



The IPM Partner[®]

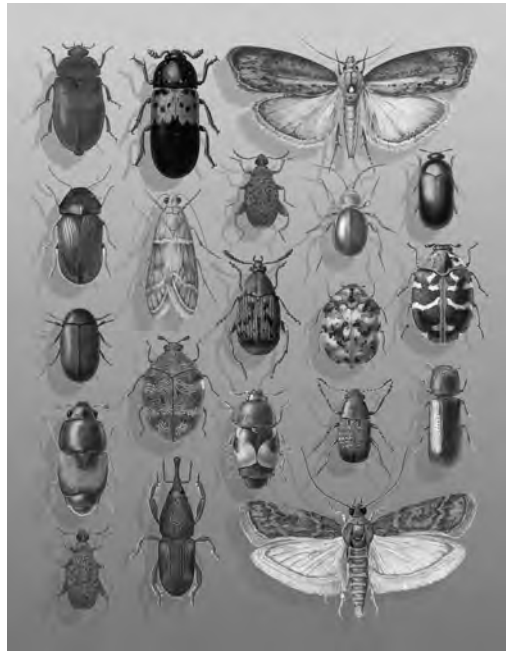
Guidelines for Stored Product Insect Monitoring

STORGARD[®]

TRÉCÉ[®]
INCORPORATED

The IPM Partner[®]

Guidelines for Stored Product Insect Monitoring



Illustrations courtesy  DEGESCH
AMERICA, INC.

STORGARD[®]



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Acknowledgments

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Storgard® IPM Partner®

About the Book • About the Company

This book is a tool. It provides a collection of data on the most common pests that infest stored products — and then puts that information into the hands of our key customers and the key contributors to IPM. The information has been sourced from personnel and publications of various universities, extension services and government research agencies. It is the most updated material available on the subject — and the first time that the material has been put together in so simple and practical a form, to our knowledge.

Knowledge is what The IPM Partner® Guidelines on Stored Product Monitoring is really all about. Indeed, it is at the heart of all that we do at Trécé. Every one of our monitoring products is designed to impart knowledge that can be practically applied to solve a problem. Every encounter with a customer, PCO, sanitarian or academician will hopefully help us gain knowledge about something we didn't know before. Every research and development dollar is a practical investment in the acquisition of knowledge that hopefully will translate into products and services that will give you a critical edge — on the pests you need to control and a clock you can only hope to contain.

Our philosophy is principally responsible for Trécé being the number one manufacturer and marketer of insect monitoring systems in the world. It has worked for us because it has worked for our clients. Quite simply, people look to us for integrated pest monitoring solutions because we know our business better than anyone in the business.

Trécé Research and Development: Keeping A Razor-Sharp Edge.

If knowledge is Trécé's core value in the marketplace, continuing research and development is our core resource. The company has, from the beginning, invested heavily in R&D, hiring the finest professionals and using state-of-the-art facilities and equipment. We are committed to always giving you the edge by always being on the leading edge ourselves. Trécé works closely with government agencies, universities and our business associates throughout the world to continuously refine and advance the technology of effective monitoring systems.

 STORGARD®

In the field and in the laboratory, Trécé trials have been focusing on improvements to our trap designs and controlled-release technology. Considerable efforts are also being expended both domestically and internationally to create a companion line of insect control products to compliment the pheromone-based detection and monitoring systems.

Manufacturing: The Dynamics of Quality and Quantity.

Much of the research and development effort over the years has gone into the creation of sophisticated manufacturing facilities and equipment at our Salinas headquarters. We make what we market at Trécé because, through planning, consistency, flexibility and rigorous quality control, we feel we can simply do a better job. Our own chemists manage all of the pheromone formulations. Our own engineers create sophisticated equipment such as our high-speed surface glue-coaters, and manage all of the system design and technical issues. And, our own professional staff manages and executes a tightly integrated manufacturing process that optimizes quality, production utilization, speed and flexibility.

Trécé's ability to expand and contract production from small custom orders to three-shift production runs is critical to our success.

 PHEROCON®

Pherocon® and Storgard®: The Monitoring Standard For Over Two Decades.

Trécé's product catalogs currently contain over 100 species-specific, pheromone-based attractants and lures, and a full line of trap models designed for a wide variety of flying and crawling insect pests that attack crops and stored commodities. These products are marketed under two internationally respected names, Pherocon® and Storgard®.

The Pherocon® line provides pest managers, farmers and agricultural consultants with an early-warning system to detect adult insect emergence and monitor pest populations so that timely control programs can be implemented. In the 1970s, Pherocon® products were utilized in early integrated pest management research and eventually became the world standard for effective monitoring. Today, these products are also used to track the migration of pests into non-infested areas. Beyond detection and monitoring, phenology models for many significant insects have been developed using Pherocon® products to establish biofix points. And, economic thresholds based on Pherocon® trap counts have been created for several insects. Taken together, these capabilities deliver a turnkey solution for optimizing treatment times — a solution the competition, without our history, research and knowledge, simply cannot deliver.

 CIDETRAK®

The Storgard® product line provides early-warning detection of potentially



damaging insect infestations during processing, transport, warehousing and marketing of foods and other commodities. Proper use of these products can reduce product losses, increase the quality of stored foods and save time and money. Storgard® has been the industry standard for more than a decade. Unlike light traps, Storgard® products are more species-specific and more sensitive to low populations — invaluable features to quality assurance managers who need to meet zero tolerance requirements in milling, baking and other food processing and storage facilities.

Many new attractants and trap designs are under development for introduction in the new millennium. Trécé has created and is conducting research and development on several new products for insect control in both field crops and stored product. These products fall under three categories: 1. mass trapping; 2. disruption; 3. attracticides. For these, Trécé has invented new technology for attraction, active ingredient protection and controlled release. Beginning early in the new millennium, Trécé plans to introduce the world's first kairomone-based female attractants for horticultural insects and several new ones for field crops and stored products.

In addition to the Pherocon® and Storgard® lines, Trécé also offers several specialty products, including a unique Japanese beetle trapping system with a permanent catch basin. Rugged, all plastic construction sets this trap apart from “bag-type” alternatives that are less effective and shorter-lived.

Knowing Our Business Means Knowing Our Customers.

It means knowing the kind of quality they demand, the kind of timeliness they run on, the kind of service and support they need. We have built an unprecedented level of loyalty by delivering on a number of critical factors: our adherence to the strictest quality assurance programs, our history of consistent reliability over two decades, and our worldwide distribution network and sophisticated international shipping and service capability.

Know What To Do Next.

Someone once said: “Wisdom is oft times simply knowing what to do next.” Those words may well put our business in the best perspective. Certainly, Trécé products help our customers know what to do next by giving them knowledge of exactly when to implement control programs. Trécé management knows that what they must always do next is more research, more development, more consulting with leading experts, agricultural advisors and customers in the field. Maybe what you ought to do next is give Trécé a call.

You Deserve An Edge.

Your Edge — And Ours — Is Knowledge.

Using Pheromone/Kairomone-Based Monitoring Systems

Performance Factors:

It is critical that sanitarian and PCO decision-makers understand that many factors can impact pheromone trap catches. The trap design, type of lure, number of traps, type glue surface, how the traps are assembled, trap placement both within the warehouse and in the commodity, and trap and lure maintenance can all dramatically change the number of insects caught. Standardization is critical to the execution of successful monitoring programs.

Maintenance:

Traps should be checked at least twice weekly until bio-fix and then at least weekly thereafter. Moths should be counted and recorded each time traps are checked and the adhesive on the trap or liner (adhesive-coated bottom) stirred each time. Traps or liners should be changed after trapping approximately 50 moths or when dirty. Or the STORGARD® system parts should be replenished and/or changed as recommended for each species. It is critical that lures be stored properly and changed according to recommendations for each species/lure.

