LIQUID FUMIGANTS: GOING, GOING, GONE.

The Environmental Protection Agency is in the midst of examining its options on regulating residues of several liquid fumigants. Currently, EPA is prevented from establishing tolerance levels on residues of some liquid fumigants because of exemptions previously granted on the active chemical ingredients of those fumigants. EPA officials have stated that the agency hopes to announce within two months its intention to propose a removal of the tolerance exemption. This action is part of EPA's cancellation, as of December 31, 1984, of the registrations that permitted the manufacturing of certain liquid fumigants, particularly carbon tetrachloride and carbon disulfide. EPA also has written to manufacturers that it will ban the sale of such fumigants after Dec. 31, 1985.

This puts the grain handler in a 'Catch-22' position. The manufacturer of processed grain does not want the liquid fumigant residues on his product even though it is legal to apply to raw grain at this time. Many of the major food processors have purchased some pretty expensive equipment to analyze for these residues and will definitely reject any samples that contain carbon-tet. Some Midwestern food producers are rejecting all grain that has a carbon-tet level of over 20 ppb. This issue has the same sound as the recent EDB dilemma. Since grain reserves can and will be carried over after the December 31, 1985 deadline, we strongly recommend not to apply the liquid fumigants on grain intended for human consumption.

METHYL BROMIDE INFORMATION UPDATE

Purdue University was contracted to duplicate the Dutch Methyl Bromide studies that brought controversy to the fumigation industry in 1984. According to Dr. Vern White of Great Lakes Chemical Co. in W. Lafayette, IN, "we are now going through the 600 page report from Purdue. Initially everything looks fine. This report should refute the study done in the Netherlands last year."

FSS will keep you up-to-date on this issue as the report becomes public.

LABEL IMPROVEMENT PROGRAM 1986

One of the most important changes in the field of fumigation will take effect 1/1/86. The Label Improvement Program 1986 should make broad changes in the use of most fumigants. The LIP will further restrict the use of all fumigants and stress the importance to monitor levels of gas in the workplace. Detection equipment (ie. Draeger) will be essential on all fumigations. The use of self-contained breathing apparatus (SCBA) (ie. MSA Ultralite) will be listed on the labels for most fumigants.

Since this LIP is still under negotiation with the fumigant manufacturers and the EPA, a detailed article concerning the LIP will appear in the Fall Fumigants & Pheromones Newsletter.

SOVIETS FUMIGATE

The Soviet Union are testing in-transit fumigation on ships. Thus far, the Soviets do not customarily permit in-transit fumigation of grain applied to control insect infestation. The test was the result of a 10-day Soviet scientific mission to the United States in late April, 1985. The Soviets observed grain loading and in-transit grain fumigation procedures in New Orleans, and discussed procedures followed by the United States in inspecting and fumigating grain export shipments. Apparently, the malathion treated grain that was being sent to Russia was arriving with some degree of insect infestation.

Articles in this Issue of FUMIGANTS & PHEROMONES

- New uses for pheromones
- Liquid Fumigants: Going, going, gone
- Featured Writer: Daryl Faustini, Ph.D. Cold Temperature Fumigation
- Pheromones: (fer-a-mons)
- Fumigants & Pheromones Seminar
- Methyl Bromide Update
- Cigarette beetle pheromone
- Student goes 'international'
- Insect Spotlight
Magnesium Phosphide for Control at Low Temperatures

Phosphine, when generated from aluminum phosphide, is not recommended for use during low temperatures due to the long exposure period (e.g., at least 336 hours at 44 degrees (F) which would interfere with manufacturing time schedules. Magnesium phosphide evolves PH3 at a faster rate and was evaluated during low temperatures. Two separate series of tests were conducted to evaluate this new fumigant. The results showed that magnesium phosphide was effective in protecting stored tobacco from the cigarette beetle.

Tobacco was fumigated for 96 hours with phosphine generated from magnesium phosphide under three storage conditions: under a polyethylene tarpaulin within a warehouse; inside a freight container; and an entire tobacco warehouse, all at low temperatures. Phosphine concentrations were monitored at several points within the tobacco and in the air space. Test spikes containing insects were placed into hogheads and cases. The test spikes contained eggs, larvae, pupae, and adults of the cigarette beetle, Lasioderma sericorne (F.). Phosphine was applied at a dosage of 20 grams / 28.3 m3. Three polyethylene tarpaulin replicates were conducted at 4.2, 9.4, and 14.2 degrees C, and the maximum phosphine air space concentrations which were developed were 600, 750, and 725 ppm, respectively. For the freight container the average ambient temperature was 7.4 degrees C and developed a maximum air space phosphine concentration of 500 ppm. The mean ambient temperature in the tobacco warehouse was 8.2 degrees (C) resulting in a maximum air space concentration of 275 ppm. To insure working safety, 48 hours aeration period was required to reach the threshold limit value (TLV) of 0.3 ppm.

The second season’s data was collected on the use of magnesium phosphide at 1.1 degrees C or 34 degrees (F). This work resulted in the certification for up to 336 hours at 44 degrees (F) which would interfere with manufacturing time schedules. These restrictions are usually 40 degrees (F) or 4 degrees (C). Most manufacturers of fumigants go on to recommend that fumigants should not be used below 60 degrees (F) or 16 degrees (C). Dr. Faustini’s tests will offer an alternative with this new magnesium phosphide fumigant.

