>
<tr>
<th>Crop</th>
<th>Crop stage</th>
<th>season</th>
<th>Location</th>
<th>Target insect pests trapped</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cauliflower</td>
<td>vegetative</td>
<td>Early/rainy</td>
<td>NCR, Delhi</td>
<td>Tobacco caterpillar: Spodoptera litura</td>
</tr>
<tr>
<td></td>
<td></td>
<td>season</td>
<td></td>
<td>Diamond back moth: Plutella xylostella</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Black cutworm, Agrotis sp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Field crickets, Gymnogryllus humeralis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mole crickets, Gryllotalpa grylotalpa</td>
</tr>
</tbody>
</table>
**Collection of literature related to the topic**  
Table: List of Insects trapped by light trap in different crops based upon literature

<table>
<thead>
<tr>
<th>Crop</th>
<th>Insect pest trapped</th>
</tr>
</thead>
</table>
| Paddy                 | rice yellow stem borer, *Scirpophaga incertulas* Walker  
                         | rice leaf folder, *Cnaphalocrocis medinalis* Guenee                                                                                                    |
|                       | green leaf hopper: *Nephotettix nigropictus* and *Nephotettix virescens*  
                         | rice plant hoppers, *Nilaparvata lugens* and *Sogatella furcifera*                                                                                     |
|                       | Rice bug: *Leptocoris varicornis* Fabr.  
                         | rice gall midge: *Orseolia oryzae*                                                                                                                        |
| Cotton                | gram pod borer, *Helicoverpa armigera*  
                         | pink bollworm: *Pectinophora gossypiella*  
                         | spotted bollworm, *Earias vittella*                                                                                                                        |
|                       | Tobacco caterpillar, *Spodoptera litura*                                                                                                                |
|                       | Jassid, *Amrasca biguttula biguttula*                                                                                                                     |
| Pulse crops           | Gram pod borer, *H. armigera*  
                         | Tobacco caterpillar, *S. litura*  
                         | Green semi looper, *Plusia chalcites*                                                                                                                      |
|                       | Cabbage semi looper, *Plusia orichalcea*                                                                                                                 |
|                       | Black cutworm, *Agrotis ipsilon*                                                                                                                          |
|                       | Field crickets, *Gymnogryllus humeralis*                                                                                                                  |
|                       | Mole crickets, *Gryllotalpa gryllotalpa*                                                                                                                   |
|                       | Grass hopper, *Trilophidia cristata*, *Gastrimargus transversus*                                                                                         |
| greengram             | seed weevil, *Apion amplum* (Faust)                                                                                                                        |
| Maize                 | stem borer, *Chilo suppressalis*  
<pre><code>                     | the European corn borer, *Ostrinia nubilalis* Hbn.                                                                                                      |
</code></pre>
<p>|                       | groundnut leaf miner, <em>Aproaerema modicella</em>                                                                                                             |
|                       | thrips, <em>Frankliniella occidentalis</em> (Pergande)                                                                                                           |
| Soybean               | soybean looper, <em>Thysanoplusia orichalcea</em>                                                                                                               |</p>
<table>
<thead>