Storage

Store lures in a refrigerator or freezer until ready to use. Freezing lures at -10°C will usually extend their shelf life to many years. When transporting lures, do not place them in the sun or on the dashboard or seat of a vehicle. Extremely hot temperatures will harm the lures. Lures being replaced should be removed from the trap and carried out of the area and disposed of so they will not interfere with trap catch.

WARNING - Please Note:

This information is supplied by Trécé, Inc. to provide guidelines by which pest managers can monitor insect populations leading to correct use and timing of spray applications or other pest management operations for certain insects. The information should be regarded as a supplementary aid in planning insect pest management. However, spray programs should not be altered solely on the basis of the information contained herein. Users of the information shall themselves determine the suitability of the information for their intended uses and shall assume all risk and liability arising from such use.

It is strongly recommended that users consult with qualified commercial pest management consultants or representative services, universities or governmental agriculture departments.



Stored Products
Lepidoptera
Moths

Illustrations courtesy Degesch America



Illustration courtesy Degesch America

Cadra cautella

Almond Moth



Illustration courtesy Degesch America

Cadra figulilella

Raisin Moth



Ephestia elutella

Tobacco Moth





Illustration courtesy Degesch America

Ephestia kuehniella

Mediterranean Flour Moth



Illustration courtesy Degesch America

Plodia interpunctella

Indianmeal Moth



Illustration courtesy Degesch America

Sitotroga cerealella

Angoumois Grain Moth





STORGARD® Product Line



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Guidelines For Monitoring System Installation and Maintenance

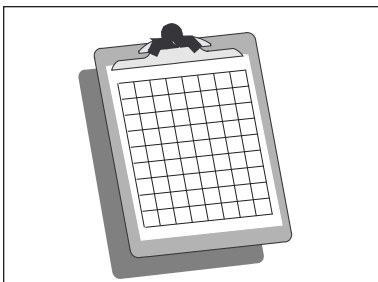
Lepidoptera (Moths)



STORGARD[®] Moth Trap Kit



STORGARD[®] Sex Pheromone Lures



Program Initiation-Use Pattern

- *Initiate monitoring program with a full-area survey for a least one month while there is insect activity.*
- *Monitor incoming commodities and off-loading areas aggressively.*
- *Position traps in grid pattern.*
- *Space traps 16-20m apart.*
- *Mark traps and map location of traps. Use the map to pinpoint areas of infestation for future reference.*
- *Decrease space between traps with high capture rates as insects are first captured in order to pinpoint contaminated areas.*
- *Reduce the number of traps after the initial survey. Concentrate traps in high-risk areas.*
- *Monitor on continuing basis.*

STORGARD[®] Sex Pheromone Lures/Maintenance

- *Store unopened in factory-sealed package. Store in a cool, dry place. Storage-temperature not to exceed: 23.9°C (75°F).*
- *Freeze carryover stock (-10°C) to maintain full potency.*
- *Replace every 6-8 weeks or according to individual package instructions.*

STORGARD[®] Trap Maintenance (Pherocon[®] II and Pherocon[®] 1C)

- *Use STORGARD[®] Lures.*
- *Check traps 1-2 times weekly. Remove trapped insects and debris.*
- *Replace PHEROCON[®] II or PHEROCON[®] 1C trap-liners ("bottoms") every 6 weeks. Dusty conditions: change trap-liners more frequently.*




Keeping Records

- *Use a record sheet like the one shown at the back of this book.*
- *Average STORGARD[®] trap moth-counts over small, homogeneous area in order to best pinpoint infested areas and isolate problem areas.*

Monitoring Results - Interpretation and Solutions

If you're finding a few insects in scattered locations, it's a sign that closer attention needs to be paid to your monitoring program. Increases in the number or areas of significant insect populations will require swift action to avoid complete plant/warehouse shut down. Use the guidelines below to focus your treatment program. Monitor on a continuing basis, regardless of the frequency and rate of capture. Count traps routinely and replace when needed (see page 1 for guidelines).

PLEASE NOTE: Insecticide applications or residue will normally not limit trap effectiveness more than a few hours if at all.

Typical layout grid – one STORGARD® trap per section.












Occasional Low Capture

Capture Frequency: Occasional
Capture Rate: Low
Management Protocol:

- Tighten STORGARD® trap-grid in areas showing marked or general increase.
- Check inventory for at-risk infested commodities.
- Remove/clean contaminated commodities.
- Check for outside sources of infestation.
- Review sanitation program and continue to monitor for infested commodities.

Treatment:

- Delay insecticide treatment until there is evidence of a significant population

Typical layout grid – one STORGARD® trap per section.

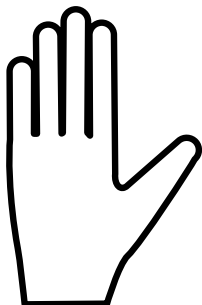
Constant Low Capture

Capture Frequency: Constant
Capture Rate: Low
Management Protocol:

- Tighten STORGARD® trap-grid in areas of marked increase only.
- Check for at-risk infested commodities.
- Remove/clean contaminated commodities.
- Check for outside sources of infestation.
- Review sanitation program and continue to monitor for infested commodities.

Treatment:

- Delay insecticide treatment until there is evidence of a significant population change or spot-treat areas considered susceptible or especially valuable.



Important Precautions

- Read and follow package instructions on all lures and traps.
- Use one lure per trap.
- Dispose of lures in a sealed container away from facility being monitored.

Trécé Contact Information

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	<h2 style="margin: 0;">Occasional High Capture</h2> <p><i>Capture Frequency: Occasional</i> <i>Capture Rate: High</i> Management Protocol:</p> <ul style="list-style-type: none"> • Tighten STORGARD® trap-grid in areas showing marked or general increase. • Remove/clean contaminated commodities. • Review sanitation program and continue to monitor for infested commodities. <p>Treatment:</p> <ul style="list-style-type: none"> • Initiate insecticide treatments in areas considered susceptible or especially valuable.
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Typical layout grid – one STORGARD® trap per section.

	<h2 style="margin: 0;">Constant Localized High Capture</h2> <p><i>Capture Frequency: Constant</i> <i>Capture Rate: High and localized</i> Management Protocol:</p> <ul style="list-style-type: none"> • Tighten STORGARD® trap-grid in areas showing marked or general increase. • Remove/clean contaminated commodities. • Review sanitation program and continue to monitor for infested commodities. <p>Treatment:</p> <ul style="list-style-type: none"> • Initiate insecticide treatments in areas considered susceptible or especially valuable.
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Typical layout grid – one STORGARD® trap per section.

	<h2 style="margin: 0;">Constant High Capture</h2> <p><i>Capture Frequency: Constant</i> <i>Capture Rate: High</i> Management Protocol:</p> <ul style="list-style-type: none"> • Remove/clean contaminated commodities. • Review sanitation program and continue to monitor for infested commodities. <p>Treatment:</p> <ul style="list-style-type: none"> • Initiate insecticide treatments immediately.
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Typical layout grid – one STORGARD® trap per section.



Illustrations courtesy Degesch America, Inc.

Cadra cautella

Almond Moth

DESCRIPTION

Adults: Wingspan: 15mm. Forewings above reddish brown marked with 2 black lines and black dots. Hindwings, light gray. Short-lived. Adults do not feed.

Eggs: About 200. Laid on or near larval food sources. 0.3-0.5mm. White when laid, turning to orange during development.

Larvae: Growth to 12-14mm. Yellow-tan. Speckled black; tawny, thick bristles. Larvae spin silken-cocoons during feeding. Larvae move away from food to crevices and cracks before pupation.



