The Creation of BugBag

Redesign of Insect Trap for Biological Pest Control

Bachelor Thesis, Design & Innovation, june 2014 Mads Rømer Svendsen & Jakob Wulff Andersen

DTU

Introduction

The project is based on research on pheromones and the project SoftPest Multitrap. Copenhagen University's Science and Life Sciences, more specifically Department of Plant and Environmental Sciences, has researched and developed the pheromones for mass trapping of the Strawberry Blossom Weevil (Anthonomus Rubi) and the European Tarnished Plant Bug (Lygus Rugulipennis). Our focus is on the user-experience associated with the pheromonebased traps. Especially the distribution, assembly, setup, collection, cleaning, storage and

The Problem

The Strawberry Blossom Weevil and European Tarnished Plant Bug are a major problem to European strawberry producers and reduces the annual yield remarkably. The conventional strawberry producers can efficiently spray with pesticides to control the pest, however, this is harmful to the environment. The ecological strawberry producers lack effective pest control methods and has no options if they are attacked by the mentioned pests. A pheromone-based pest control method is a promising alternative and it is useful for both conventional- and ecological strawberry producers. However, a userdriven redesign of SoftPest Multitrap (figure 1) is necessary. This is to ensure that the traps can be easily implemented in the various production methods and be a competitive alternative to pesticides.

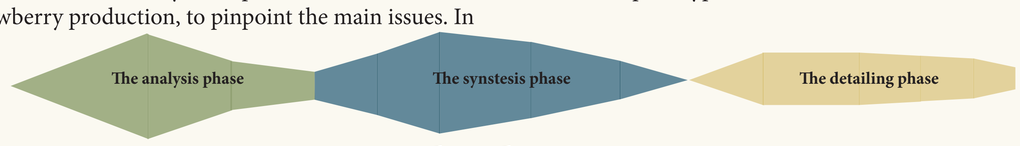
Figure 1

How it works

1. The insects are attracted by the pheromone in the top center of the trap.
2. The insects either fly or crawl as near as possible to the pheromone and therefore end up sitting on the wings of the trap.
3. After some time the insects get tired and are likely to fall off the wings down through the funnel into the insect container.
4. The insects are not smart enough to find out through the funnel holes due to their natural instincts which makes them strive upwards and towards light and scents. The gauze net thereby deceives the insects so they starve to death in the insect container.

The Design Process

The project has consisted of three phases - the analysis phase, the synthesis phase and the detailing phase. This is to structure the process and get all around the subject. In the analysis phase we have involved the users and studied every work process associated with strawberry production, to pinpoint the main issues. In the synthesis phase we have been generating, structuring and combining ideas, ending up with six different concepts. In the detailing phase we have combined two concepts, to detail a final concept and make a CAD-model and produce a functional prototype.

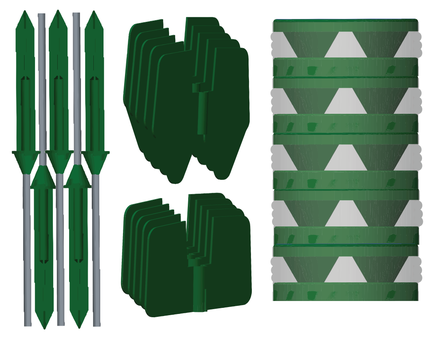


User Participatory Method

Due to the strawberry season starting in the spring, we had to setup different scenarios when doing our field ressearch in february. We observed our users go through different established work rutines. Later on we presented the 6 concepts, to use their knowledge for evaluation and to involve them in the selection of the final concept.

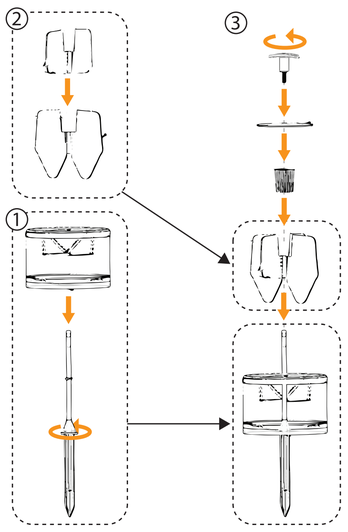
Distribution

The traps are distributed unassembled and therefore requires minimum space for packaging. The amount of traps required to protect 1 hectare of strawberry field (approximately 50 traps) is easily packed in a cardboard box of approximately 70x30x40cm (LxWxH).