Conclusion of Study:
- Tobacco can be fumigated year-round without requiring heated buildings.
- Aeration of air space can be completed within 48 hours and the Threshold Limit Value (TLV) in tobacco can be reached in 48 to 72 hours post fumigation, if solid plastic liners (except Tyrek®) are not involved.
- Shorter residence time when compared to aluminum phosphide under same conditions.
- Winter fumigation will ultimately affect development of subsequent beetle generations, yielding less potential leaf damage.
- Fumigations can be staggered, lessening the strain of a large annual fumigation resulting in less gas being released into the atmosphere.
- Overwintering larvae, the most prevalent stage during the winter, are affected by the gas.
- 100% mortality was obtained in all cigarette beetle life stages tested.

Phosphine

Phosphine is the main fumigant used by the tobacco industry to arrest the cigarette beetle and tobacco moth. The importance of this fumigant results in continuous R & D to evaluate new methods of application or new formulations to provide the industry with greater insect control. Phosphine (Hydrogen phosphide) is biologically active and appears to present little long-term human health hazards.

COLD TEMPERATURE FUMIGATIONS

By: Daryl Faustini, Ph.D., Philip Morris Research Center, Richmond, VA.

FEATURED WRITER:

Daryl Faustini is a Research Scientist (Entomologist) for Philip Morris, USA. He is a world authority on pheromones and fumigants.

Cigarette beetles should be put on notice that this man is out to make life rough for them. Before starting with PM in 1982, he took a culmination of knowledge from the University of California, Ohio State, and the University of Wisconsin to the state of Virginia and the Tobacco industry.

Daryl is working with the cigarette beetle pheromone. In addition, he has improved techniques for the elimination of stored product insects using magnesium phosphide. His article will highlight his methods and results on Cold Temperature Fumigation.

This two-year study was designed to test the new fumigant DEGESCH-Fumi Cell™ for efficacy under winter conditions in stored tobacco. Often we are called upon to eliminate insects that have entered a commodity under warm conditions and have gone dormant to overwinter only to emerge in the spring to start the cycle over again. If these overwintering insects can be eliminated under cold conditions, they will not contaminate stored products. It seems logical to prevent the spread of pest insects at the overwintering stage rather than allow damage to occur during the warmer months when damage most assuredly occurs.

All fumigant labels have restrictions as to what temperature levels allow use of the product. These restrictions are usually 40 degrees (F) or 4 degrees (C). Most manufacturers of fumigants go on to recommend that fumigants should not be used below 60 degrees (F) or 16 degrees (C). Dr. Faustini’s tests will offer an alternative with this new magnesium phosphide fumigant.
CIGARETTE BEETLE PHEROMONE

Insects Limited, Inc. distributes a sex-attractant pheromone for the cigarette beetle (Lasioderma sericorne). This product goes by the name SERRICO™. It was first isolated by the Japanese in 1981. Since its introduction, it has become a viable monitoring tool for this destructive stored product insect pest. Serrico works by attracting the male beetles then trapping them on a special adhesive. This product has been developed by the Japan Tobacco and Salt Public Corporation to lessen the impact of conventional insecticides to control insect pests. The Serrico traps use a recently synthesized sex-pheromone called Serricornin. A powerful attractant, Serricornin, is set in conjunction with a food lure, and used to lure adult cigarette beetles onto the adhesive. The Serricornin and food lures come in tablets that are centered in the trap. We have found that the lure works better if you place the lures on edge in the trap rather than laying it flat.

One trap will protect about 10,000 cubic feet (1111 sq. ft.) for about 3 weeks.

Cigarette Beetle: This insect is found world-wide and especially in the southern half of the United States. In addition to being a pest to the tobacco industry, it is found in Natural Food Stores, Grocery Stores, Bakeries, Spice Manufacturing, Herbariums, and other places where dried vegetable matter is stored. It is often found in insect light traps. Practically all damage is done by the larvae.

The total development period is 8 - 13 weeks. The adults are strong flyers and seem to be most active around sunset when temperatures are above 65 degrees(F). Notice how the head is tucked down on the adult. This and the presence of many random hairs on the adult will help you identify this destructive pest.

FREE INSECT IDENTIFICATION

If you would like a second opinion on the stored product insects that are causing you problems, Insects Limited, Inc. will provide free identification assistance. We will be happy to send you identification aids, or you may send us preserved specimens for identification.

Specimens should be carefully wrapped in loose tissue paper or enclosed in a container along with a sample of the product in which it was found. Please include a note describing the circumstances under which the insects were found (Type of product, moisture conditions, etc.).

KNOWING THE PEST IS HALF THE BATTLE IN CONTROLLING IT

SPECIAL DISCOUNT ON PHEROMONE TRAPS!

Insects Limited, Inc. is offering a limited discount on pheromone traps: $10.00 off on the new "No Survivor™" Warehouse traps. This is an improved trapping system designed to last a whole trapping season.

One kit contains:
- 4 traps w/12 replaceable liners
- 8 Indian meal moth BioLures (120 days each)
- 8 Trogoderma BioLures (120 days each)

Please send me _____ kits
Discount Price: $64.00
Shipping: 3.00
Indiana Sales Tax (5%): (3.20)

SERRICO TRAPS; INTRODUCTORY OFFER

Insects Limited, Inc. has been selected as the sole distributor for the patented cigarette beetle pheromone (Sericornin) for the United States and Canada. Serrico® comes packed 10 traps/lures per kit and 20 kits per case. Because of its compact size, Serrico Traps can be placed just about anywhere, conveniently.