<tr>
<th>Plant Group</th>
<th>Pest Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarcane</td>
<td><em>Sesamia calamistis</em>, <em>Mythimna</em> spp., <em>Spodoptera exempta</em>, <em>Chilo injuscatellus</em> Snellen, <em>Scirpophaga</em> sp.</td>
</tr>
<tr>
<td>White grub</td>
<td></td>
</tr>
<tr>
<td>Grasshopper</td>
<td></td>
</tr>
<tr>
<td>Sorghum crop, Brinjal</td>
<td>stem borer, <em>Chilo partellus</em></td>
</tr>
<tr>
<td>Tomato</td>
<td>The tomato leafminer, <em>Tula absoluta</em>, <em>Helicoverpa armigera</em></td>
</tr>
<tr>
<td>Cole crops</td>
<td>Diamond back moth, <em>Plutella xylostella</em></td>
</tr>
<tr>
<td>turnip</td>
<td>turnip moth, <em>Scotia segetum</em> Schiff.</td>
</tr>
<tr>
<td></td>
<td><em>Harpalus griseus</em>, <em>H. calceatus</em>, <em>Amara bifrons</em> and <em>H. froelichi</em> (in an apple orchard near Bucharest, Hungary)</td>
</tr>
<tr>
<td></td>
<td><em>Agrotis segetum</em>, <em>Peridroma saucia</em></td>
</tr>
<tr>
<td>Tropical and subtropical fruits</td>
<td></td>
</tr>
<tr>
<td>Mango</td>
<td>mango leafhoppers, <em>Idioscopus</em> spp., <em>I. clypealis</em> and <em>I. niveosparsus</em></td>
</tr>
<tr>
<td>Date palm</td>
<td><em>Oryctes elegans</em> Prell.</td>
</tr>
<tr>
<td></td>
<td>date palm fruit stalk borer, <em>Oryctes elegans</em> Prell</td>
</tr>
<tr>
<td>Polyphagous insect pests and others</td>
<td>white grub, <em>Holotrichia</em> sp.</td>
</tr>
<tr>
<td></td>
<td><em>Mythimina</em> sp., <em>Agrotis ipsilon</em> (Hufn.)</td>
</tr>
<tr>
<td></td>
<td>beet armyworm, <em>Spodoptera exigua</em> (Hubner), cutworm, <em>Agrotis ipsilon</em> (Hufn.)</td>
</tr>
<tr>
<td></td>
<td>scarabaeids including <em>Anomala dimidiata</em>, <em>Holotrichia longipennis</em>, <em>Mimela fulgidivittata</em></td>
</tr>
<tr>
<td></td>
<td><em>Dysdercus cingulatus</em></td>
</tr>
<tr>
<td></td>
<td><em>Spodoptera littoralis</em> (Boisd.)</td>
</tr>
<tr>
<td></td>
<td><em>Agrotis flammatra</em></td>
</tr>
<tr>
<td>Animal Name</td>
<td>Scientific Name</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>cutworms</td>
<td>Agrotis spp. (Lepidoptera: Noctuidae)</td>
</tr>
<tr>
<td>H. assulta</td>
<td></td>
</tr>
<tr>
<td>beet armyworm</td>
<td>Spodoptera exigua</td>
</tr>
<tr>
<td>Achaea janata</td>
<td></td>
</tr>
<tr>
<td>Grammodes stolida</td>
<td></td>
</tr>
<tr>
<td>Parallelia torrida</td>
<td></td>
</tr>
<tr>
<td>Spirama retorta</td>
<td></td>
</tr>
<tr>
<td>Tobacco horn worm</td>
<td>Menduca sexta in USA</td>
</tr>
<tr>
<td>Acherontia lachesis</td>
<td></td>
</tr>
<tr>
<td>Dolbina inexacta</td>
<td></td>
</tr>
<tr>
<td>Psilogramma increta</td>
<td></td>
</tr>
<tr>
<td>Clanidopsis exusta</td>
<td></td>
</tr>
<tr>
<td>Oxyambulyx liturata</td>
<td></td>
</tr>
<tr>
<td>0. maculifera</td>
<td></td>
</tr>
<tr>
<td>Marumba dyras dyras</td>
<td></td>
</tr>
<tr>
<td>Acomsmyrxy naga</td>
<td></td>
</tr>
<tr>
<td>Acomsmyrxy sericeus</td>
<td></td>
</tr>
<tr>
<td>Nephele didyama</td>
<td></td>
</tr>
<tr>
<td>Cechenena lineosa lineosa</td>
<td></td>
</tr>
<tr>
<td>Hippotion eson, H. rafflesi, H. celerio</td>
<td></td>
</tr>
<tr>
<td>Therreta clotho clotho</td>
<td></td>
</tr>
<tr>
<td>Thysanoplusia orichalcea (Fab.)</td>
<td></td>
</tr>
<tr>
<td>adult midges</td>
<td>Tokunagayusurika akamusi,</td>
</tr>
<tr>
<td>Hyphaecia immans</td>
<td></td>
</tr>
<tr>
<td>chironomid midges</td>
<td>Polypedilum arundinetum</td>
</tr>
<tr>
<td>Parachironomus arcuatus</td>
<td></td>
</tr>
<tr>
<td>Microchironomus ishii</td>
<td></td>
</tr>
<tr>
<td>Tanytarsus oyamai</td>
<td></td>
</tr>
<tr>
<td>Chironomus kienesis</td>
<td></td>
</tr>
<tr>
<td>Tanypus punctipennis</td>
<td></td>
</tr>
<tr>
<td>Pentapedilum tigrinum</td>
<td></td>
</tr>
<tr>
<td>Polypedilum masudai</td>
<td></td>
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<tr>
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<td>Cricotopus sylvestris</td>
<td></td>
</tr>
<tr>
<td>Tokunagayusurika akamusi</td>
<td></td>
</tr>
<tr>
<td>The phlebotomine sand fly Lutzomyia velezi sp.nov.</td>
<td></td>
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<tr>
<td>Spodoptera exempta</td>
<td></td>
</tr>
<tr>
<td>Autographa nigrisigna</td>
<td></td>
</tr>
<tr>
<td>Loxostege sticticalis,</td>
<td></td>
</tr>
<tr>
<td>Spodoptera exigua</td>
<td></td>
</tr>
<tr>
<td>Lacanobia oleracea</td>
<td></td>
</tr>
<tr>
<td>Mamestra brassicae</td>
<td></td>
</tr>
<tr>
<td>Hyphantria cunea</td>
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</tr>
</tbody>
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Autographa gamma  
Thysanoplusia orichalcea  
Sesamia inferens  
Spirama retorta  