Larvae: *Cadra cautella*

Pupae: Approximately the same size as larvae. Yellowish to tan; mid-brown head and prothoracic shield. Pupation in cocoons built in crevices concealed by webbing.

Host: Cereal products, candies, nuts, dried fruits.

CAUSE OF DAMAGE

Consumption of stored grain by larvae. Contaminates stored products with silken web and frass produced by larvae.

PHENOLOGY¹

Life cycle	25-30 days
Eggs hatch	3-17 days
Larvae (while feeding)	41-87 days
Pupae	4-18 days
Mating/oviposition	1-2 days after eclosion
Adult life-span	2-26 days
Threshold temperature	15°-36°C (59°-97°F)

LURE

STORGARD® IMM+4/PLODIA controlled-release sex pheromone.

TRAP

PHEROCON® II or PHEROCON® 1C with PLODIA lure.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.



Cadra figulilella

Raisin Moth

DESCRIPTION

Adults: *Wingspan: 15mm.*

Forewings are yellow-gray. Hindwings are dull-white with a yellow-gray border. Short-lived. Adults do not feed. In the U.S., emergence of adult moths begins in April and peaks in May. Larvae first noticed on muscat raisins around Fresno, CA, 1928. Peak abundance, 1930. Flight on warm nights from one-half hour after sunset until dawn.

Eggs: *350. Laid on or near larval food sources. 0.4mm. Elliptical. White.*

Larvae: *13mm. Corn yellow. Spotted purple in four rows along the back. Larvae spin silken-webs during feeding. Larvae molt 4-8 times. Overwintering in storage extends larvae feeding until spring. No adults or eggs present during winter. Larvae migrate*



Larvae: Cadra figulilella

Pupae: *6mm. Light red-brown.*

Pupation in cocoons.

Host: *Raisins. All common varieties of ripening fruit-crops in the field; infested commodities in storage, including dried fruits, carobs, cottonseed cake, cacao beans, and cashew kernels.*

CAUSE OF DAMAGE

Consumption of stored grain by larvae. Contaminates stored products with silken web and frass produced by larvae.

PHENOLOGY*

Life cycle	30 days
Eggs hatch	3-6 days
Larvae (while feeding)	30-180 days
Pupae	10 days
Mating/oviposition	1-2 days after eclosion
Adult life-span	11-16 days
Threshold temperature	15°-37°C (59°-99.5°F)

LURE

STORGARD® IMM+4/PLODIA controlled-release sex pheromone.

TRAP

PHEROCON® II or PHEROCON® 1C with PLODIA lure.

**In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.*



Illustrations courtesy Degesch America, Inc.

Ephestia elutella

Tobacco Moth

DESCRIPTION

Adults: Wingspan: 15mm.

Forewings are velvet-brown and mottled with dull-white bands. Hindwings are light gray. Short-lived. Adults do not feed. Active at dawn or dusk. Smaller in size but otherwise similar to *Ephestia kuehniella* (Mediterranean Flour Moth).

Eggs: 150-200. Laid on or near larval food sources. 0.5mm. Elliptical. White.

Larvae: 10-15mm. Range from yellowish to tan to pinkish. Larvae spin silken-webs during feeding. Larvae migrate away from food before pupation.



Larvae: *Ephestia elutella*

Pupae: Approximately the same size as larvae. Pupation in cocoons concealed in webbing.

Host: Tobacco. Wide-variety of cereals, vegetables, and seeds.

CAUSE OF DAMAGE

Consumption of stored grain by larvae. Contaminates stored products with silken web produced by larvae.

PHENOLOGY*

Life cycle	30-180 days
Eggs hatch	4-20 days
Larvae (while feeding)	30-70 days
Pupae	10-23 days
Mating/oviposition	1-2 days after eclosion
Adult life-span	5-20 days
Threshold temperature	10°-30°C (50°-86°F)

LURE

STORGARD® IMM+4/PLODIA controlled-release sex pheromone.

TRAP

PHEROCON® II or PHEROCON® 1C with PLODIA lure.

*In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.



Illustrations courtesy Degesch America, Inc.

Ephestia kuehniella

Mediterranean Flour Moth

DESCRIPTION

Adults: Wingspan: 22mm.

Body and forewings lead gray and speckled white and brown. Forewings traversed with black zigzag markings and wavy dark bands. Hindwings (not visible at rest) are gray-white. Short-lived. Adults do not feed.

Eggs: Up to 300. Laid on or near larval food sources. 0.5mm. Elliptical. White. Either a folding or nipple-like projection at anterior.

Larvae: Growth to 12mm. Cream to brick red. Honey-colored head. Lightly speckled black. Mature larvae spin silken-cocoons during feeding. Larvae migrate away from food before pupation.



Larvae: *Ephestia kuehniella*

Pupae: Approximately the same size as larvae. Red-brown. Pupation in cocoons.

Host: Flours, whole or cracked grain, bran, spices, candies, nuts, dried fruit.

CAUSE OF DAMAGE

Consumption of stored grain by larvae. Contaminates stored products with silken thread produced by larvae. Products matted from silken-thread clog processing machinery

PHENOLOGY*

Life cycle	30-180 days
Eggs hatch	1-7 days
Larvae (while feeding)	7-14 days
Pupae	56-70 days
Mating/oviposition	1-2 days after eclosion
Adult life-span	1-6 months
Threshold temperature	12°-28°C (54°-82°F)

LURE

STORGARD® IMM+4/PLODIA controlled-release sex pheromone.

TRAP

PHEROCON® II or PHEROCON® 1C with PLODIA lure.

*In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.



Illustrations courtesy Degesch America, Inc.

Plodia interpunctella

Indianmeal Moth

DESCRIPTION

Adults: Wingspan: 19mm.

Forewings: silver-gray. Distal two-thirds of the forewings, red- to copper-brown. Hindwings, dull white. Short-lived. Adults do not feed.

Eggs: 300-400. Laid on or near stored cereal, flours, or other larval food sources. 0.3-0.5mm Long. Oval. Reticulated chorion. White to yellow-white.

Larvae: Growth to 12.5mm. White when eggs hatch. During development, hues of yellow, green, tan, and pink. Mature larvae, dull white. Mature larvae live and feed in spun-silk cocoons.



Larvae: *Plodia interpunctella*

Pupae: Slightly larger in size than larvae. Light brown.

Host: All types of stored-grains, especially food-products high in carbohydrates and proteins: corn meal (Indianmeal), cereals, packaged cereals, flours, beans, candies, chocolate, nuts, and dried fruits and meats.

CAUSE OF DAMAGE

Consumption of stored grain by larvae; infests field crops such as drying and dried raisins, cherries, apricot and peach pits. Contaminates stored products with silken web and frass.

PHENOLOGY¹

Life cycle	28-35 days ²
Eggs hatch	2-22 days
Larvae (while feeding)	21-240 days
Pupae	4-9 days
Mating/oviposition	1-2 days after eclosion
Adult life-span	2-30 days
Threshold temperature	15°-32°C (59°-90°F)

LURE

STORGARD® IMM+4/PLODIA controlled-release sex pheromone.

TRAP

PHEROCON® II or PHEROCON® 1C with PLODIA lure.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²As many as 8 overlapping generations per year.



Illustrations courtesy Degesch America, Inc.

