



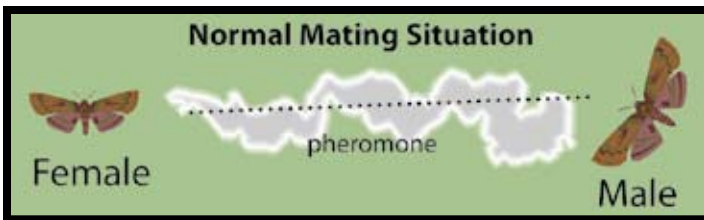
User's Guide to Mating Disruption and Attract & Kill Formulations

Updated 12/21/2011

PART ONE: INSECT PHEROMONE THEORY

INSECT PHEROMONES

Semiochemicals, such as sex pheromones, are chemical signals that insects use to communicate with one another. Sex pheromones are released by female insects to let males know they are available to mate. The female releases this chemical signal, which is carried by the wind to males. When a male becomes aware of the pheromone, he follows the plume upwind to reach the female and mate with her.

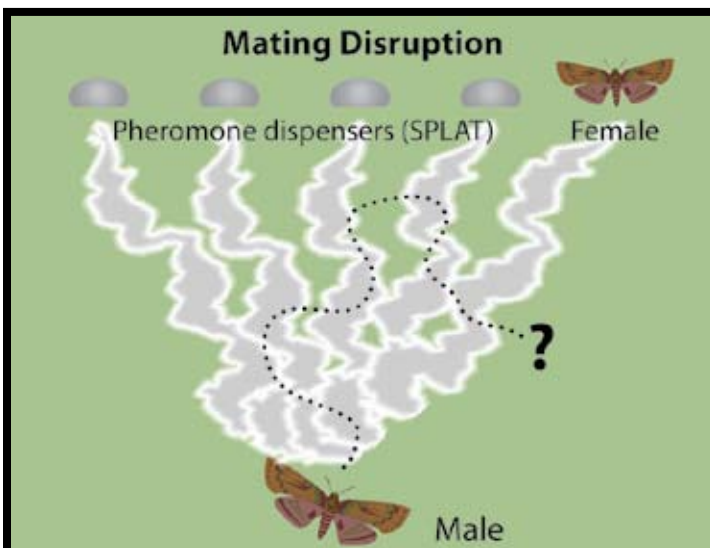


The majority of insect pheromone products use synthetic copies of the female pheromones, which will only attract males. Female sex pheromones have no effect on females.

Pheromones are also species specific, so there is no effect on any other species other than the target species, with only few exceptions.

MATING DISRUPTION

Mating disruption is an insecticide-free pest management strategy that uses synthetically produced nature identical pheromones to confuse males and limit their ability to locate females for mating. By reducing the likelihood of successful mating through mating disruption, the infestation level decreases.



HOW DOES MATING DISRUPTION WORK?

By placing several pheromone dispensers in the insect's habitat (i.e. codling moth pheromone dispensers in an apple orchard) we can permeate the atmosphere with pheromone and disrupt mating in 4 ways:

1. Habituation - Males become so accustomed to the pheromone that they do not respond to it. Since the pheromone is everywhere, they respond to it as if it was just naturally part of the environment. When a female tries to signal a male with her pheromone, he does not even notice it.

2. Camouflage - Males become bombarded by the pheromone, so that they cannot find the females they seek. When a female tries to signal a male with her pheromone, he is aware of it and wants to find her, but there is so much pheromone around him that he cannot distinguish between the pheromone dispensers and the female.

3. Competitive Attraction - Males are attracted to the pheromone put out by the pheromone dispensers, so actively seek to find the dispensers and not the female. This reduces the chance that they will find the female and mate with her.

4. Trapping - When the pheromone dispenser is placed in a trap, the males respond to the pheromone and become trapped. This removes the male from the population, thereby reducing the amount of mating that can occur.

ATTRACT & KILL

Attract & kill is an extension of mating disruption, which is characterized by the inclusion of an insecticide in addition to the pheromone active ingredient. By doing this, it is possible to achieve the same control methods as mating disruption, with the potential for increased efficacy resulting from the toxicity of the insecticide.

An additional benefit of an attract & kill formulation is that these formulations generally require less pheromone to be effective, since the target species does not need to be overwhelmed by the pheromone, it only needs to be attracted to it. Soon after the male touches or ingests the material (depending on the in-

secticide used) it is removed from the reproduction pool.

MONITORING

Monitoring refers to the practice of deploying sticky traps which are baited with pheromone lures for a single target species, then checking these traps on a regular basis to determine the level of activity.



The number of traps to be used per acre can vary depending on many factors, although 1 trap per acre can be a good starting point. More traps will give a more complete picture of the activity in your area.

Monitoring traps should always be deployed when using mating disruption or attract & kill control methods, since they will help you determine the efficacy of your control methods.