Please send me ____ Serrico Kits.
$45.00 per kit; 10 traps, 10 sex-attractant lures, and 10 food lures included in each kit. ($4.50 per trap)
$540 per case; 20 kits per case. ($27.00/kit)

Name _______________ 
Company Name ____________________________ 
City/State/Zip __________________________
FUMIGANTS & PHEROMONES SEMINAR

155 people attended the FUMIGANTS & PHEROMONES Seminar in Indianapolis on November 29 & 30, 1984. This day and a half meeting was attended by people from the grain, food processing, popcorn, seed and turf industries. The purpose of this re-certification seminar was to update the industry on new products, new techniques, and advanced strategies for controlling insects in stored food. One of the highlights of the meeting was a talk given by Dr. Roger Gold, Professor of Entomology at the University of Nebraska. Dr. Gold gave an inspiring presentation entitled: Vapona; Friend or Foe? He reminded us of some of the common sense practices that were taught to us; but, sometimes, we don't believe that the effort is needed. Gloves, gloves, gloves... there is not one thing more important in reducing pesticide exposure than a good pair of $9.00/ non-lined neoprene gloves that extend up the arms about 16 inches. It seems that much of the exposure to pesticides occurs when one pours an insecticide into the application equipment. We often think less about skin absorption from pesticides than we do inhalation exposure. We protect our lungs but allow pesticides to enter our blood stream. We purchase hundreds of dollars worth of respiratory equipment for scuba type gas masks but forget a pair of rubber gloves. Dr. Gold concluded his talk by saying that "If you are going to continue to use such highly toxic pesticides as 5% or 20% Vapona, first consider safety." To the question Vapona; Friend or Foe? Dr. Gold's answer was "Yes!" FSS believes that vapona should be treated just like a fumigant. If used with respect and proper safety equipment, vapona can be an environmentally safe insecticide. Not too long ago (1980), pyrethrin sprays skyrocketed to over $100 per gallon. Well it was amazing to see vapona enter the scene with quite relaxed label restrictions. For use in food and grain, our recommendations are to use vapona as a control tool and not as a routine preventative treatment. By rotating the use of 3% pyrethrin and 5% vapona, effective control of exposed insect pests can be achieved. This will remove a chance for residue build-up on the finished product and prevent (or prolong) a resistance problem. FSS & IL will be sponsoring another seminar in 1986. We want to keep you informed.

SEMINAR ON TAPE

Most of the FUMIGANTS & PHEROMONES Seminar was captured on VHF video tapes. Those of you who could not attend the seminar or who would like to review the talks can do so by contacting FSS.

Topics on tape:
"How to Fumigate a Grain Bin with Phostoxin Fumigant," David Mueller
"Empty Grain Bin Fumigation," James Sargent, Ph.D.
"MAGTOXIN... A Replacement for EDB," J.B. Sullivan, Ph.D.
"How to Implement and Evaluate a Pheromone Trapping Program," David Mueller
"New German Cockroach Pheromone," Chris Latto
"New Fumigation Technique; A passive dosimeter," J.B. Sullivan, Ph.D.
"Vapona: Friend or Foe?" Roger Gold, Ph.D.

George Okumura on Insects
"Developing a Pest Management Program for the Seed and Popcorn Industries," David Mueller

These topics are available on a first-come rental basis. Please contact FSS for more information.

AUDIO CASSETTES AVAILABLE

Pheromones - Practical Aspects & Monitoring by David K. Mueller from the National Pest Control Association meeting in San Antonio.

NEW USE FOR PHEROMONES

Insect perimeter control using pheromone traps/lures can reduce the number of indoor insects in a food storage area.

We have known for years that most of the rodents which infest a facility are from native outdoor mice. Charles Knott showed in studies of a rodent infestation in a food warehouse that "95 to 100% of the source of interior mouse problems are uncontrolled, invading exterior mice."

The same is true for insects. By placing pheromone traps/lures outdoors, an indication of outdoor stress from various destructive insects can be assessed. After several years of monitoring around food and grain facilities, Insects Limited, Inc. has shown that enormous populations of certain stored product insects will exist outdoors naturally.

In Southern California, as many as 500 warehouse beetles can be captured per day. It is not uncommon to catch these warehouse beetles outdoors in Idaho and Wisconsin. We have captured up to 500 Indian meal moths per month in many parts of the Midwest in the summer months. Since these insects were introduced into this country by early settlers, they have learned to survive nicely.

Several food operations in the Midwest have used this insect perimeter control method successfully. Their indoor totals of target insects have dropped. A two year practical field trial research study was supervised by George Okumura. Pheromone traps with BioLures for the warehouse beetle (Trogoderma variabili) were placed directly next to the rodent boxes along a perimeter fence that was 300 to 500 feet from the plant. By plotting indoor and outdoor trap catches with the aid of a special computer program for pheromone monitoring, they have determined that they are reducing the total number of insects reaching the indoors. This is a classic example of a Plateau Two usage of pheromones. Mass trapping can be effective for reducing a population of destructive stored product insects both indoors and outdoors. The orchard, cotton, orange, and blueberry industries have known this for years, but their standards of insect control and the standards of insect control for the food industry will contrast from tolerance to elimination.