Roman beekeepers used light-traps for the control of Galleria mellonella  

Acrosternum hilare (Hemiptera: Pentatomidae)  

Haralpus rufipes (Coleoptera: Carabidae), Adoretus sp. (scarabaeid)  

Euprostis spp. (lymantrid), Brahmina spp. (scarabaeid), Lacon spp. (elaterid), Epilachna sp. (coccinellid), Anomala spp. (scarabaeid), Pycna repanda (cicadid), Agrotis spp. (noctuid).  

hemipterous insects belonging to 58 genera of 16 families (Alydidae, Anthocoridae, Berytidae, Coreidae, Cydnidae, Dicranoccephalidae, Joppeicidae, Lygaeidae, Miridae, Nabidae, Pentatomidae, Plasidae, Piesmidae, Pyrrhocoridae, Reduviidae and Rhopalidae).  

| Crop: Sugarcane | Location: Distt. Sonipat, Haryana |  
| Insect order | Av. Insect trapped inside light trap/night/trap |  
| Lepidoptera | 19 |  
| Coleoptera | 8 |  
| Hymenoptera | 1 |  

Table 1. Insect trapped inside light traps installed near sugarcane fields during first fortnight of June, 2010  

| Insect families | Insect orders | Av. insects escaped/night/trap |  
| Formicidae | Hymenoptera | 7 |  
| Braconidae | Hymenoptera | 3 |  
| Forficulidae | Dermaptera | 2 |  
| Staphylinidae | Coleoptera | 85 |  
| Unidentified (small beetles) | Coleoptera | 398 |  

Table 1.1. Insect escaped from the filter chamber through the pores of light trap (5mm) installed near sugarcane fields during first fortnight of June, 2010  

| Insect order | Av. Insect trapped inside light trap/night/trap |  
| Coleoptera | 81 |  
| Hemiptera | 8 |  
| Hymenoptera | 1 |  
| Lepidoptera | 4 |  
| Orthoptera | 1 |  

Table 2. Insect trapped inside light traps installed near sugarcane fields during 2nd fortnight of June, 2010  

Table 2.1. Insect escaped from the filter chamber through the pores (5 mm) of light trap installed near sugarcane fields during 2nd fortnight of June, 2010

<table>
<thead>
<tr>
<th>Insect families</th>
<th>Insect orders</th>
<th>Av. insects escaped/night/ trapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formicidae</td>
<td>Hymenoptera</td>
<td>243</td>
</tr>
<tr>
<td>Unidentified (small wasps)</td>
<td>Hymenoptera</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 3. Insect trapped inside light traps installed near sugarcane fields during 2nd fortnight of October, 2010

<table>
<thead>
<tr>
<th>Insect order</th>
<th>Av. Insect trapped inside light trap/night/ trapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleoptera</td>
<td>142</td>
</tr>
<tr>
<td>Hemiptera</td>
<td>431</td>
</tr>
<tr>
<td>Lepidoptera</td>
<td>66</td>
</tr>
</tbody>
</table>

Table 3.1. Insect escaped from the filter chamber through the pores (5 mm) of light trap installed near sugarcane fields during 2nd fortnight of October, 2010

<table>
<thead>
<tr>
<th>Insect families</th>
<th>Insect orders</th>
<th>Av. insects escaped/night/ trapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylinidae insects</td>
<td>Coleoptera</td>
<td>1100</td>
</tr>
<tr>
<td>Unidentified small beetles</td>
<td>Coleoptera</td>
<td>8231</td>
</tr>
<tr>
<td>Unidentified</td>
<td>Hemiptera</td>
<td>120</td>
</tr>
<tr>
<td>Ichneumonidae</td>
<td>Hymenoptera</td>
<td>8</td>
</tr>
<tr>
<td>Braconidae</td>
<td>Hymenoptera</td>
<td>5</td>
</tr>
<tr>
<td>Unidentified</td>
<td>Dermaptera</td>
<td>127</td>
</tr>
</tbody>
</table>