Sitotroga cerealella

Angoumois Grain Moth

DESCRIPTION

Adults: *Wingspan: 12mm. Fringed wings: yellow-brown. Forewings marked with darker lines. Hindwings notched. Short-lived. Adults do not feed.*

Eggs: *40-150. Laid on or near stored cereal and flours, wheat heads, and exposed corn ears. 2mm. Long. White, changing to red-brown within a few days.*

Larvae: *Growth to 6mm. Pale yellow; poorly developed abdominal prolegs. Larvae bore into grain kernels, feeding off the endosperm or germ of hard kernels. Mature larvae eat a channel to the outside of the grain and spin a silken cocoon.*



Larvae: *Sitotroga cerealella*

Pupae: *Approximately the same size as larvae. Reddish brown. Mature larvae pupate in-situ, emerging “from the grain as a moth.”*

Host: *All types bulk and bagged grains and field crops, especially wheat and corn.*

CAUSE OF DAMAGE

Consumption of all types of stored-grains and/or field crops such as wheat and corn. Channel made by larvae leaves a transparent, circular “window” in kernels. A single kernel may host multiple larvae. The most common and most destructive grain moth in the United States.

PHENOLOGY¹

Life cycle	28-35 days (usually slower)
Eggs hatch	7-28 days
Larvae (while feeding)	7-14 days
Pupae	8-20 days
Mating/oviposition	immediately after eclosion
Adult life-span	10-30 days
Threshold temperature	17°-36°C (62.6°-96.8°F)

LURE

STORGARD® AGM controlled-release sex pheromone.

TRAP

PHEROCON® II or PHEROCON® 1C with AGM lure.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

Using Pheromone/Kairomone-Based Monitoring Systems

Performance Factors:

It is critical that sanitarian and PCO decision-makers understand that many factors can impact pheromone trap catches. The trap design, type of lure, number of traps, type glue surface, how the traps are assembled, trap placement both within the warehouse and in the commodity, and trap and lure maintenance can all dramatically change the number of insects caught. Standardization is critical to the execution of successful monitoring programs.

Maintenance:

Traps should be checked at least twice weekly until bio-fix and then at least weekly thereafter. Moths should be counted and recorded each time traps are checked and the adhesive on the trap or liner (adhesive-coated bottom) stirred each time. Traps or liners should be changed after trapping approximately 50 moths or when dirty. Or the STORGARD® system parts should be replenished and/or changed as recommended for each species. It is critical that lures be stored properly and changed according to recommendations for each species/lure.

Storage

Store lures in a refrigerator or freezer until ready to use. Freezing lures at -10°C will usually extend their shelf life to many years. When transporting lures, do not place them in the sun or on the dashboard or seat of a vehicle. Extremely hot temperatures will harm the lures. Lures being replaced should be removed from the trap and carried out of the area and disposed of so they will not interfere with trap catch.

WARNING - Please Note:

This information is supplied by Trécé®, Inc. to provide guidelines by which pest managers can monitor insect populations leading to correct use and timing of spray applications or other pest management operations for certain insects. The information should be regarded as a supplementary aid in planning insect pest management. However, spray programs should not be altered solely on the basis of the information contained herein. Users of the information shall themselves determine the suitability of the information for their intended uses and shall assume all risk and liability arising from such use.

It is strongly recommended that users consult with qualified commercial pest management consultants or representative services, universities or governmental agriculture departments.



Stored Products

Coleoptera

Beetles



Illustration courtesy Degesch America

Lasioderma
serricorne
Cigarette Beetle

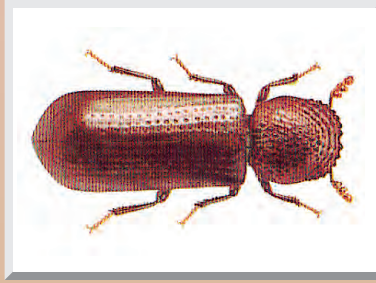


Illustration courtesy Degesch America

Rhyzopertha
dominica
Lesser Grain Borer



Sitophilus
oryzae
Rice Weevil



Illustration courtesy Degesch America

Oryzaephilus
surinamensis
Sawtoothed Grain Beetle



Illustration courtesy Degesch America

Sitophilus
granarius
Granary Weevil

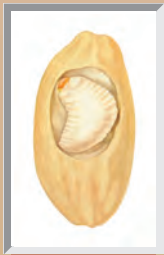




Illustration courtesy Degesch America

Sitophilus
oryzae
Rice Weevil



Illustration courtesy Degesch America

Tribolium
castaneum
Red Flour Beetle



Illustration courtesy Degesch America

Trogoderma
granarium
Khapra Beetle



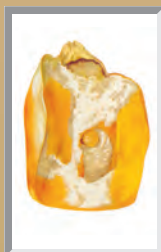
Illustration courtesy Degesch America

Sitophilus
zeamais
Maize Weevil



Illustration courtesy Degesch America

Tribolium
confusum
Confused Flour Beetle





STORGARD® Product Line



TRÉCÉ® Incorporated, 1143 Madison Lane, Salinas, California 93907 USA
 Telephone: 831-758-0204 • Facsimile: 831-758-2625 • E-mail: custserv@trece.com

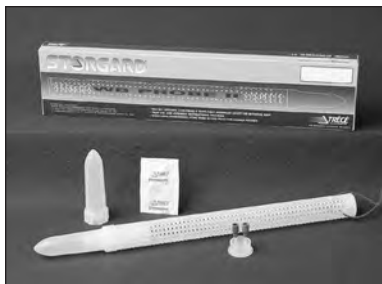
©1999 TRÉCÉ Incorporated
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 ® = registered trademark and ™ = trademark of TRÉCÉ Incorporated, Salinas, CA USA

Guidelines For Monitoring System Installation and Maintenance

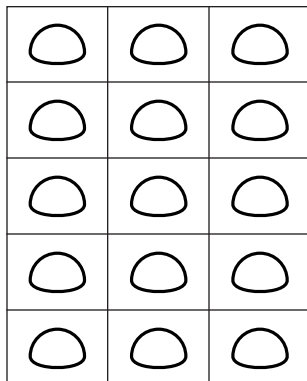
Coleoptera (Beetles)



STORGARD® (FLITeTRAK®) Beetle-Trap Kit with the DOME™ Trap



STORGARD® WB PROBE II® Kit/Beetle-Trap



Grid Pattern

Program Initiation-Use Pattern

STORGARD® Beetle-Trap (DOME™ Design)

- Initiate monitoring program with a full-area survey for a least one month while there is insect activity.
- Monitor incoming commodities and off-loading areas aggressively.
- Initially position traps in a grid pattern.
- Space 10-20m apart or according to guidelines below.
- Mark traps and map location of traps. Use the map to pinpoint areas of infestation for future reference.
- Decrease space between traps with high capture rates as insects are first captured in order to pinpoint contaminated areas.
- Reduce the number of traps after the initial survey. Concentrate traps in high-risk areas.
- Monitor on continuing basis.

STORGARD® WB PROBE II® Beetle-Trap

- Initiate monitoring program at time of storage for best results
- Use aggregation or sex-pheromones when suggested.
- Inspect 24-48 hours after placement for early assessment of populations.
- Check traps every 2 weeks after initial inspection, removing insects and debris.
- Clean traps with soapy water if desired.

Trap Placement

STORGARD® Beetle-Trap (DOME™ Design)*

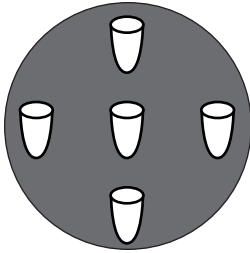
- Place on floor, ledges, baled product, or pallets.
- Position in grid pattern.

**Tribolium castaneum* (Red Flour Beetle) and *Tribolium confusum* (Confused Flour Beetle): space at 10m.

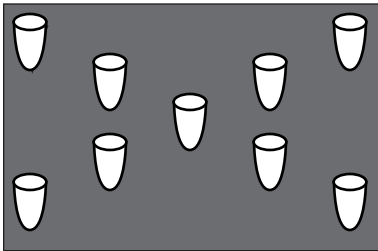
**Lasioderma serricorne* (Cigarette beetle) and *Trogoderma granarium* (Khapra beetle): space at 15-20m.