Some people worry that by placing these pheromone traps outside of a food facility more insects will collect and possibly have a negative effect on an insect control program. This is not the case. Insects have a tremendous sense of smell. They detect the smell of food from great distances if this smell of food originates...
inside of a plant or from a roof exhaust you can be sure that the pest insects will be attracted to this area. By placing the pheromone traps at least 75' from a sensitive area, you can not only catch migrating target pests that area entering the perimeter of a facility, but you can pull the pest insects away from the area.

Often live plants around a food storage area will be suspected of attracting certain pest insects. Spiria bushes, flowering trees, and many flowering bushes look good aesthetically, but act as a source of infestation for food handlers. A pheromone trap can show if this is the case with your facility.

Popcorn and seed companies are aware that the Indian meal moth will exist in adjacent storage bins and be a source of a problem in finished popcorn and seed. By outdoor trapping with pheromone traps, a barrier can be placed around an area to help prevent this migration.

Zero tolerance of insect contamination in food is becoming the acceptable level for most food companies. This can be achieved by using modern pest management tools such as pheromones to monitor and mass trap insects.

**GRAIN BIN INSPECTION**

If you place 500 ten dollar bills in a wallet, would you check it more than once a year? A 20,000 bushel bin of corn has a value of about $50,000; but it doesn't get inspected very often.

Grain bin inspection is an important job. Growers will strive to grow a few more bushels per acre each year only to allow stored grain insects to feast on their efforts. It is easier and more economical to save a bushel of grain than it is to grow a bushel to replace it.

**Visual Inspection**

Most grain insects are surface feeders and will be found in the fines. The southwest corner of the bin is where most insects will collect during cooler months.

Take a random sample from several areas in the bin when inspecting it. Take time to inspect a grain sample and allow the insects to become active. Some insects will play opossum at first but then start moving. If the grain temperature is below 65 degrees (F), place the sample near a light bulb to warm it.

Inspect the grain closely at 2 to 4 week intervals. Take a sample from the top to bottom of at least one pint of grain per 1000 bushels. Examine the insects. The insect species that you find will determine whether to fumigate. For example, foreign grain beetles feed on molds. If you find these insects, aerating or drying the bin might reduce the population. If you have snouted weevil, you need to fumigate.

Look for webbing on the side wall of a bin. The most frequently found stored grain pest in the United States is the Indian meal moth. The larvae (caterpillar, a.k.a. worms) of this pest leaves a silken strain of webbing when it crawls. It produces this webbing from its mouth and will grasp the strain with its claw-like feet to crawl on a vertical or flat surface. This webbing will also cause havoc with the natural aeration of a grain bin. By visually examining for this webbing and recognizing it as a potential problem, insect damage and dockage can be prevented. Remember that this blanket of webbing is produced one micron-sized strain at a time. This webbing acts as a blanket to allow continued development of additional generations of moths throughout the winter.

**Remote Monitoring with Pheromone Traps**

Modern pest management has been successful in reducing the impact of destructive pest insects. Pheromone traps such as the Burkholder Grain Probe (See Picture) has allowed for grain handlers to monitor for insect outbreaks in their bins. This method of detection is 10 times better than random samplings in detecting hidden infestation. Several universities are using this 14 inch plastic probe to survey for grain insects throughout their states. They have shown this to be a useful tool with or without the insect pheromone attractants. Contact Insects Limited, Inc. of Indianapolis for further details about remote monitoring.

**Empty Bin Preparation**

The first step in keeping out robbers in a grain bin is sanitation. Before putting grain in the bin make sure it is as clean as possible. Remove debris and weeds from the outside of the bin, too. At least two weeks before the grain is put in the bin, spray the walls, cross pieces, and braces with a residual spray. Malathion has been used for four decades to eliminate insects in grain bins. Now malathion will not kill many of the grain insects. Many of our grain insects are resistant to malathion in the United States. Methoxychlor should be used as an alternative residual spray. Methoxychlor 2# EC is labeled for empty grain bins and should be mixed with water. It should be applied until it runs off at a rate of one gallon per 500 sq. ft. Care should be taken to drip the spray under the aeration tunnels and around the outside of a grain bin. Proper respiratory equipment is essential when applying this insecticide.

"NO PEST" Strips are effective in preventing flying insects from entering a grain bin. The dripsless Texile Industrial Label is best in a hot grain bin head space. One strip per 1000 cubic feet of empty space is recommended. New strips should be placed in the bins every 2 to 3 months. These inexpensive preventions could be the difference between a 5 cent/bushel dockage, a customer complaint, a webbing problem, a needed fumigation, or a relatively insect-free grain bin.

**Fumigation**

Often it is necessary to completely eliminate insects in grain bins. With the loss of many of our grain fumigants, it is highly recommended that this job be left to professional fumigators. There is no other form of pesticide application potentially more dangerous than fumigation. Call a fumigation expert for assistance in this area.

Millions of dollars worth of grain are needlessly destroyed each year because of negligence. By close inspection of stored grain and knowledge of the type of insect causing the problem, one can better determine a strategy to control it. Knowing the pest is half the battle in controlling it. Find out "who is coming to dinner."

By: David K. Mueller, Professional Entomologist, President, Fumigation Service & Supply, Inc. and Insects Limited, Inc. of Indianapolis, IN.
INSECT SPOTLIGHT

THE INDIAN MEAL MOTH: Public Enemy #1

One insect is found more often than any other on stored food and grain in the United States. This is the dreaded Indian meal moth (IMM). This small moth alone is responsible for most of the insect problems associated with the seed, popcorn, and grain industries. Let’s take a little time to find out about this guy that spends your money so freely.

