Fumigants & Pheromones

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Routing:

EPA Award Winner
Best of the Best

A Newsletter for the Insect Control & Pest Management Industry, est. 1981

Keratin: That's tough to chew

by Pat Kelley

When an animal dies outdoors, after about one month, all that is left of the poor creature is a pile of hair, skin, and bones. The reason that these parts remain is the simple fact that Mother Nature has very few participants willing and able to consume these materials. Keratin in the hair, skin, nails, hooves, horn, and the enamel on teeth make it extremely difficult to digest for nearly every species in our world.

Now get ready for a daily dose of science! Keratin is composed of polymers of amino acids making it an extremely stable and strong substance. Polymers are simply large chains of molecules composed of many similar smaller chains linked together *(Think of chainmail armor).* In the case of keratin, the most common chain is the amino acid called cysteine. Cysteine contains a high amount of sulfur and the disulfide bonds in cysteine are a key factor for keratin's durability in nature. This is a big reason why it is difficult to digest.

The high amount of sulfur in keratin is the reason why singed hair smells strong to us.

Common keratin consuming insect pests (clockwise from top left): Varied carpet beetle, Webbing clothes moth, Black carpet beetle and Casemaking clothes moth

Just how difficult is keratin to ingest? Consider house cats and wild cats alike that constantly clean, lick, and ingest their fur. Even in the highly acidic digestive tracts of these predatory animals, their ingested hair does not break down. Instead it accumulates into hair balls that need to be coughed up or even removed for the health of the cat. This shows that keratin is one tough compound! Also, think about a time that you may have accidentally burned or singed your hair. The high amount of sulfur in keratin is the reason why singed hair smells strong to us.

A few select insects have evolved to be able to break down keratin for their own benefit. The digestive tracts in the larvae of clothes moths and several species of carpet beetles have adapted to be able to disassemble the disulfide bonds in the keratin and utilize the protein in hair, skin, and other natural materials. In this sense, these insects are beneficial and, quite frankly, without this particular set of insects, we would have large numbers of partially decomposed animal carcasses lying all around the place. Mankind's only real problem with these insects occurs when we want to preserve certain furs, hides, antlers or other keratin based material in our homes and museums. The same insects that help us in nature can be a curse in these locations.

Take a brief moment to soak in all of the specialized biological processes that go into breaking down these complex animal proteins. While you're at it, get a haircut. Your keratin is getting long!

New Equipment for Insects Limited Lab

by Pete Swords
Pheromone Chemist, Insects Limited, Inc.

Each year Insects Limited, Inc. produces large quantities of high purity insect pheromone for use in our lures. Until recently, top selling pheromones such as webbing clothes moth, cigarette beetle and rice weevil, were synthesized in a 5 liter reaction vessel that yielded a few hundred grams or more each batch. A hundred grams of pheromones will produce about 100,000 lures. With the addition of our new equipment, batch sizes will be able to increase four times in quantity. The new reaction vessel from ChemGlass® has a reaction volume of 20 liters. This 20 liter reaction vessel is equipped with a two-tier mechanical agitator, temperature probes, glass ports for larger drop funnel connections and a double glass jacket around the reaction vessel to keep reactions at the desired temperature.

Many reactions that take place in our laboratory are temperature specific. These specific reactions need to take place at -70°C (-94°F). To reach these very low temperatures, insulated reservoirs containing cold baths of a mixture of dry ice and methanol were used. This technique of dry ice/methanol mixture will be less relied upon with the addition of a Huber® chilling system. This 800 pound system contains thermal fluid that flows directly into the jacketed reactor of the reaction vessel and chills the system down to -70° (-94°F) within thirty minutes. Acquiring this new equipment will increase yield and production for high demand, high purity pheromones as well as saving time and energy spent on chemical synthesis.

New 20 liter reactor (left) and -70 degree industrial chiller (right) for pheromone production.

Dave's Soapbox

...for what it's worth

by David Mueller

Dave Mueller, president of Insects Limited and Fumigation Service & Supply, Inc. was given a gift of a ride around the Indy 500 by the employees of FSS/IL. The Indy cars were outfitted with two seats and the driver was race car veteran Davey Hamilton. Mueller recalls the ride: "Nothing prepares you for this ride around the track. We reached 180 miles per hour in the straightaways and 6 Gs in the turns. The pressure on your lungs going around the turns is crushing, you can barely breathe."