- Mark traps and map location of traps.
- Decrease space between traps in areas where insects are first captured in order to pinpoint contaminated areas.

*Note: Replaces FLITeTRAK® M² and CB³ products.



STORGARD® WB² Probes – Round Bin



STORGARD® WB² Probes – Flat Storage



STORGARD® Sex Pheromone Lures



STORGARD® the "DOME" Trap.
(Clear view showing lure and trap.)

STORGARD® WB PROBE II® Beetle-Trap (Round Bins)

- Position 3-5 traps in the pattern: put the first trap in the center of the bin; distribute the remaining traps halfway between the center of bin and edge of the bin, but not closer than 2.5m from the bin wall.

Trap Placement in Flat Storage Areas

- Position 5-9 traps in an X-shaped pattern.
- Space traps at 2-2.5m intervals initially; longer intervals may be sufficient once program has been established.
- Place traps so the top of each is level or slightly below the grain surface.
- Mark traps and map location of traps.

STORGARD® RE-BAIT™ Lures/Attractants Maintenance

Aggregation or Sex Pheromone Lures

- Store unopened in factory-sealed package. Store in a cool, dry place. Storage-temperature not to exceed: 23.9°C (75°F).
- Replace every 4-8 weeks except as noted below:
 - *Lasioderma serricorne* (cigarette beetle): replace every 8 weeks.
 - *Tribolium castaneum* (Red Flour Beetle) and *Tribolium confusum* (Confused Flour Beetle): replace every 4 weeks.
 - *Trogoderma granarium* (Khapra Beetle): replace every 4-6 weeks.

Kairomone/Food Attractant

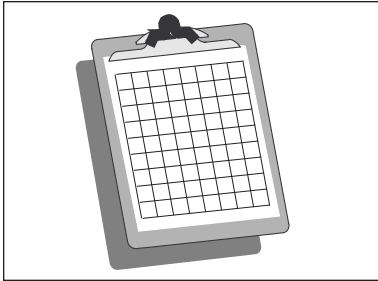
- Store unopened in factory-sealed package. Store in a cool, dry place. Storage-temperature not to exceed: 23.9°C (75°F).
- Replenish or add a few droplets to the trap pad every 1-2 weeks.

STORGARD® Traps

STORGARD® Beetle-Trap with the "DOME"™*

- Use the appropriate STORGARD® RE-BAIT™ pheromone and/or Kairomone/food attractant. See package instructions to correctly match lures and traps.
- Check traps 1-2 times weekly. Remove trapped insects and debris.
- Maintain a few milliliters of RE-BAIT™ Kairomone/food attractant on the trap pad. The amount should be enough to kill trapped insects, but not so much as to make counting kills difficult. Freestanding liquid is not necessary for effective trapping.
- Add RE-BAIT™ (Kairomone/food attractant) to the trap pad only. RE-BAIT™ (Kairomone/food attractant) spilled on the vertical walls of the trap may collect dust and allow beetle to escape the trap.
- Leave trap housing and reservoir connected at all times.
- Clean trap reservoir with soapy water when required.

*Note: Replaces FLITeTRAK® M² and CB³ products.



Keeping Records

- Use a record sheet like the one shown at the back of this book.
- Average STORGARD® trap moth-counts over small, homogeneous area in order to best pinpoint infested areas and isolate problem areas.

Monitoring Results - Interpretation and Solutions

If you're finding a few insects in scattered locations, it's a sign that closer attention needs to be paid to your monitoring program. Increases in the number or areas of significant insect populations will require swift action to avoid complete plant/warehouse shut down. Use the guidelines below to focus your treatment program. Monitor on a continuing basis, regardless of the frequency and rate of capture. Count traps routinely and replace when needed (see pages 11-12 for guidelines).

PLEASE NOTE: Insecticide applications or residue will normally not limit trap effectiveness more than a few hours if at all.

	<h3>Occasional Low Capture</h3> <p><i>Capture Frequency: Occasional</i> <i>Capture Rate: Low</i> Management Protocol:</p> <ul style="list-style-type: none"> • Tighten STORGARD® trap-grid in areas showing marked or general increase. • Check inventory for at-risk infested commodities. • Remove/clean contaminated commodities. • Check for outside sources of infestation. • Review sanitation program and continue to monitor for infested commodities. <p>Treatment:</p> <ul style="list-style-type: none"> • Delay insecticide treatment until there is evidence of a significant population
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Typical layout grid – one STORGARD® trap per section.

	<h3>Constant Low Capture</h3> <p><i>Capture Frequency: Constant</i> <i>Capture Rate: Low</i> Management Protocol:</p> <ul style="list-style-type: none"> • Tighten STORGARD® trap-grid in areas of marked increase only. • Check for at-risk infested commodities. • Remove/clean contaminated commodities. • Check for outside sources of infestation. • Review sanitation program and continue to monitor for infested commodities. <p>Treatment:</p> <ul style="list-style-type: none"> • Delay insecticide treatment until there is evidence of a significant population change or spot-treat areas considered susceptible or especially valuable.
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Typical layout grid – one STORGARD® trap per section.

Occasional High Capture

Capture Frequency: Occasional
Capture Rate: High
Management Protocol:

- Tighten STORGARD® trap-grid in areas showing marked or general increase.
- Remove/clean contaminated commodities.
- Review sanitation program and continue to monitor for infested commodities.

Treatment:

- Initiate insecticide treatments in areas considered susceptible or especially valuable.

Typical layout grid – one STORGARD® trap per section.

Constant Localized High Capture

Capture Frequency: Constant
Capture Rate: High and localized
Management Protocol:

- Tighten STORGARD® trap-grid in areas showing marked or general increase.
- Remove/clean contaminated commodities.
- Review sanitation program and continue to monitor for infested commodities.

Treatment:

- Initiate insecticide treatments in areas considered susceptible or especially valuable.

Typical layout grid – one STORGARD® trap per section.

Constant High Capture

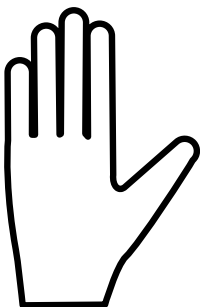
Capture Frequency: Constant
Capture Rate: High
Management Protocol:

- Remove/clean contaminated commodities.
- Review sanitation program and continue to monitor for infested commodities.

Treatment:

- Initiate insecticide treatments immediately.

Typical layout grid – one STORGARD® trap per section.

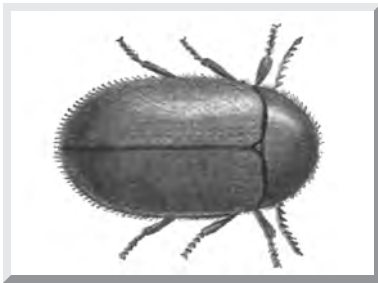


Important Precautions

- Read and follow package instructions on all lures and traps.
- Use one lure per trap.
- Dispose of lures in a sealed container away from facility being monitored.

Trécé Contact Information

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 831-758-0204 / Fax 831-758-2625 / E-mail: trece@trece.com



Illustrations courtesy Degesch America, Inc.

Lasioderma serricorne

Cigarette Beetle

DESCRIPTION

Adults: 2-4mm. Red-brown. Oval. Head hidden under neck shield and not visible from above. Adults do not feed. Strong fliers. Females larger than males. Common worldwide.

Eggs: 10-100. White. Laid loosely on infested grain.