This is one of the easiest stored food insects to identify because the adults have a colorful appearance and the larvae leave a silken webbing trail wherever they crawl.

Description

Newly emerged adults are bi-colored and measure about ⅛" from top to bottom. Their hind wings are a uniform silver gray while their front wings are light on the basal third and show a copper luster and reddish-brown shade on the other two-thirds. These colors will not always be present because an adult moth will lose its scales from its wings as it crawls. The damaging stage for this pest is the larvae. The larvae hatch from small eggs, undergo 3 - 7 molts, and reach ⅛" in size upon maturity. These larvae (worms) are yellowish-white in color but will take on several tints of light green, pink, and brown. When the temperature gets below 55 degrees (F), the older larvae will overwinter and continue to feed where possible. This overwintering larvae is difficult to kill and special precautions should be taken when doing a fumigation for this overwintering IMM larval stage.

Life Cycle:

Eggs
Eggs are microscopic (0.3-0.5 mm), and are usually laid at night singly or in groups of up to 40 eggs. Female adults lay 350-500 eggs during their short lifetime. Eggs hatch after 4 - 8 days.

Larva
Larvae usually feed in protected areas such as the ears on a bag or in cracks and crevices. In popcorn, whole grain, and seed, they attack the germ end of the kernel. Occasionally you will see a pin-hole in a bag where a larva has crawled out. Since these larvae are surface feeders and prefer crawling on the outside of a commodity, they will chew their way out of a sealed bag and rarely into the bag from the outside. By inspecting the package closely under a microscope, one can determine easily if the larvae crawled out or crawled in. An analogy can be made to a man digging a hole in the ground with a shovel. The hole is wider at the surface and smaller as he digs. The same is true with IMM larvae chewing into packaging materials. The surface that is wider will be the entry side. Each larva produces the silken webbing from the mouth region and sticks it to the surface on which it is attempting to crawl. It then grabs the webbing with its crocheted legs and pulls itself forward. This makes even vertical climbing possible. Duration of larval life depends on environmental conditions and food supply. It normally takes between 13-28 days.

Pupa
This quiescent stage can be seen covered in a silken cocoon. These pupa casings are usually found in protected areas such as bag flaps, wall corners, and inside corrugated cardboard. These are perches from which the adult moth will dry its wings and take its first flight. Pupation lasts from 10-14 days. No damage occurs during this stage.

Adults
This is a short-lived insect. The adults only live for about one week. They don't feed while they are adults, but they will gather water and dew from plants while in this stage. Their primary function is to mate. This is why pheromone traps for this insect have been so successful. The IMM adult male is easily decoyed into a sticky trap that contains a pheromone lure. The adult IMM is most active at sunset and can be found resting with its wings tucked back over its abdomen during the day with its head cocked back looking for predators. They copulate within 24 hours of emergence, with copulation lasting 10-120 minutes.

Life cycle
All insect life cycles are dependent on temperature and environmental conditions; but in the summer months, the IMM will take 5 to 7 weeks to develop. There are usually 4 to 5 generations per year. With the recent use of pheromone traps outdoors, it should be noted that this insect is commonly found foraging outdoors. Although this pest is not native to the U.S., it has spread throughout. It was first described in 1827.

Control Procedures

Fumigation, residual pesticides, and space treatments are all effective. An integrated approach will increase the success for controlling the Indian meal moth while keeping the cost down. The strips, impregnated with DDVP (Vapona), have shown great success in the headspaces of grain bins. This should be considered a preventative treatment that will be more effective if placed in the bins before the grain reaches 60 degrees. Fumigation with Phostoxin fumigant may be justified when the webbing is thick on the grain surface and bin walls. FSS does not recommend using the Biological Control methods such as B.T. (Bacillus thurigensis) bacteria, parasitic wasps, or Malathion. Resistance in field strains of IMM to malathion and some pyrethroids has been reported and seems to be wide spread. The results that are coming in from users of B.T. show that the material is effective in some situations, but success is not consistent. In a warehouse with minor IMM problems, 5% Vapona in a ULD space treatment has shown remarkable success. (Note: Always treat Vapona as a fumigant).
Public Enemy #1: Plodia interpunctella (alias: Indian meal moth or IMM) can be controlled by early monitoring with pheromone traps. If a contamination is found, appropriate corrective action can be taken. If the infestation gets out of control and a major economic threshold is reached, a fumigation using Phostoxin® fumigant is needed. This insect pest becomes more of a nuisance than is a pest which destroys large quantities of food. The filthy webbing is a give-away to its presence, and its distinctive coloration and markings make it easy to identify.

“KNOWING THE PEST IS HALF THE BATTLE IN CONTROLLING IT”

FREIGHT COSTS GO DOWN

Freight bills are one of the largest expenses in business. FSS has made arrangements for the lowest possible rates for our customers on common carrier and UPS shipments. On truck transportation, we are getting 15% – 28% discount on freight costs to our customers. Small quantities of Phostoxin® fumigant and five gallon containers of some insecticides that once had to be sent common carrier can now be sent by UPS. These include the mini-packs (10 small flasks) of Phostoxin® tablets and Phostoxin® pellet 4 Pack. Five gallons of Methoxychlor 25% EC, Malathion 25% EC, and DDVP - Five. FSS strives to have competitive prices and unbeatable service!!