"I can't imagine the real race when the drivers are reaching speeds of 240 mph and racing for three hours plus. On each turn you hear the tires screech and you see the white wall get closer to you before stopping three feet or less away. The racing uniforms are hot to wear and the helmets are tight and confining. They are nothing like a motorcycle helmet. It is inconceivable that the distance from the third turn to the fourth turn is a mere flick of the wrist to drive the short shoot to send this race car into the turns. The reaction time is impressive. If you are the type of person that likes to do something that frightens you everyday, come to Indy in the month of May and sign up for a ride."

May 25 will be the 98th running of the Indianapolis 500 mile race. Over 250,000 people come to celebrate Memorial Day and this famous car race. The pageantry and parades last the whole month of May. If you are ever in Indy during the month of May make sure you give us a call and stop by our office or meet us at the track.

10 Ways to Serve You Better...

1. **Technical Support:** Our team of entomologists with over 80 years of experience believe you should start with the insect first. A fumigation for rice weevil is different than for flour beetles which is different than a fungus feeder. Insects Limited specializes in various applications of pest management. Fumigation Service & Supply provides premium custom fumigations and commercial service to protect stored products. We are a leader in pheromone technology. As sister companies, we share our talents and experiences. "We study the science to practice the art."

2. **Newsletters:** Since 1981, FSS has offered updates and industry news for protecting stored products. Communication is a priority to our customers. Over 1.5 million Fumigants & Pheromones Newsletters have gone out to 60 countries over the last 33 years. We hope that the information that you receive from this newsletter will help you in your business, and you, in turn, will help support our business.

3. **Education:** We organize and participate in educational programs locally, nationally and internationally. "We believe that if you want to be professional, you must stay current."

4. **Trade Associations and Organizations:** FSS continues to support many trade organizations that support you: National Feed and Grain Association, Grain Elevator and Processing Society (GEAPS), Indiana GEAPS and Illinois GEAPS board members, International Association of Operative Millers (IAOM), Ohio Seed Trade Association, Popcorn Institute - technical committee, Kentucky Agro-Business Assoc, National Pest Control Association, Illinois Pest Control Association, Michigan Agri-Business Association, Wisconsin Pest

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Wendell Burkholder Award Winner

Dr. Frank Arthur

Dr. Frank Arthur is the recipient of the 2014 Wendell Burkholder Award. He will present the Wendell Burkholder Lecture on Stored Product Protection at the 11th Fumigants & Pheromones Conference in Krakow, Poland on June 3. His topic is New Grain Protectant Research. Past recipients include: Rudiger Plarre, Paul Cogan, Tom Phillips, Paul Fields, and Frank Arthur

Dr. Frank Arthur is a Research Entomologist with USDA-ARS Center for Grain and Animal Health Research. Dr. Arthur's research in evaluating residuals used in post-harvest insect control helps industry professionals make the right decisions in controlling insects that can literally eat up profits and cause serious disruptions at your facility.

In a recent continued education program for the Grain Elevator and Processing Society and the International Association for Operating Millers in Auburn, Indiana, Dr. Arthur reviewed the different strategies employed to control a variety of stored product pests. He identified distinct behaviors of internal versus external insects and shared efficacy data on several products used to control each. A particularly valuable study was conducted using contact insecticides to control adult red flour beetles when a food source is present. Survival of beetles exposed on a concrete surface increased when food was present, and can also lead to reduced residual efficacy of insecticides. The presence of extraneous material such as sawdust or debris can also lead to increased survival through removal of the insecticide from a treated surface. The debris, perhaps, provides a cleansing effect where the residual is removed and is further enhanced with the presence of actual food. This supports the importance of overall plant hygiene in grain facilities where residuals are used.

Another very important point made by Dr. Arthur was the correlation of new infestations to resident insect populations within a bin or silo. Results from suction aeration versus pressure aeration was discussed and showed **suction aeration to be more successful in controlling insect activity from year to year**. However, aeration may have an impact on the overall control when stored grain is already infested from resident insect populations. While sanitation becomes increasingly difficult as facilities continue to grow in size, the impact of resident populations remaining in bins and at the site proved is a source of new and rapid infestations.

You can access Dr. Arthur's research described and on other topics at http://ars.usda.gov/pandp/people/people.htm?personid=197.