TRAP SHUTDOWN

Trap shutdown refers to the absence of trapped insects in the pheromone monitoring traps after pheromone treatment has been applied.

Once a pheromone treatment has been applied, the target species will be much less likely to locate the monitoring trap (as they would have similar difficulty finding a female to mate with). Trap shutdown throughout a growing season is usually a good indicator that effective mating disruption control has been accomplished. Monitoring traps should be monitored at least once a week to determine if mating disruption control is still effective. In situations when the season is longer (which requires more than one SPLAT application) or the target species is active year round, if the target species is being caught in the monitoring traps, then this is an indication that the mating disruption control effect has declined and the next application of SPLAT should be made.

TREATMENT AREA

There are several important factors that will influence the effectiveness of mating disruption for a treatment area. Determining whether an area is suitable

for mating disruption, and preparing an area for treatment, is critical for the success (or potential failure) of mating disruption programs. Two important factors to consider are:

BORDER EFFECT

In general, mating disruption works best in plots that are square-shaped with an area of at least 10 acres. Plots which are less than 10 acres or irregular shaped will have lower success due to the "border effect".

Border effect refers to the increased level of damage that is typically found around the borders of a pheromone treated area. There is always the possibility that mated females could reproduce outside the treated area and enter the border area to deposit eggs. Treatments based on female sex pheromones will have no effect on these females.

The prevalence of the border effect relies on many factors, especially the distance the target species will fly after mating. Some insects can fly long distances, increasing the border area. Others do not, which minimizes or eliminates the border effect.

To help minimize the border effect, apply so that 80% of the SPLAT is applied evenly throughout the area. Then apply the remaining 20% to the border areas. Ensuring that neighboring plots are treated effectively increases the treated area and will help to reduce the border effect.

UNTREATED OR INEFFECTIVELY TREATED AREAS IN THE VICINITY

In general, if there are host plants up to 200 meters outside your treated plot that are not treated for the target species, there is a possibility that male insects or mated female insects from these host plants may be attracted to, or fly into your treated plot. Control measures should be taken on these host plants, which may include if possible, expanding your treated area to encompass these host plants. In small plots of less than 10 acres, if there are untreated host plants up to 200 meters outside your plot, mating disruption may not be suitable.

PART TWO: SPLAT

SPLAT

SPLAT (Specialized Pheromone & Lure Application Technology) is a biologically inert matrix used by ISCA for the delivery of insect pheromones and other semiochemicals. SPLAT is made up of waxes, vegetable oils, water and other food grade materials which are non-toxic and bio-degradable.



SPLAT has the consistency of a hand lotion when it is applied and it hardens when it dries. A few hours after it is applied, the dry SPLAT is similar to the wax in candles or crayons.

HOW IT WORKS

To achieve mating disruption or attract & kill control, it is necessary to deploy the pheromone or active ingredient in the field. These chemicals are generally volatile, so they quickly evaporate or degrade when applied alone. By formulating these chemicals into SPLAT, the field life of these chemicals can be extended from weeks to months.

SPLAT also provides UV protection to the active ingredient and becomes rainfast after 3 hours.



DOLLOPS

One of the defining characteristics of SPLAT is the application pattern. SPLAT is not applied as a spray, but rather in discrete point sources, or "dollops". The dollops are applied throughout an area

Once the formulation is applied in the field, the pheromones on the surface are released while those on the inside remain protected. Over time, water evaporates from the dollop, shrinking the outer surface. When

this happens, the molecules on the inside of the dollop are pushed towards the surface.

DOLLOP SHAPE

To achieve maximum efficiency in the field, it is very important that the dollops are applied in a way that minimizes its relative surface area. The most ideal dollop shape is a spherical ball shape. Flat dollops reduce the longevity of the product.

DOLLOP SIZE AND NUMBER

Larger dollops will emit pheromone for a longer duration in the field than smaller dollops, since they have a bigger reservoir of pheromone.

More point sources applied in an area will promote

Traditional Pheromone Dispensers

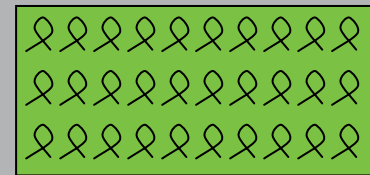


Figure 1a: For traditional dispensers, changes in the number of dispensers, changes amount of AI per acre.

SPLAT Pheromone Dispensers

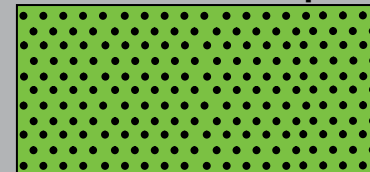


Figure 1b: For high pest pressure, number of applied dispensers can be increased while size of each dispenser is decreased; AI per acre remains unchanged.