FUMIGATORS’ TIP:

A. To convert grams per cubic meter (or milligrams per liter or ounces per 1,000 cubic feet) into parts by volume:

1. Divide the given value by the molecular weight of the gas and multiply by 22.4; the resulting figure is the number of cubic centimeters of gas per liter of air.

2. 1,000 times the figure obtained is the value in parts per million by volume.

3. One tenth of the figure obtained in (1) is the percentage by volume.

ISSUE 7: Fumigants & Pheromones

The Label Improvement Program 1986 (LIP) is going to change the entire outlook on the fumigation field. The newsletter will focus on these changes. It will effect every company that uses fumigants and could eliminate some fumigant uses.

Fumigants & Pheromones is published by Fumigation Service & Supply, Inc. and Insects Limited, Inc. for the professional pesticide applicator. We hope that the information that you receive from this newsletter will help you in your business, and you, in turn, will support our business efforts. If you have an associate that would be interested in receiving this newsletter, please contact the address below. We would welcome any comments or suggestions for topics.

Address correspondence to: David K. Mueller, Fumigation Service & Supply, Inc., 10505 N. College Ave., Indianapolis, IN 46280

HIGH SCHOOL STUDENT GOES ‘INTERNATIONAL’

Chris Latta, a 9th grader from Henderson, Kentucky, won the right to attend this year’s International Science Fair in Shreveport, Louisiana.

Chris has been working for the past two years on the German cockroach aggregation pheromone. He was a speaker at the Fumigants & Pheromones Seminar sponsored by FSS & ILI, during which time his school received a $500 grant for their continued work with pheromones.

Chris is a member of Susan Mueller’s Gifted Science Program at South Junior High School. He was invited to speak to over 600 entomologists at this year’s North Central Branch meeting of The Entomological Society of America in Lexington, Ky. His impressive presentation of field trial studies on the German cockroach aggregation pheromone gained him and his research partner national media coverage. Their invitation was compared to a little leaguer being asked to give batting instructions to the major leaguers.

Chris’s research project shows how attractive a crude extract of aggregation pheromone can be compared to a conventional roach motel and how, by varying the concentration, one can fine tune the attractiveness of the pheromone. Congratulations, Chris!

“DO YOU ORIENTAL MODELS GET BETTER MILEAGE?”

Special of the month:

AGGRESSIVE PRICING / UNBEATABLE SERVICE!

Pyrethrin prices take a dip.

FSS will offer a special on dual synergized Pyrethrin (Prentiss Label), Isopar carrier for:

- $42.80/ gal. in 5 ga. cans
- 40.65/ gal. in 30 ga. drums
- 39.40/ gal. in 55 ga. drums

Freight is pre-paid on 65 gallons or more. This price is effective until July 30, 1985.

All pyrethrin prices have been lowered. FSS handles over 45 different types of pyrethrin insecticides. Check our prices on your formulation of insecticides.

Aggressive pricing / Unbeatable service.

FREE OFFER: To assist you in keeping better records of your “Restricted Use Pesticide” usage, FSS would like to send you our PESTICIDE LOG. It is a convenient file folder which lists that vital information that is necessary to fulfill your recordkeeping requirement. Fill out the blank below and send for your PESTICIDE LOG.

Name ____________________________

Company’s Name ________________________________

Address ________________________________

City/State/Zip ________________________________

☐ Please send me a free PESTICIDE LOG

☐ Please send me a new 1985 PRODUCT GUIDE
Mr. Bill Boucher, Chief Federal Grain Inspector, from Indianapolis reported that there are three major changes in the Federal Grain Standards. The first change is with corn and it will eliminate moisture as a grading factor. 18% moisture corn can now be #1 grade corn. This will standardize corn with other small grains that don’t have a moisture requirement starting September 9, 1985.

Second, wheat will have one of its grades deleted. “Light garlicky” will be eliminated. Three or more wild garlic bulbs per sample will be graded garlicky as of May 1, 1985.

Third, soybeans will no longer have moisture as a grading factor as of September 9, 1985.

**RESIDUES: TOP CONSUMER WORRY**

A recent Food Marketing Institute survey of attitudes toward food reveals that residues are the number one concern of consumers. Their fear of residues surpasses additives, preservatives, cholesterol, sugar, salt, and artificial coloring.

In this survey, 77 percent of those responding said residues were a serious hazard in the food supply, compared to 45 percent for cholesterol, and 37 percent for salt.

**HOUSE FLY PHEROMONE**

A new pheromone trapping system is now available for the common house fly (Musca domestica). This trap incorporates a sex pheromone (Z-9-Tricosene + Z-9-Heneicosene) and a food attractant for better results in attracting and capturing the pest house fly.

Stick-A-Fly trap was researched, developed, and tested by leading entomologists. It is effective in trapping house flies with No Poisons and No Insecticide Vapors. Sex-A-Trax Lure attracts house flies to be trapped in the nondrying glue. It should not be considered a total control tool. The attractiveness of the pheromone for the common house fly is not as powerful as some of the moth species (ie. Indian meal moth), but will help to reduce the number of flies in an area.

Call Insects Limited, Inc. for more information.

