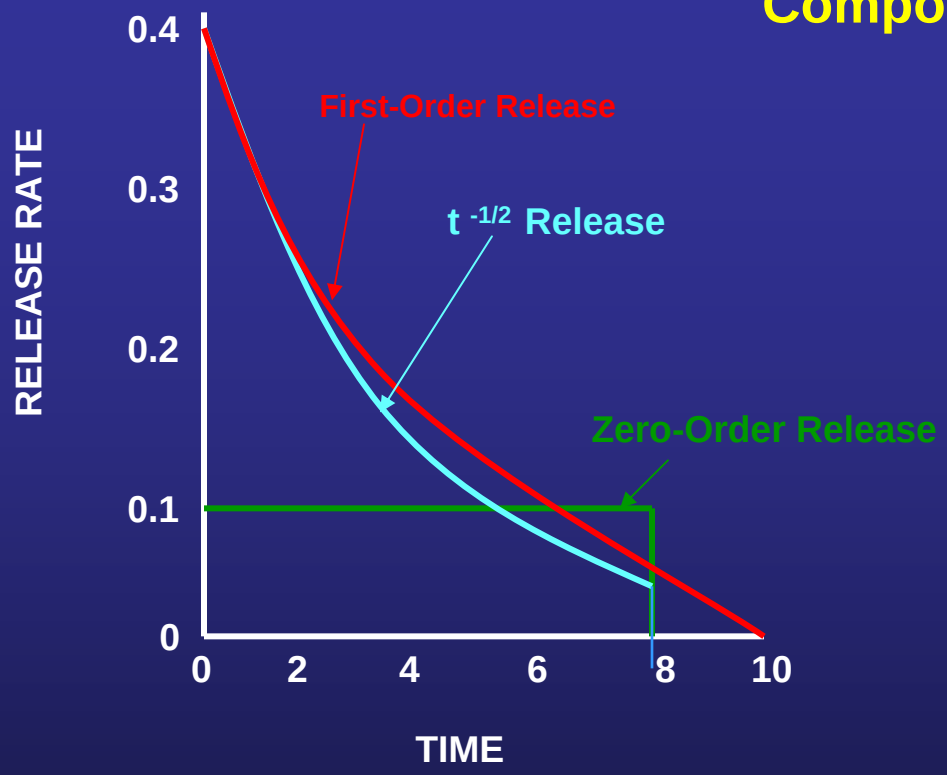
DELIVERY SYSTEMS WITH MULTIPLE APPLICATIONS

Technology Development Center
Lee County Mosquito Control District
Post Office Box 60005
Ft. Myers, FL 33906, USA

Matricap® Technology

Controlled-Release Profiles of Bioactive Agents from Solid Compositions



Zero-Order Release- The release rate remains constant until the composition is exhausted of contaminant-reducing agent(s)

First-Order Release- The release rate is proportional to the mass of contaminant-reducing agent(s) contained in the composition

Square-root-of-time ($T^{-1/2}$)- The release rate is linear with the reciprocal of the square root of time

Benefits of Controlled Delivery

Penetration

Persistence

Targeting

Granular Controlled - Delivery Pesticide Formulations

Single-Action (1 pesticide)

Examples: *B.t.i.*
Pyriproxyfen
Temephos
Phenylpyrazoles

Joint-Action (2 or more pesticides)

Examples: *B.t.i.* + *B.sphaericus*
B.t.i. + Methoprene
B.t.i. + Pyriproxyfen
B.t.i. + Methoprene + Pyriproxyfen

Matricap® Controlled - Delivery Compositions

↓

Coating / Coating Complex
(Fatty Alcohols, Fatty Acids and/or Esters Including Salts)

↓

Solid Matrices
(Polymer / Nonpolymer Carriers)