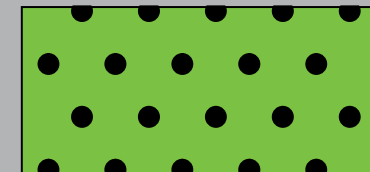


Figure 1c: For low pest pressure, number of applied dispensers can be decreased while size of each dispenser is increased; AI per acre remains unchanged.

Unlike traditional dispensers (1a), the number of SPLAT point sources can be tailored according to the pest density without changing the amount of AI per acre. For high pest densities, the use of many small point sources (1b) are more effective; for low pest densities, the use of fewer large point sources (1c) will provide adequate protection while providing protection for the entire season.

better pest suppression. Although the number can vary by species, it is generally ideal to have at least 200 point sources per acre.

DOLLOP PLACEMENT

SPLAT can be applied anywhere on the branches or foliage. Ideal placement is on a branch in the shaded canopy. Application directly to fruit should be avoided, although the damage caused is likely only cosmetic (depending on formulation).

USAGE GUIDELINES

WEATHER CONDITIONS

SPLAT will change consistency with temperature - thickening in colder temperatures and thinning in hotter temperatures.

STORAGE AND SHELF LIFE

For short term storage, keep SPLAT in the provided containers in a cool dry place. For long term storage, SPLAT should be stored in refrigeration between 35°F and 45°F. Do not freeze SPLAT.

APPLICATION CONDITIONS

For mechanized applications, apply SPLAT when the ambient temperature is above 55°F and below 95°F, which provides the optimal flowable characteristics for mechanized applications. If SPLAT was refrigerated for storage, allow SPLAT to warm to this temperature range, then follow procedures for mixing SPLAT before application.

For manual applications including caulking guns, if SPLAT was refrigerated for storage, it can be applied directly from refrigeration, which gives SPLAT a thicker more viscous consistency, and dispenses rounder SPLAT dollops. As SPLAT warms, it will gradually have a thinner less viscous consistency. To achieve rounder SPLAT dollops at warmer temperatures, where possible, apply SPLAT to horizontal surfaces (such as tree branches) instead of vertical surfaces (such as tree trunks) which causes SPLAT dollops to run downwards due to gravity.

SPLAT dollops typically cure within 2-3 hours following application, after which they will become rainfast, UV and temperature resistant. Do not apply SPLAT if rain is expected within 2-3 hours of application or if the temperature is expected to be above 95°F within 2-3 hours of application.

CHOOSING YOUR APPLICATION METHOD:

Shown below are suggested steps to review when choosing your application method, and preparing to use your application method. Most of these steps are only needed to prepare for your first time application with your chosen application method. Each application method has its advantages and disadvantages, so please choose the application method which maximizes the advantages and minimizes the disadvantages for your pest management situation. You can view the SPLAT YouTube page for more information about application methods and videos of various application methods.

1. Decide on an application method at least 4 weeks prior to application.
2. It is recommended to order SPLAT blank material (no AI) to test application equipment and become familiarized with SPLAT application.
3. Calibrate and test application equipment for the desired output. One way to test, practice, and develop procedures for your application method is to practice by applying SPLAT on corrugated box material.
4. If you are using a team of applicators, arrange to brief applicators, and provide opportunity for applicators to familiarize and practice SPLAT application with SPLAT blank material before the day of application. Among others, some recommended points to brief applicators include:
 - How to load and refill application equipment.
 - What is the ideal dollop size and shape
 - What is the application density, such as, number of dollops per acre/hectare, number of dollops per plant, number of dollops for border reinforcement to reduce border effect if necessary.
 - What steps if any should be taken after application, for example, equipment disassembly and cleaning, if necessary; how and where to store the unused SPLAT.
 - Arrange for your applicators to practice your SPLAT application cycle: before application procedures, application procedures (load, apply, refill), after application procedures.
5. If needed, arrange to consult with ISCA via email, telephone or video conference to review equipment and methods.

MIXING

The components of SPLAT will naturally separate as the product sits over time. Always mix SPLAT immediately before application using a drill and paint mixer, or similar.

If product packaging prevents mixing, such as caulking tubes, store tubes horizontally and minimize time in storage.

Always inspect SPLAT before application to ensure consistency of the product.



APPLICATION METHODS

MANUAL APPLICATION METHODS

The most economical method of applying SPLAT involves the use of simple hand tools. SPLAT can be applied using small wooden spatulas. SPLAT can also be pre-packed in caulking tubes for use with standard caulking guns.



MECHANICAL APPLICATION METHODS

SPLAT is a flowable material, capable of being pumped and applied using mechanical application equipment. SPLAT has been successfully applied using systems adapted to ATV's, tractors, airplanes and helicopters.

VIDEO DEMONSTRATIONS

Video demonstrations are viewable on ISCA's Youtube Channel, you can view them here:

www.youtube.com/iscatech.



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