Submitted by Jeff Waggoner, General Manager

Wendell Burkholder and his former student Tom Phillips in York, England for the 3rd Fumigants & Pheromones Conference. Tom was the Burkholder Award winner that year.

Dr. Wendell Burkholder (1928–2012) was a pioneer in the field of insect pheromones for biological pest control as an alternative to the widespread use of insecticides. His landmark research and product development have preserved countless tons of food supplies particularly in developing countries. Wendell traveled throughout the world sharing his knowledge. He was the inventor and original patent holder of a synthetic pheromone used in controlling grain weevils and a pesticide-free trap for the monitoring and control of insects. The Wendell Burkholder Award was created in 1993 for excellence in stored product protection. Wendell served as a member of the editorial board of the Journal of Chemical Ecology from 1980 to 1996 and the Journal of Stored Products Research from 1992 to 1998. He also contributed chapters to books and articles to professional journals, for a total of more than 150 scientific publications.

Wendell was a gentle and kind man with a wonderful sense of humor. All who knew him treasured the twinkle in his eye and his smile. Wendell was devoted to his wife and family. A patient and generous mentor, Wendell was much beloved by his many graduate students and visiting scholars from around the world.

Insect Eggs

Are openings in stored-product insect eggs related to effectiveness of fumigants?

by S. G. Gautam, Ph.D.
G. P. Opit, Ph.D.
(Oklahoma State University),
and S. Walse, Ph.D.
(USDA-ARS)

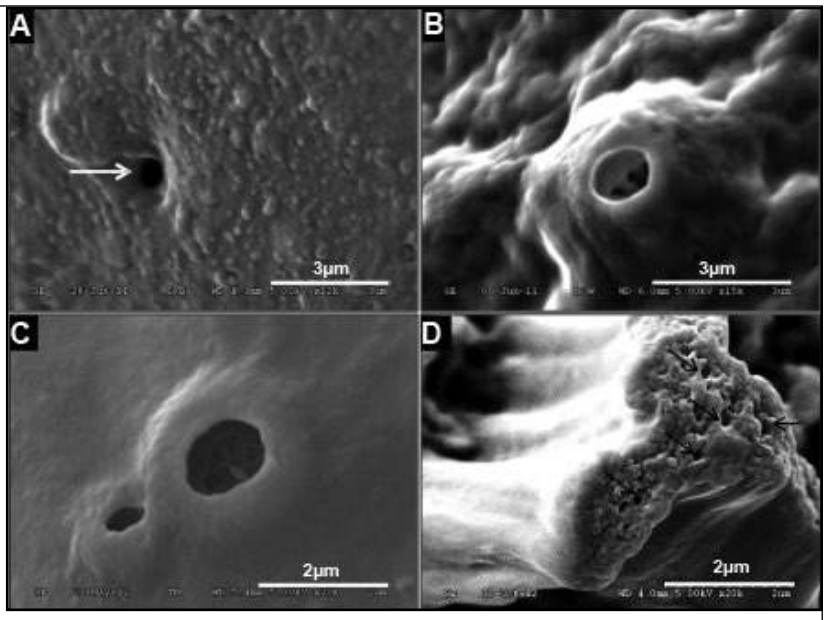

Figure 1. SEM pictures of aeropyles. Dried fruit beetle (A), navel orangeworm (B, note the intrachorionic meshwork), tobacco moth (C, note the intrachorionic meshwork), and cigarette beetle (D, note the many aeropyles with relatively smaller openings).

Fumigants have long been used for effective postharvest management of stored-product insect pests. Coincident with the regulatory phaseout of methyl bromide (MeBr), the use of sulfuryl fluoride (SF) for postharvest disinfestation has increased. However, SF is a species-specific ovicide and eggs of some species require much higher concentration x time exposure or several days of exposure for control (UNEP 2011). The egg stage is the most fumigant-tolerant insect stage and may require higher concentration x time exposure than other life stages. Species-specific response of eggs to SF led us to investigate why some stored-product insect eggs are difficult to kill using fumigants. We compared the egg morphology of driedfruit beetle (DFB) eggs that require relatively higher SF concentrations to kill, to navel orangeworm (NOW), cigarette beetle (CB), and tobacco moth (TM) eggs, which require relatively lower SF concentrations to kill.