Larvae: Grows to 4mm. Pale yellow. Light brown head. Bent. Densely crinite. Very mobile, decreasing with age. Pupation in cocoons.



Larvae: *Lasioderma serricorne*

Pupae: Approximately the same size as larvae. Green-yellow. Pupae develop within cocoon.

Host: Tobacco. Infestation not limited to tobacco products. Hosts include rice, dried fruits, some spices and herbs, nuts, and cocoa.

CAUSE OF DAMAGE

Consumption of food products by larvae.

PHENOLOGY¹

Life cycle	40-70 days ²
Eggs hatch	5-7 days
Larvae (while feeding)	16-70 days
Pupae	7-14 days
Mating/oviposition	1 week after eclosion
Adult life-span	6-42 days
Threshold temperature	20°-37°C (68°-98.6°F)

LURE

STORGARD[®], CB controlled release sex pheromone, STORGARD[®] kairomone food/attractant³, RE-BAIT™ sex pheromone lure and kairomone/food attractant.

TRAP

STORGARD[®] (FLITeTRAK[®] M²) beetle-trap DOME™ design.*

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²Greatly dependent on host and temperature.

³Used only to retain and kill this insect.

*Note: Replaces FLITeTRAK[®] M² and CB³ products.



Illustrations courtesy Degesch America, Inc.

DESCRIPTION

Adults: 2.5-3.5 mm. Slender, flat. Chocolate brown. Named for the peculiar saw-tooth projections on either side of thorax.

Eggs: Up to 400 eggs. Laid singly or loosely clustered in grain or crevices.

Larvae: Grows to 2.5mm. Elongated. White to pale yellow with beige bristles. Yellowish and green bands on the thoracic and abdominal dorsal surface. Prominent head.



Larvae: *Oryzaephilus surinamensis*

Oryzaephilus surinamensis

Sawtoothed Grain Beetle

Pupae: Approximately 1.5mm. Oval-shaped. Compact. White to pale white. Pupae develop in cocoons made from food particles.

Host: All types of raw stored-grains: including flour, milled cereal, breakfast cereals, dried fruits and meats, candies, and nuts.

Consumption of food products. May also cause heating of stored grains.

PHENOLOGY¹

Life cycle	21-28 days ²
Eggs hatch	3-17 days
Larvae (while feeding)	1-14 days
Pupae	6-9 days ³
Mating/oviposition	1 week after eclosion
Adult life-span	6-10 months up to 3 years
Threshold temperature	30°-35°C (86°-95°F)

LURE

STORGARD® kairomone/food attractant⁴,
RE-BAIT™ kairomone/food attractant.

TRAP

STORGARD® (FLITeTRAK® M²) beetle-trap⁵ DOME™ design* or
STORGARD® WB PROBE II® beetle-trap⁶.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²Numerous overlapping generations.

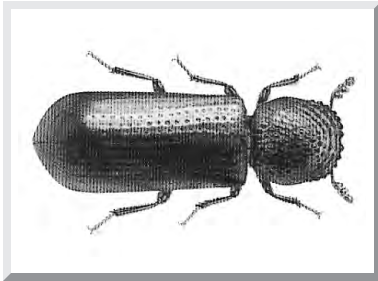
³Adults emerge 1 to 3 weeks.

⁴Used only to retain and kill this insect.

⁵Use in intermediate and finished commodities.

⁶Use in raw grains.

*Note: Replaces FLITeTRAK® M² and CB³ products.



Illustrations courtesy Degesch America, Inc.

Rhyzopertha dominica

Lesser Grain Borer

DESCRIPTION

Adults: 3mm. Slender (0.5mm wide), cylindrical. Polished dark-brown to black. Thorax and elytra rough between longitudinal lines of pits. Head turned down under thorax and not visible from above. Powerful jaws for cutting into wood. Strong fliers. Sometimes known as Australian wheat weevil. Common worldwide.

Eggs: 300-500. White. Laid singly or loosely clustered on loose grain.

Larvae: Grows to 3mm. Elongated. C-shaped. White to pale yellow. Head and thorax larger in diameter than abdomen. Larvae initially feed on flour made by adults or bore into partially damaged grains. Larvae complete growth within grain. Pupation inside grain.



Larvae: *Rhyzopertha dominica*

Pupae: Approximately 2mm.

White to pale green. Pupae develop within grain.

Host: All types of stored-grains, especially cereal and coarse grains.

CAUSE OF DAMAGE

Consumption of food products by larvae and adults.

PHENOLOGY¹

Life cycle	25-30 days ²
Eggs hatch	3-4 days
Larvae (while feeding)	7-14 days
Pupae	7 days
Mating/oviposition	immediately after boring out of grain
Adult life-span	3-8 months
Threshold temperature	32°-35°C (89.6°-95°F)

LURE

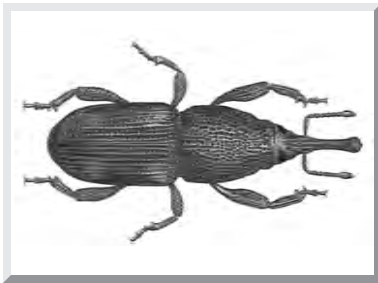
STORGARD® LBG controlled-release sex-pheromone lure.

TRAP

STORGARD® WB PROBE II® beetle-trap.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²Numerous overlapping generations.



Illustrations courtesy Degesch America, Inc.

DESCRIPTION

Adults: 3-4mm. Hard. Lightly polished black or chestnut brown. Pronotum marked with elongated pits. Deep grooves in elytra. Elongated beak. Stout mandibles. No flying wings. Distinguish from *Sitophilus oryzae* (rice weevil) and *Sitophilus zeamais* (maize weevil) by elongated pits on pronotum and absence of flying wings. Sometimes known as billbug or elephant bug. Common worldwide.

Eggs: 50-250. White. Adult females bore a small hole into grain kernel and deposit eggs. Female leaves gelatinous fluid to seal hole.

Larvae: White. Brown head. Fleshy. Legless. Larvae develop and feed within grain kernel.



Larvae: *Sitophilus granarius*

Sitophilus granarius

Granary Weevil

Pupae: Approximately 0.5mm. White. Pupae develop within grain.

Host: All types of stored-grains, especially wheat, corn, oats, barley, and sorghum.

CAUSE OF DAMAGE

Consumption of food products by larvae and adults.

PHENOLOGY¹

Life cycle	28-35 days ²
Eggs hatch	5-7 days
Larvae (while feeding)	35-45 days
Pupae	8-11 days
Mating/oviposition	5 d. after eclosion
Adult life-span	3-8 months
Threshold temperature	15°-35°C (59°-95°F)

LURE

STORGARD® kairomone food attractant, RE-BAIT™ kairomone/food attractant.

TRAP

STORGARD® (FLITeTRAK® M²) beetle-trap³ DOME™ design* or STORGARD® WB PROBE II® beetle-trap⁴.

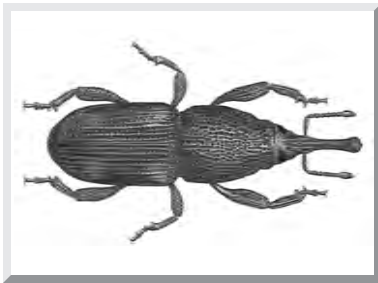
¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²In warm weather or heated storage, several overlapping generations yearly. Cold weather greatly prolongs development; may overwinter in unheated storage as larvae or free-living adult.

³Use in intermediate and finished commodities.

⁴Use in raw grains.

*Note: Replaces FLITeTRAK® M² and CB³ products.



Illustrations courtesy Degesch America, Inc.