**DID YOU KNOW?**

- that 95% of the animal kingdom is made up of insects.
- that insects in this country nullify the labor of 1,000,000 men each year.
- that 10% of all food and fiber is lost to stored product pests in the U.S., and 57% in India.
- if the average weight of an insect is 2.5 mg, less than 0.0001 oz., the weight of the insect population exceeds man’s by a factor of about ten.
- that the first recorded biological control for insects was in China on citrus for ants in the year AD304.
Insects live in a world of odors. They use these olfactory cues to direct a variety of complex social behaviors, including courtship, mating, and egg laying. Although PCOs and entomologists have been aware of this highly-sophisticated form of communication for decades, only recently has the pest control industry begun to use this language to misdirect harmful insect pests through the use of pheromones (pronounced fer-a-mon).

Pheromones are chemical substances which insects use to communicate. Pheromones dominate the behavior of insects, from the more obvious mate location to the more subtle coordination and caste determination of social insect colonies. The term pheromone was first coined over 20 years ago. It comes from two Greek words: pherin, which means “to carry” and homan, which means “to excite or stimulate.” These signals work much like hormones do in the human body. They are messengers.

All animals use pheromones to communicate. At one time or another, everyone has observed a cat rubbing its head against a person’s leg. These animals have a scent gland at the base of their whiskers. When they rub against their master, they are telling other cats that “this person is my property.” Dogs also use pheromones to mark their territorial boundaries on trees, shrubs, and fire hydrants.

Humans are not exempt from this highly-sophisticated form of communication, although their systems are not as highly-developed as the insect world’s, which has had 350 million years of evolution to fine tune its pheromone capabilities. It is believed that man excretes a pheromone from a sweat gland in his armpit. Others believe that females emit a pheromone from their breath during certain days in their cycle. This might account for the emphasis we place on hugging and kissing.

Reduced pesticide use. The production of synthetic organic pesticides in 1979 was 1.4 million pounds, and that’s not including the 82 million additional pounds that were imported into the United States in that same year. However, we are starting to see a downward trend in insecticide usage in this country. The use of potentially hazardous pesticides and insecticides may someday be tempered by the effective use of naturally-occurring chemicals, most notably pheromones. This trend is already apparent in agriculture.

For example, in recent years insecticide use in apple orchards has been reduced up to 50 percent by monitoring with pheromone traps. The Mediterranean fruit fly incident, which is still fresh in the minds of many Californians, also points to the importance of quarantine pest monitoring.

The interest in pheromones to manipulate pest insect behavior has been enormous in the past few years. Scientists are publishing volumes of new research on the subject. H.C. Brown, of Purdue University, received a Nobel Prize in 1979 for his work on pheromone synthesis.

In addition, zero insect tolerance in our homes and food is a recent requirement of our “civilized society.” The consumer demands that his food be pure. Any sign of insect adulteration may cause customer complaints, produce product recalls, cancellation of service agreements, and possible lawsuits. Stored products are particularly susceptible to insect infestation. Sensitive insect monitoring with pheromone traps is becoming the norm in the food processing and warehousing industries. Some gauge is needed to determine when an insect population has reached the economic threshold. Dr. Ken Vick, of the United States Department of Agriculture, Gainesville, Florida, says, “In food warehouses, insect populations must always be kept as low as possible; detection of hidden infestations is especial-
Examples of corrugated paper pheromone traps. The plastic dish contains an absorbent paper pad and approximately 30 drops of an oil lure that also serves as a killing agent. Pheromone treated rubber septa are placed in the V-notched sections of the trap. (Photos courtesy of Dr. Wendell Burkholder)

Ways to use pheromones. There are a number of ways for the PCO to use pheromones. First, they can be used in monitoring insect activity. In this method, small amounts of pheromone, literally micrograms or nanograms, are released from lures (controlled release dispensers), which then are placed carefully in entrapment devices. The purpose of using pheromone traps to monitor insect populations is to enable one to accurately assess the size of the population and the timing of emergence. If the population reaches an alarming size, appropriate corrective action can be taken. Insecticides or other controls can then be coordinated with the life cycle of the target insect (see chart on page 64). Pesticides are applied only when the pest population reaches an unacceptable level, and one can vary the amount of insecticide that is used while timing the application to correspond with the emergence of new generations of pests.

A second way pheromones can be used to control insects is through mass trapping. In this method, large numbers of traps are placed in an account to trap large quantities of insects. In addition, this method works best where relatively low numbers of insects exist. The closer you get in the distribution chain of food products to the consumer, the better this method works.

The third way to use pheromones to reduce insect populations is called the confusion or mating disruption method. In this strategy, sex attractant pheromones are distributed over large areas of highly valued crops or products. The air becomes so saturated with this chemical signal that the mating communication be-

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ly important when food is to be distributed over large geographical areas.” Food stored in public warehouses seem to cause special concern for the food industry in that one bad lot can infest a large amount of previously insect-free products.

Dr. Wendell Burkholder, a world renowned pheromone scientist from the University of Wisconsin, adds, “In the future, attractant pheromones will undoubtedly be used to monitor moth populations in warehouses. Then, when a population is detected, increased monitoring could be phased into a control program that would involve mass trapping.”

Imagine, if you will, a female moth sitting on the wall next to you. At some point, she raises her abdomen and releases a tiny wisp of “perfume.” She might fan the plume of pheromone in an attempt to attract a male moth of the same species from the other side of the room. The male moth detects the first few molecules of this powerful “perfume” that passes across his antennae. He sets aflame to find this potential mate. In the case of a gypsy moth, this naturally-occurring female attractant can lure a male gypsy moth up to three miles away. This is not true of stored-product insects, which can only detect scents over much shorter distances.