Stored-product insect eggs take in gas by diffusion through the chorion (egg wall) and via chorionic respiratory openings, namely, aeropyles and micropyles. **Aeropyles** (Figure 1) are microscopic holes that open into the inner chorion meshwork and enable continuous gas exchange with the ambient environment. **Micropyles** are small openings on the surface of the egg wall through which male insect sperms enter the egg.

We compared the abundance, distribution, and location of aeropyles and micropyles on the surface of DFB, NOW, TM, and CB eggs using a scanning electron microscope. We then measured parameters that may influence gas exchange such as, the total aeropylar cross sectional area (i.e., the average cross sectional area of aeropyles multiplied by the average number of aeropyles per egg), the number of aeropyles per square micrometer (µm^2), and the surface-to-volume ratio of eggs (Table 1). DFB eggs, which are the most SF-tolerant, had only two aeropyles and the smallest aeropylar area compared to NOW, TM, and CB eggs (Table 1). The movement of gas through egg chorion is slow relative to movement through respiratory openings. Therefore, over an equivalent period of time, eggs with a larger number of aeropyles or micropyles are very likely exposed to more fumigant than eggs with fewer respiratory openings. **Since mortality is most often directly related to exposure, eggs with a larger number of aeropyles or micropyles should be easier to kill** (Gautam et al. 2014).

Insect Eggs	Number of aeropyles	Total aeropylar area (µm^2)	Surface-to-volume ratio
Dried fruit beetle	2 ± 0.0	2.16 ± 0.19	17.0 x 10^{-3} ± 2.2 x 10^{-4}
Navel orangeworm	7.24 ± 0.36	5.50 ± 0.34	14.9 x 10^{-3} ± 1.3 x 10^{-4}
Tobacco moth	17.4 ± 0.79	20.71 ± 1.39	13.9 x 10^{-3} ± 1.1 x 10^{-4}
Cigarette beetle	291,200 ± 13,145	990.1 ± 180.4	24.1 x 10^{-3} ± 2.9 x 10^{-4}

Table 1. Factors influencing gas diffusion in DFB, NOW, TM, and CB eggs include number of aeropyles, total aeropylar cross sectional area, and SA:V ratio.

References cited

Gautam, S. G., G. P. Opit, J. S. Tebbets, D. Margosan, and S. Walse. 2014. *Egg morphology of key stored-product insect pests of the United States. Annals of the Entomological Society of America: 107: 1-10.*

(UNEP) United Nations Environment Programme. 2011. *Special review on achieving control of pest eggs by sulfuryl fluoride, pp. 110-136. In Report of the Technology and Economic Assessment Panel. (http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/TEAP_Progress_Report_May_2011.pdf).*

Dave's Soapbox

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Control Association, American Museum Association, Indianapolis Chamber of Commerce, American Chemical Society, Pi Chi Omega - Pest Control Fraternity, Purdue Department of Entomology Developmental Committee, Michigan Pest Management, Illinois Crop Improvement Assoc, Indiana Hardwood Lumberman's Assoc, Grain & Feed Association of Illinois, Ohio AgriBusiness Assoc, and Entomology Society of America and Board Certified Entomologists.

Invasive Insect Winter Kill

West Lafayette, Indiana: A Purdue University entomologist said an invasive insect that's taken a big bite out of the ash tree populations likely survived the frigid winter with few losses in its numbers. Purdue exotic forest pest educator Adam Witte said the emerald ash borer's larvae only die when temperatures reach minus 28 degrees beneath ash trees' bark.

Emerald ash borer larvae

5. Customer Service — Get it there right the first time and on time: Most orders are shipped the same day at Insects Limited and FSS. If your order comes to us before 3:00 p.m. we strive to ship the same day. It is important to have current Safety Data Sheets with your products. Updated Safety Data Sheets are posted on our website for easy reference. Our new box truck can pick up and deliver fumigants. We stand ready to do emergency fumigations caused by shutdowns.

6. Websites and Social Media: FSS, IL, and GreenWay have modern and informative websites. Our social media committee meets monthly to update our social sites with current informative articles, and pictures. Our new YouTube videos will help offer training on fumigation and insect identification. With our Stormfront software you can order pheromone traps and lures from our online store anytime, including weekends and holidays.