Sitophilus oryzae

Rice Weevil

DESCRIPTION

Adults: 2.5-3.5mm. Red-brown to near black. Small snout. Usually marked with 4 red-brown spots on wing covers. Densely pitted thorax. Able to fly. Early life stages and development nearly identical to *Sitophilus granarius*. Distinguish from *Sitophilus granarius* (granary weevil) by color and markings and fully-developed wings. Common worldwide. Cold sensitive. Abundant and voracious in warm countries where conditions permit continuous breeding.

Eggs: 300-400. White. Laid loosely on infested grain.

Larvae: Grows to 4mm. White. Adult females bore a small hole into grain kernel and deposit eggs. Female leaves gelatinous fluid to seal hole. Cold sensitive. Pupation in-situ.



Larvae: *Sitophilus oryzae*

Pupae: Grows to .5mm. White.

Brown head. Larvae develop and feed within grain kernel.

Host: All types of grain. Infestation not limited to grain products.

Hosts include various food plants as well as noodles, legumes, tobacco products, baked goods, and flour.

CAUSE OF DAMAGE

Consumption of food products by larvae and adults. Presence can increase incidence of secondary pest such as fungi and mites. Irregular shaped holes in grain signal infestation.

PHENOLOGY¹

Life cycle	28-56 days ²
Eggs hatch	6-7 days
Larvae (while feeding)	35-45 days
Pupae	7-14 days ³
Mating/oviposition	5 days after eclosion
Adult life-span	4-5 months
Threshold temperature	15°-35°C (59°-95°F)

LURE

STORGARD® kairomone food attractant, RE-BAIT™ kairomone/food attractant.

TRAP

STORGARD® (FLITeTRAK® M²) beetle-trap³ DOME™ design* or STORGARD® WB PROBE II® beetle-trap⁴.

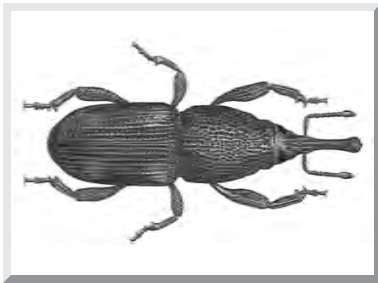
¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²In heated storage or warm countries, several overlapping generations.

³Use in intermediate and finished commodities.

⁴Use in raw grains.

*Note: Replaces FLITeTRAK® M² and CB³ products.



Illustrations courtesy Degesch America, Inc.

Sitophilus zeamais

Maize Weevil

DESCRIPTION

Adults: 4-5mm. Red-brown to black. Small snout. Pronounced red-brown spots on wing covers. Thorax densely and uniformly pitted. Able to fly. Early life stages and development nearly identical to *Sitophilus oryzae*. Distinguish from *Sitophilus oryzae* (rice weevil) by larger size and wing markings. Common worldwide. Cold sensitive. Abundant and voracious in warm and hot countries where conditions permit continuous breeding. Long considered a larger strain of *Sitophilus oryzae* (rice weevil), now recognized as a separate species. Often found with *Sitophilus granarius* (grain weevil).

Eggs: 300-400. White. Laid loosely on infested grain.

Larvae: Grows to 4mm. White. Adult females bore a small hole into grain kernel and deposit eggs. Female leaves gelatinous fluid to seal hole. Cold sensitive. Larvae only develop at temperatures above 13°C (56°F). Pupation in-situ.



Larvae: *Sitophilus zeamais*

Pupae: Grows to 0.5mm. White. Brown head. Larvae develop and feed within grain kernel.

Host: Corn. Infestation not limited to grain products. Hosts include various food plants as well as legumes, tobacco products, baked goods such as bread, flour, and chestnuts.

CAUSE OF DAMAGE

Consumption of food products by larvae and adults. Adults frequently fly from stored grain to infest mature crops in the field.

PHENOLOGY¹

Life cycle	30 days ² minimum
Eggs hatch	5-7 days
Larvae (while feeding)	35-45 days
Pupae	7-14 days ³
Mating/oviposition	5 days after eclosion
Adult life-span	4-5 months
Threshold temperature	13°-35°C (56°-95°F)

LURE

STORGARD® kairomone food attractant, RE-BAIT™ kairomone/food attractant.

TRAP

STORGARD® (FLITeTRAK® M²) beetle-trap⁴ DOME™ design* or STORGARD® WB PROBE II® beetle-trap⁵.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²Numerous overlapping generations.

³Adults emerge 1 to 3 weeks.

⁴Use in intermediate and finished commodities.

⁵Use in raw grains.

*Note: Replaces FLITeTRAK® M² and CB³ products.



Illustrations courtesy Degesch America, Inc.

DESCRIPTION

Adults: 3mm. Slender. Flattened. Oval. Shiny. Red-brown. Head and upper parts of thorax densely patterned with very small punctures. Wing covers are ridged lengthwise and sparsely patterned with punctures, as are the head and upper thorax. Found world wide. Most common in the Southern U.S. Long-lived. Able to fly.

Compare with *Tribolium confusum* (Confused Flour Beetle) next page. The two insects are closely related and almost identical in appearance; a magnifying glass is required to distinguish from *Tribolium confusum* (Confused Flour Beetle). The two beetles are distinguished chiefly by their antennae: the last few segments of the *Tribolium castaneum* (Red Flour Beetle) antennae end in a club formed by three, abruptly larger segments; the antennae segments of *Tribolium confusum* (Confused Flour Beetle) expand gradually toward the distal end.

Eggs: 400-450. White. Laid singly or loosely clustered on loose grain where adults live; eggs laid over several months. Females may lay as many as 1,000 eggs over lifetime.

Tribolium castaneum

Red Flour Beetle

Larvae: Grows to 2.5mm. Slender. Cylindrical. Yellow-brown. Darker brown head; slender and pointed processes at the posterior end. Larvae feed 1-4 months before pupation.



Larvae: *Tribolium castaneum*

White changing to yellow and then brown. Pupae develop within grain. Temperature sensitive (see Phenology below).

Host: Stored-grains, flour, milled grains, spices, nuts, ginger, peas, beans, dried fruits, tobacco seed, milk powder, chocolate.

PHENOLOGY¹

Life cycle	60-90 days ²
Eggs hatch	5-12 days
Larvae (while feeding)	35-45 days
Pupae	7-14 days
Mating/oviposition	immediately after eclosion
Adult life-span	18-24 months
Threshold temperature	22°-40°C (71.6°-104°F) ³

LURE

STORGARD® controlled release aggregation pheromone lure,
STORGARD® kairomone/food attractant,
RE-BAIT™ kairomone/food attractant.

TRAP

STORGARD® (FLITeTRAK® M²) beetle-trap⁴ DOME™ design* or STORGARD® WB PROBE II® beetle-trap⁵.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²Numerous overlapping generations.

³Not seasonal in heated storage.

⁴Use in intermediate and finished commodities.

⁵Use in raw grains.

*Note: Replaces FLITeTRAK® M² and CB³ products.



Illustrations courtesy Degesch America, Inc.

Tribolium confusum

Confused Flour Beetle

DESCRIPTION

Adults: 3mm. Slender. Flattened. Oval. Shiny. Red-brown. Head and upper parts of thorax densely patterned with very small punctures. Wing covers are ridged lengthwise and sparsely patterned with punctures, as head and upper thorax. Found around the world. The most common and damaging insect to flour mills in the U.S. Long-lived. Does not fly. Rapid infestation of fresh products from grain-covered eggs sticking to containers of all varieties. Compare with *Tribolium castaneum* (Red Flour Beetle), previous page.

Eggs: 400-450. White. Laid singly or loosely clustered on loose grain where adults live; eggs laid over several months. Females may lay as many as 1,000 eggs over lifetime.