Table: Percentage escape of Staphylinidae insects (order Coleoptera) from light trap pores of (different sizes) installed in sugarcane fields during first fortnight of June, 2010

<table>
<thead>
<tr>
<th>Insects</th>
<th>% insects escaped/night from the pores (pore size 5mm at centre)</th>
<th>% insects escaped/night from the pores (pore size 3mm at centre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylinidae insects</td>
<td>73.4</td>
<td>38.5</td>
</tr>
</tbody>
</table>

Crop: Paddy
Location: Near NCR, Delhi and Distt. Sonipat, Haryana
Table 1. Insect trapped inside light traps installed in paddy fields during 1st fortnight of Sept., 2010

<table>
<thead>
<tr>
<th>Insect order</th>
<th>Av. Insect trapped inside light trap/night/ trapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lepidoptera</td>
<td>83</td>
</tr>
<tr>
<td>Coleoptera</td>
<td>26</td>
</tr>
<tr>
<td>Hemiptera</td>
<td>24</td>
</tr>
<tr>
<td>Orthoptera</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 1.1. Insect escaped from the filter chamber through the pores (5 mm) of light trap installed in paddy fields during 1st fortnight of Sept., 2010
<table>
<thead>
<tr>
<th>Insect families</th>
<th>Insect orders</th>
<th>Av. insects escaped/night/trap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylinidae</td>
<td>Coleoptera</td>
<td>192</td>
</tr>
<tr>
<td>Unidentified small beetles</td>
<td>Coleoptera</td>
<td>141</td>
</tr>
<tr>
<td>Braconidae</td>
<td>Hymenoptera</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 2. Insect trapped inside light traps installed in paddy fields during 1st fortnight of Oct., 2010

<table>
<thead>
<tr>
<th>Insect order</th>
<th>Av. Insect trapped inside light trap/night/trap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleoptera</td>
<td>135</td>
</tr>
<tr>
<td>Lepidoptera</td>
<td>19</td>
</tr>
<tr>
<td>Hemiptera</td>
<td>660</td>
</tr>
<tr>
<td>Odonata</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2.1. Insect escaped from the filter chamber through the pores (5 mm) of light trap installed in paddy fields during 1st fortnight of Oct., 2010

<table>
<thead>
<tr>
<th>Insect families</th>
<th>Insect orders</th>
<th>Av. insects escaped/night/trap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylinidae</td>
<td>Coleoptera</td>
<td>222</td>
</tr>
<tr>
<td>Unidentified small beetles</td>
<td>Coleoptera</td>
<td>391</td>
</tr>
<tr>
<td>Unidentified small beetles</td>
<td>Hemiptera</td>
<td>213</td>
</tr>
</tbody>
</table>

Table 3. Comparison of insects trapped and escaped in the light traps installed in different crops during 2010

<table>
<thead>
<tr>
<th>Crop</th>
<th>Period</th>
<th>Insects trapped in the newly developed light trap/night/trap</th>
<th>Insects escaped from the pores (5 mm diameter) of the newly developed light trap/night/trap</th>
<th>Insects to be trapped and died in the ordinary light traps present in the markets/night/trap</th>
<th>% insects saved from unnecessary mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarcane</td>
<td>1st fortnight of June</td>
<td>28</td>
<td>495</td>
<td>523</td>
<td>94.65</td>
</tr>
<tr>
<td></td>
<td>2nd fortnight of June</td>
<td>95</td>
<td>249</td>
<td>344</td>
<td>72.38</td>
</tr>
<tr>
<td></td>
<td>2nd fortnight of October</td>
<td>639</td>
<td>9591</td>
<td>10,230</td>
<td>93.75</td>
</tr>
<tr>
<td>Paddy</td>
<td>1st fortnight of September</td>
<td>135</td>
<td>342</td>
<td>477</td>
<td>71.70</td>
</tr>
<tr>
<td></td>
<td>1st fortnight of October</td>
<td>815</td>
<td>826</td>
<td>1641</td>
<td>50.34</td>
</tr>
</tbody>
</table>
The advantages of this insect trap are:

(i) This trap can be used to monitor or mass trap the population of phototrophic insect pests in the crop fields.

(ii) The mass trapping of both the sexes of the harmful insect pests will reduce their population in the crop fields.