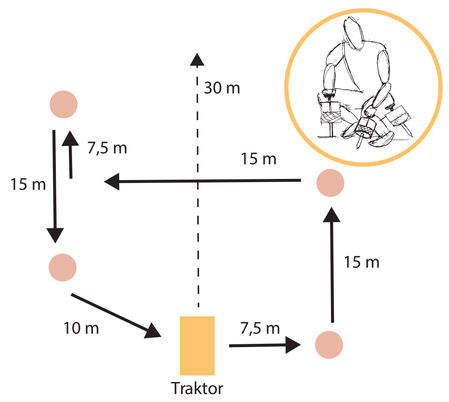
Assembly

The traps' components are mounted on the centered pole by mimicking a pearl on a string-principle making assembly of the traps a fast and intuitive process. First the pre-assembled insect container, consisting of a funnel, a gauze net and a conical plastic bottom is mounted on the centered pole by sliding the centered pole through the holes of the components. The pole comes pre-assembled with the plastic spear-end as seen on the illustrations. Then the wings are also assembled using a slit-principle. Finally the pheromone container, top cover are mounted and fastened by screwing the handle in the thread of the pole top. One trap is estimated to be assembled in less than 30 seconds.



Setup

Each trap covers the field in a radius of approximately 7,5 meter. The traps are positioned in a hexagonal pattern to ensure that maximum of the field area is protected. The traps can easily and efficiently be set up by 1 worker, who uses a tractor mounted with a trailer. The traps are set up four at a time, before returning to the tractor, walking in the pattern shown by the illustration. It is estimated that it takes 25 minutes to set up traps covering 1 hectare (approximately 50 traps).



Disposal

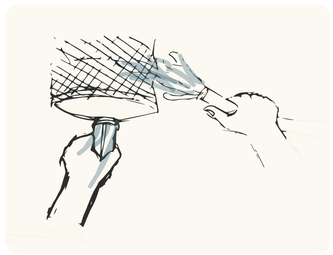
The majority of the components are made of HDPE while the pole is made of galvanized steel. Therefore broken components can be conveniently disposed through the existing waste management system on the strawberry production site.

Storage

The traps can be stored in any desired or available container. Due to the foldability of the gauze net and the overall compact size of the trap, disassembly before storage is not necessary. Furthermore the overall space needed for storage is relatively small in most strawberry production sites. The spear end is not sharp, so whether the traps are packed orderly or randomly there is no risk of damaging the gauze net.

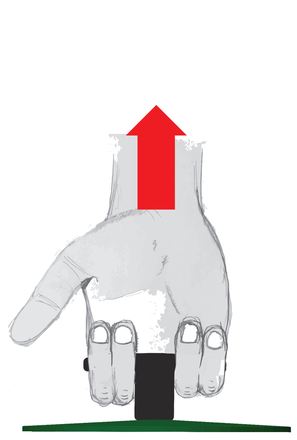
Cleaning

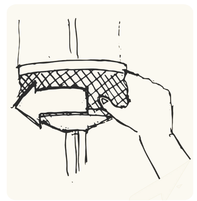
The traps can easily be cleaned with spraying water, both on the plastic component and also through the gauze net by afterwards emptying the insect container as described in the text below. The metal pole is made of galvanized steel to prevent it from corroding. The cleaning of 50 traps is estimated to take

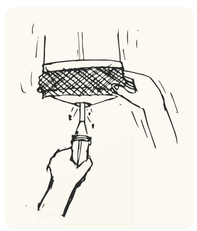


Collecting

The collection of traps is practically carried out like the setup process. The handle feature enables that the traps can be pulled up fast and ergonomically. After pulling up a trap, it is easily emptied through the hole in the center of the conical bottom. First the bottom is loosened by screwing it out of the slits in the conical bottom. When loosened the bottom can easily be lifted up from the conical stop to open the hole. The collecting and emptying of 50 traps is estimated to take 34 minutes.