Larvae: Grows to 2.5mm. Slender. Cylindrical. Yellow-brown. Darker brown head; slender and pointed processes at the posterior end. Larvae feed 1-4 months before pupation.



Larvae: *Tribolium confusum*

Pupae: Approximately 2mm. White changing to yellow and then brown. Pupae develop within grain. Temperature sensitive (see Phenology below).

Host: All types of stored-grains, especially flour and other milled grains. Other hosts include beans, dried fruits and nuts, chocolate,

and spices such as cayenne pepper.

CAUSE OF DAMAGE

Consumption of food products by larvae and adults; release of quinonoid allomones causes discoloration of host products and foul odor.

PHENOLOGY¹

Life cycle	60-90 days ²
Eggs hatch	5-12 days
Larvae (while feeding)	30-120 days
Pupae	7-14 days
Mating/oviposition	1-2 days
Adult life-span	18-24 months
Threshold temperature	22°-40°C (71.6°-104°F) ³

LURE

STORGARD[®] controlled release aggregation pheromone lure, STORGARD[®] kairomone/food attractant, RE-BAIT™ kairomone/food attractant.

TRAP

STORGARD[®] (FLITeTRAK[®] M²) beetle-trap⁴ DOME™ design* or STORGARD[®] WB PROBE II[®] beetle-trap⁵.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²Numerous overlapping generations. ³Not seasonal in heated storage.

⁴Use in intermediate and finished commodities.

⁵Use in raw grains.

*Note: Replaces FLITeTRAK[®] M² and CB³ products.



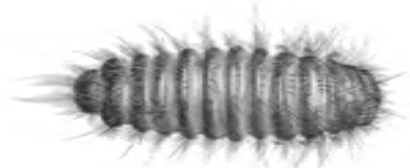
Illustrations courtesy Degesch America, Inc.

DESCRIPTION

Adults: 2-3mm. dark brown. Oval. Smudged yellow-brown and red-brown transverse markings on wing covers. Short-lived. Adults do not feed or fly. Quarantined in U.S.

Eggs: 80-125. White. Laid loosely on infested grain.

Larvae: Grows to 5mm. Yellow-brown. Spindle-shaped. Densely covered with setae. Mature larvae migrate away from food to pupate. In unfavorable conditions larvae can survive without food and withstand low temperatures for long periods. (See Phenology.)



Larvae: *Trogoderma granarium*

Trogoderma granarium

*Khapra Beetle
and other Trogoderma spp.*

Pupae: 3mm. Brown. Pupation occurs in last stage of larval skin.

Host: All grains and grain products., including pinto beans, cotton seed, alfalfa seed, castor beans, nuts, fish meal and so on. Cereal grains often hollowed out until only the husk remains.

CAUSE OF DAMAGE

Consumption of food products by larvae. Adult do no damage.

PHENOLOGY¹

Life cycle	30-37 days ²
Eggs hatch	4-10 days
Larvae (while feeding)	18-65 days
Pupae	3-6 days
Mating/oviposition	shortly after eclosion
Adult life-span	3-19 days
Threshold temperature	21°-35°C (69.8°-95°F) ³

LURE

STORGARD[®] controlled release sex pheromone, STORGARD[®] kairomone/food attractant, RE-BAIT™ kairomone/food attractant.

TRAP

STORGARD[®] (FLITeTRAK[®] M²) beetle-trap⁴ DOME™ design* or STORGARD[®] Wall Trap or STORGARD[®] WB PROBE II[®] beetle-trap⁵.

¹In the absence of definitive data, Trécé, Incorporated, offers this concept of phenology from available sources and field experience.

²Multiple generations. Lengthy diapause, up to 4 years, under unfavorable conditions.

³No development under 21°C (69.8°F); rapid development at 35°C (95°F)

⁴Use in intermediate and finished commodities.

⁵Use in raw grains.

*Note: Replaces FLITeTRAK[®] M² and CB³ products.

STORGARD® Pheromone/Kairomone Lure Storage Guide

Insect Name	Expected Storage Period			
	6 mo.	1 year	2 years	3 years
<i>Cadra cautella</i> (Almond Moth)	◆●■	◆●■	■	■
<i>Ephestia elutella</i> (Tobacco Moth)	◆●■	◆●■	●■	■
<i>Cadra figulilella</i> (Raisin Moth)	◆●■	◆●■	●■	■
<i>Ephestia kuehniella</i> (Mediterranean Flour Moth)	◆●■	◆●■	●■	■
<i>Plodia interpunctella</i> (Indianmeal Moth)	◆●■	◆●■	●■	■
<i>Sitotroga cerealella</i> (Angoumois Grain Moth)	◆●■	◆●■	■	■
<i>Lasioderma serricorne</i> (Cigarette Beetle)	◆●■	◆●■	■	■
<i>Oryzaephilus surinamensis*</i> (Sawtoothed Grain Beetle)	◆●■	●■	■	■
<i>Rhyzopertha dominica</i> (Lesser Grain Borer)	◆●■	◆●■	■	■
<i>Sitophilus granarius*</i> (Granary Weevil)	◆●■	●■	■	■
<i>Sitophilus oryzae*</i> (Rice Weevil)	◆●■	●■	■	■
<i>Sitophilus zeamais*</i> (Maize Weevil)	◆●■	●■	■	■
<i>Tribolium castaneum</i> (Red Flour Beetle)	●■	■	■	■
<i>Tribolium confusum</i> (Confused Flour Beetle)	●■	■	■	■
<i>Trogoderma granarium</i> (Khapra Beetle) & other Trogoderma	◆●■	●■	■	■

◆ = Room Temperature ● = Refrigerated ■ = Frozen
 *Kairomone attractant only. Pheromone NOT currently available.
 NOTE: Always store Kairomone (oil-based attractant) under refrigeration or freezer if it is to be in storage more than 6 months.

STORGARD® IPM Partner® Insect Monitoring Record

Location

Sublocation

Insect Species	Date				Subtotal				M/T/D				Subtotal				M/T/D				Grand Total	M/T/D								
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4										
<i>Cadra cautella</i> (Almond Moth)	**A:																													
	***L:																													
<i>Ephestia elutella</i> (Tobacco Moth)	**A:																													
	***L:																													
<i>Cadra figulilella</i> (Raisin Moth)	**A:																													
	***L:																													
<i>Ephestia kuehniella</i> (Mediterranean Flour Moth)	**A:																													
	***L:																													
<i>Plodia interpunctella</i> (Indianmeal Moth)	**A:																													
	***L:																													
<i>Sitotroga cerealella</i> (Angoumois Grain Moth)	**A:																													
	***L:																													
<i>Lasioderma serricorne</i> (Cigarette Beetle)	**A:																													
	***L:																													
<i>Oryzaephilus surinamensis</i> (Sawtoothed Grain Beetle)	**A:																													
	***L:																													
<i>Rhyzopertha dominica</i> (Lesser Grain Borer)	**A:																													
	***L:																													
<i>Sitophilus granarius</i> (Granary Weevil)	**A:																													
	***L:																													
<i>Sitophilus oryzae</i> (Rice Weevil)	**A:																													
	***L:																													
<i>Sitophilus zeamais</i> (Maize Weevil)	**A:																													
	***L:																													
<i>Tribolium castaneum</i> (Red Flour Beetle)	**A:																													
	***L:																													
<i>Tribolium confusum</i> (Confused Flour Beetle)	**A:																													
	***L:																													
<i>Trogoderma granarium</i> (Khapra Beetle)	**A:																													
and other Trogoderma	***L:																													

* M/T/D: Moths/Trap/Day (divide subtotal/total) by total days monitored

** A: Adult

*** L: Larvae



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