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tween two potential mates is blocked. It can be compared to a blindfolded man who wanders around a large area trying to pick out a woman wearing Chanel No. 5 only to find that someone spilled the bottle of perfume throughout the room.

By collecting and saving the data of a trap catch, one can sometimes see a trend. By knowing the biology of a particular target pest, one can make intelligent decisions regarding the timing of a control program.

PCOs also should keep in mind that pheromone traps are very useful in monitoring pest populations, particularly after a clean-out or monthly service has been provided.

Types of pheromones. There are several types of pheromones used in the pest control industry. These include sex attractant, aggregation, and food attractant pheromones.

Naturally-occurring sex-attractant pheromones increase the chances of successful mating. Copulation occurs after two main events occur. First, the male and female insects must locate each other through long-range chemical signals called sex-attractants. After a potential mate has been located, a second type of behavior comes into play. A courtship pheromone will trigger a short range behavioral response in many insects. This may take the form of a physical dance or an intra-specific chemical emission. It has been noted in nature that approximately 98 percent of all insect courtships fail to end in successful mating. That is one big reason why synthetic sex pheromones are so effective. They make successful mating, a process which is difficult at best even under the most ideal of circumstances, nearly impossible.

Fewer than 100 sex-attractant molecules on the antennae of a male moth may be sufficient to stimulate a behavioral response. Insects naturally emit only small quantities of this powerful “perfume.”

In nature, some insects have evolved larger and more ornate antennae to better receive these pheromone signals. Consequently, they have a far greater chance in locating a mate over long distances.

Aggregation pheromones are chemicals released by insects that lead to an increase in their density in the vicinity of the pheromone source. Aggregation pheromones often lead to an increased probability of successful mating and are utilized by a wide variety of insects. Among the insects which utilize this type of pheromone are cockroaches, bees, wasps, and beetles. Cockroaches release large quantities of pheromone from their hindgut upon disposing of their frass. The frass serves as an ideal

### Aggregation pheromones often lead to an increased probability of successful mating and are utilized by a wide variety of insects. Among the insects which utilize this type of pheromone are cockroaches, bees, wasps, and beetles.

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**PRACTICAL PHEROMONE TRAPPING PROGRAM**

![Graph showing population density over time](image)

Notice the peaks of warehouse beetle activity in this status report from a food processing plant in the Midwest. This valuable data can help one predict when the next cycle is to emerge.
PROPER TRAP PLACEMENT

The use of pheromones to misdirect insect behavior and prevent the reproduction of pest species is providing an exciting new approach to pest control for PCOs.

Indiana, has been actively pursuing the research and development of an effective German cockroach pheromone. This pheromone is naturally produced by both the male and female roaches when they are in a contented resting state. Upon close examination of this bothersome pest, one often notices spots where it has rested for an extended period of time. These spots, along with the pheromone that is found on their frass, act as directional focal points. Dr. Austin Frishman, a noted pest control industry consultant, often refers to these as "focal focal points."

A controlled release dispenser, with these two components of the German cockroach aggregation pheromone, is commercially available from Insects Limited, Inc.

Food attractants, substances that are key elements of an insect's diet, also will lure pests into a trap. Food lures are not as specific as the other types of pheromones, but they can be as attractive as some aggregation pheromones. In combination with sex-attractant and aggregation pheromones, they can increase a trap's total catch. Food attractant traps will capture both the adult and larval stages of female and male insects, whereas some types of pheromones will only capture one Gender. It also has been observed that female insects often lay their eggs near the food attractant and emerging larvae soon get entrapped.

Insect behavior. The insect's ability to detect pheromones has been finely tuned through millions of years of evolution. An example of this was observed by Dr. Wendell Burkholder while studying the aggregation pheromone of the grain weevil. He noticed that the male rice weevil would not release its pheromone unless there was food present. By placing one berry of wheat in the vial, pheromone production was triggered.

Temperature, air velocity, and photo period also are important factors in dictating when pheromones are released by insects. Even in an indoor situation, an understanding of these micro-environments will improve the effectiveness of pheromone traps. Pheromones are carried by air currents, which form a plume that is broadened by turbulence and diffusion when they move down wind.

In addition, the photo period or time of day is important in the use of pheromones to help control insects. For example, a female moth may release pheromone only during one or two hours each night. The males may respond only during a similarly narrow time frame. For instance, the Indian meal moth and the Mediterranean flour moth both are attracted to the same pheromone. However, the male Indian meal moth is more active at sunset and the male Mediterranean flour moth is more active at sunrise.

The future. Pheromones and other less toxic chemicals that change the behavior of insects are being called upon more and more to monitor and control a variety of insect pests. There are some obvious trends in insect control throughout the world that point to a need to manage pest populations rather than to continually bombard them with organic pesticides.

The use of potentially hazardous pesticides and insecticides may someday be tempered, if not replaced, by the effective use of chemicals naturally produced by insects themselves. The interest in pheromones in recent years has been fueled by their potential to modify the behavior of pests and control them with significantly reduced levels of insecticides. The use of pheromones to misdirect insect behavior and prevent the reproduction of pest species is providing an exciting new approach to pest control.

— David Mueller

The author is President of Insects Limited, Inc. and Fumigation Service & Supply, Inc., Indianapolis, Indiana.