7. Phosphine Resistance Testing: We can determine the level of resistance in pest insects. For over 10 years we have been doing testing for resistance in our lab in Westfield. It is important to collect and evaluate beetles and weevils prior to fumigations to know what dosage rate is needed to offer an effective fumigation. This service is free of charge to our customers.

8. Experience: Our fumigation crews have many years of *experience*. We have 25 licensed fumigators in offices across the Midwest: Indianapolis; Chicago; Bloomington, Illinois; Cedar Rapids, Iowa; Cincinnati; Ft. Wayne, and Lansing, Michigan.

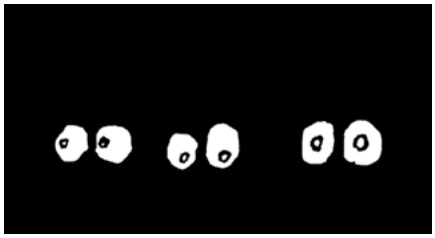
9. We have USDA Export Fumigation Warehouses to fumigate stored products year round: This includes logs, seed, popcorn, wood packaging materials, bed bug infested materials, and many other items that need fumigating in a temperature controlled and secure environment.

10. Safety & Compliance: This includes Fumigation Management Plans (FMP), state licensing, drug testing, and onsite safety supervision and compliance. We comply with your safety standards. All FSS employees have background checks, physical exams, and submit to random drug testing.

We are very proud of our safety record at FSS and Insects Limited. Our new workman's compensation MOD rating is 0.70. We have not had an onsite lost time accident since 1993…21 years.

We look forward to working with you and your company in 2014 to offer safe, professional, and cost effective pest management services. I hope these ten categories listed above would stand out as a qualified premium provider for your pest management program. I thank you for your business in the past and look forward to working with you in 2014.

D. K. Mueller



To Mulch or Not to Mulch

Mulching and recycling have done more for the residential pest control industry than anything else.

One of the first signs of spring is bags of mulch arriving at the gas stations and garden stores. Americans are obsessed with mulching around their homes. Mulch will hold down the weeds but it will attract insects. Few people associate mulch with insects but insects use these mulched areas like an oasis when summer comes and moisture is scare. One entomologist showed that any mulch thicker than 4-5 inches will retain moisture year round and become a source of home invasion from ants, millipedes, centipedes, earwigs, termites, and hundreds of other moisture seeking pests that live within a few feet of your home.

What can you do? Replace your mulching with inorganic mulches or nonplant materials and include, gravel, pebbles, rock chips, and crushed stone. If you still want the organic mulches, then only use a thin layer of less than 4-5 inches and check to make sure it dries out during the summer months.

GreenWay, launched by Insects Limited, announces a new product.

by Casey Vollmer

GreenWay's new Food Moth Trap is non-toxic, ready-to-use, long-lasting, and child and pet safe. The product captures male Indian meal moths. The trap and lure combination help protect your cereals, nuts, flour, pet food, and other stored products. Each box contains 2 traps and 2 fiber pheromone lures.

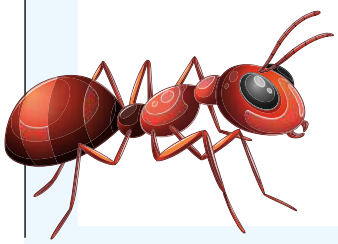
In addition to the Food Moth Trap, GreenWay also carries a Clothes Moth Trap and Pantry Patrol Insect Trap, both of which are non-toxic. GreenWay is committed to solving pest problems by offering alternatives to traditional pesticides. To place an order or for more information, visit www.GreenWayTraps.com.

"Quotable Quotes"

"Knowledge is the foundation of pest management."
— Jim Campbell, USDA Entomologist

ANT FACTS

C.B. Williams theorized in 1994 that there were one million trillion insects on this Earth. There are:



- ***10,000 trillion ants***
- ***700 species of ants in the US***
- ***25 species of ants that attack structures***
- ***5 public health risk ants***

— By Frank Meek, Orkin

NEWSLETTER

Fumigants & Pheromones is published by Fumigation Service & Supply, Inc. and Insects Limited, Inc. 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 who would be interested in receiving this newsletter, please contact the address below. We would welcome any comments or suggestions for topics. Address correspondence to: Peggy Rutkowski, Fumigation Service & Supply, Inc., 16950 Westfield Park Rd., Westfield, IN 46074 USA.

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