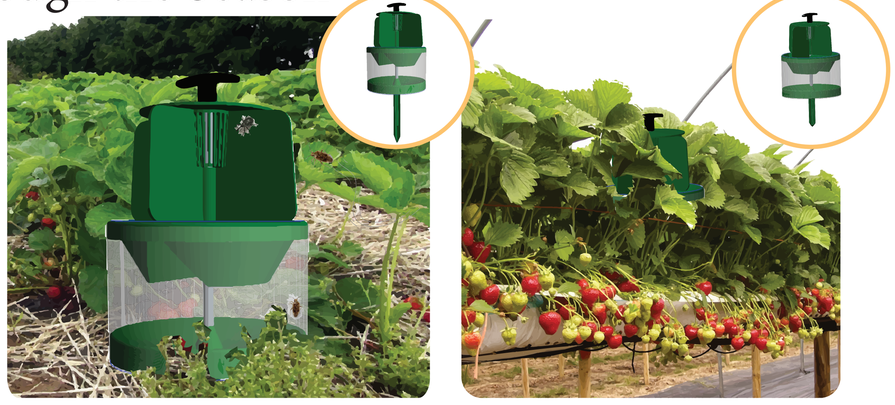






No Maintenance through the Season

The trap design is dimensioned to be as small and stable as possible. The height (22 cm) and radius (15 cm) of the trap is inspired by the size of a 1-year old strawberry plant, which allows machine hoeing over and under the trap, during the season. The spear-end feature ensures stable mounting in dry, hard or clayey soil. Two variations of the plastic spear-end makes the trap implementable in both open air and tunnel cultivation. The trap does not need to be emptied since the insect container is voluminous enough for a season. Due to the transparency of the gauze net it is



Market Considerations

An important aspect in this project is how competitive the trap is in relation to pesticides. To make an estimate, we decided to set up two scenarios and calculate the production costs. One for a 0-series production and one for a mass production. We conclude that the production cost spans from approximately € 40 and down to € 5 per unit (figure 2). The price depends on the production methods and number of units. We know that a market pull strategy is possible on the ecological market, due to a lack of alternative pest control methods. A technology push strategy is preferred when entering the conventional market. The strawberry producers are really profit-conscious, so pheromone-based pest control has to compete economically with pesticides. We set up nine different scenarios (figure 3) to compare the total costs, when time consumption and necessary equipment is added up. We conclude that pheromone-based pest control is preferable compared to pesticides, if pesticides result in an infestation of spider mites. If pheromone-based pest control is compared only to insecticides, insecticides are a few hundred euros cheaper pr. hectare. Before entering the market a more accurate and comprehensive market research

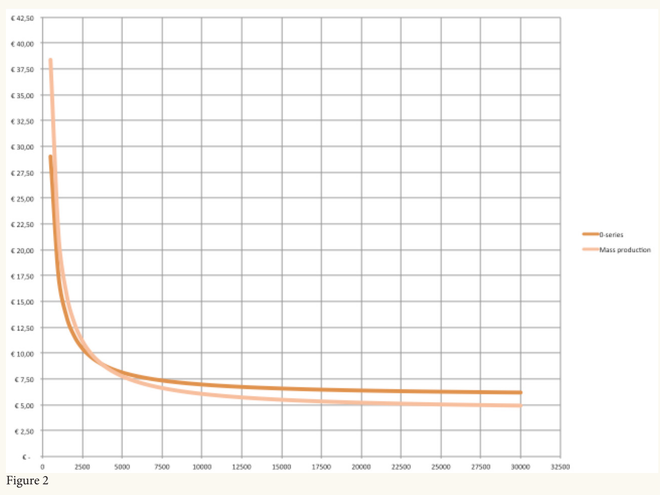


Figure 2

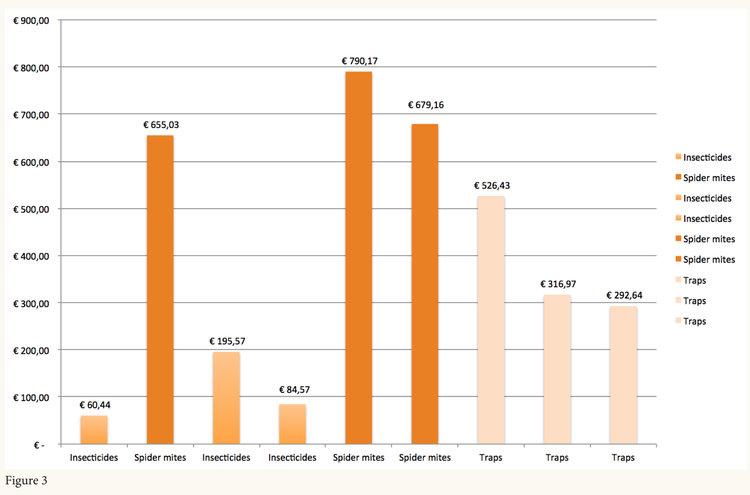


Figure 3