(iii) The space to accommodate large trapping of population of insect pests can be possible by just increasing the length or the diameter of the insect collecting chamber or both.

(iv) The sole dependency on the chemical pesticides for the control of insect pests can be minimized.

(v) Expenditure on pesticides and their application will decrease. Biodiversity will increase. Eco-system will be least disrupted.

(vi) Decrease in the pressure of pesticides on other natural enemies will allow them to play an additive part in suppressing the insect pests. The natural control balance between insect pest and natural enemies which at present is lost due to the mortality of natural enemies by the injudicious use of chemicals over the years may be restored in the ecosystems.

(vii) It is durable and can be used again and again.

(viii) The trapped insects can be easily removed and used for any purpose.

(ix) The individual or a group of farmers can use this light trap to control the insect pests damaging the crops and side by side save the beneficial parasitoid wasps.

As those skilled in the art will understand, there are many variations or alterations of the device that can be made using the principles and devices discovered by the inventor. Therefore, the above description is not intended to be limiting but, instead, illustrative.
Accordingly, it is the intention of the inventor to embrace all such variations and alterations as fall within the spirit and broad scope of the appended claims.
Claims:

1. A light trap for managing insects comprising:
   at least one insect attracting light source;
   a receptacle having an opening into which insects can enter and trapped in the insect collecting chamber kept below it;
   the receptacle accommodating baffles and the roof over it;
   the roof having provisions to install the whole unit in the crop fields;
   the insect collecting chamber having porous means in it; the insect collecting chamber accommodating at least one structure having porous mean(s) in it and having provisions to rotate it in/on the insect collecting chamber;
   the structure having porous mean(s) comprising of at least one regulator to regulate its rotation as per requirement;
   at least one protective covering over the insect collecting chamber having solid top portion, walls and preferably hollow bottom; at least an insect attracting light with a timer inside the protective covering for attracting the trapped insects from the insect collecting chamber towards it for the aim of insect grading and sieving.

2. The light trap as claimed in claim 1, wherein the insect collecting chamber having porous means accommodating another structure(s) having porous means to facilitate insects of a special category to escape from it to outside based upon their specific body size.

3. The light trap as claimed in claim 1, wherein the regulator attached to the structure(s) having porous means governs the size of the porous means of the insect collecting chamber.

4. The light trap as claimed in claim 1, wherein the protective covering accommodates at least one insect attracting light inside it for attracting the trapped insects towards it from the insect collecting chamber.
5. The light trap as claimed in claim 1, wherein the pore size of insect light trap in the filter chamber varies from 2mm to 20mm.

6. A light trap for managing insects substantially as herein described with reference to the accompanying drawings.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC: A01M 1/04 (2006.01); A01M 5/00 (2006.01); A01M 5/02 (2006.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01 M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of data base and, where practicable, search terms used)
EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
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<td>US 411372 A (LANDAUS, LIONEL RICARDO) 24 October 1978 (24.10.1978) Claim 1; Description Column 2 Line 53 - Column 3 Line 3; Fig. 1</td>
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</table>

[1] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

Date of the actual completion of the international search 07 May 2012 (07.05.2012)

Date of mailing of the international search report 14 May 2012 (14.05.2012)

Name and mailing address of the ISA/AT Austrian Patent Office Dresdner Straße 87, A-1200 Vienna

Authorized officer HUNGER U.

Facsimile No. +43 / 1 / 534 24-535 Telephone No. +43 / 1 / 534 24-363

Form PCT/ISA/210 (second sheet) (July 2009)
<table>
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<td>This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:</td>
</tr>
<tr>
<td>1.  </td>
<td>Claims Nos.: &lt;br&gt;because they relate to subject matter not required to be searched by this Authority, namely:</td>
</tr>
<tr>
<td>2. ¾ Claims Nos.: 6</td>
<td>because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically.</td>
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<tr>
<td></td>
<td>Claim 6 contains a reference to the examples within the description and to the description itself. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here. As no concrete technical feature is revealed in claim 6, the claim was found unsearchable.</td>
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<td>3.  </td>
<td>Claims Nos.: &lt;br&gt;because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).</td>
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<td>As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.</td>
</tr>
<tr>
<td>2.  </td>
<td>As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.</td>
</tr>
<tr>
<td>3.  </td>
<td>As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:</td>
</tr>
<tr>
<td>4.  </td>
<td>No required additional search fees were timely paid by the applicant. Consequently, this international search report is only those claims for which fees were paid, specifically claims Nos.:</td>
</tr>
</tbody>
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**Remark on Protest**

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.
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