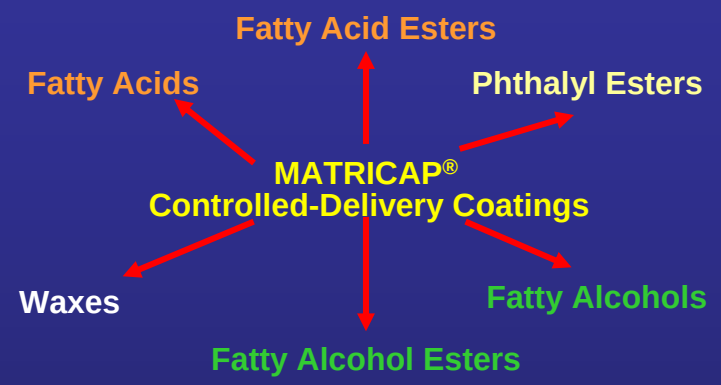
↓

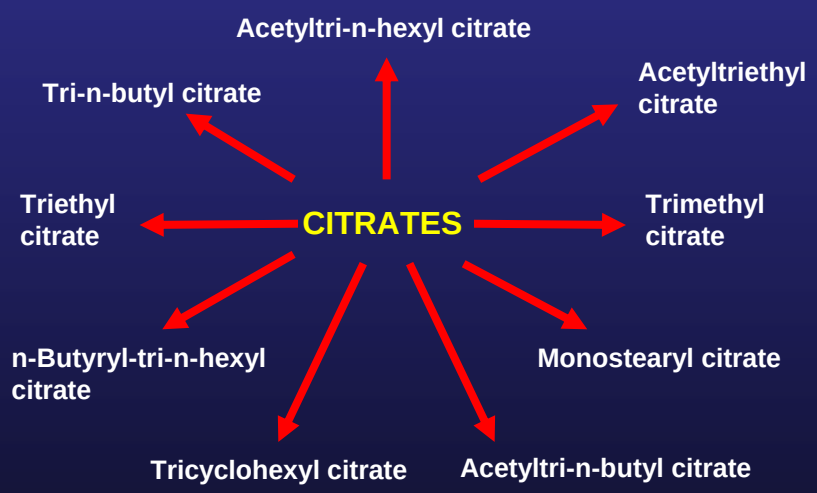
Mosquito Larvicides / Pesticides
(Biolarvicides, IGRs, CNS Inhibitors, etc.)

↓

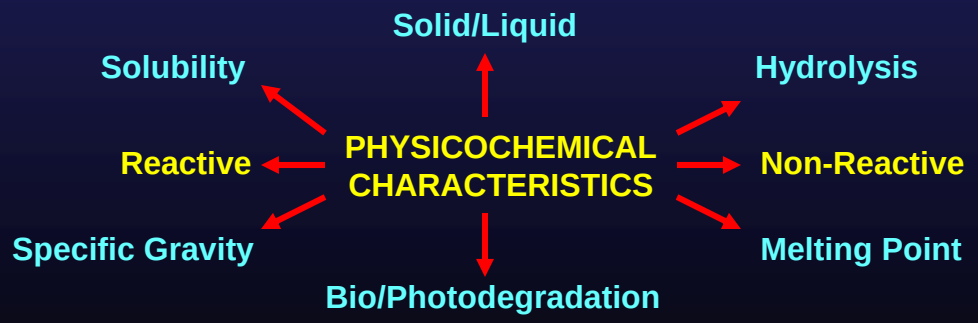
Optional Formulation Aids
(Binders, Stickers, Regulators)

Matricap® Controlled-Delivery Coatings





Acetates	Isobutyrates	Sebacates	PVA
Adipates	Isophthalates	Stearates	HPMC
Azelates	Laurates	Succinates	PEO
Benzoates	Linoleates	Toluates	
Caprylamides	Maleates	Toluamides	
Capramides	Mellitates	Tallates	
Caprates	Myristates	Naphthenic Hydrocarbons	
Citrates	Octanoates	Chlorinated Paraffins	
Cocoates	Oleates	Waxes	
Decanoates	Palmitates	Expoxidized Vegetable Oils	
Fumarates	Pelargonates	Stearyl Alcohol	
Glutarates	Phosphates	Cetyl Alcohol	
Glycolates	Phthalates	Myristyl Alcohol	
Heptanoates	Ricinoleates	Octadecanoic Acid	



EPA Inert List 3 – Inert Pesticide Ingredient of unknown toxicity

EPA Inert Lists 4A/4B – Inert pesticide ingredients that pose minimal environmental and public health risk

Matricap® Matrices

Silicas
Cellulose Fibers
Metal Oxides
Clays
Slag
Lava
Polyethylene Oxide
Polyvinyl Alcohol
Polyvinyl Alcohol Copolymers
Infusorial Earth
Hydroxypropyl Methyl Cellulose
Paper
Pin Chips
Cetyl Alcohol
Stearyl Alcohol
Non-Acrylic Polymers

Vermiculite
Cork
Corn Cob
Bagasse
Seeds
Seed Hulls
Carbon Materials
Starches
Modified Starches
Carrrageenans
Algin
Xanthates
Agar
Food Proteins
Rubber
Plaster

Gypsum
Cement
Concrete
Asphalt
Wood
Fiber Glass
Glass
Metals
Metal Alloys
Mineral Aggregate
Clothing Fabrics
Leather
Natural Fibers
Synthetic Fibers
Liposomes
Lipospheres

Bioactive Agents

Insecticides
Toxicants
Adulticides
Ovicides
Larvicides
Petroleum Oils
Nymphicides
Pupicides
Attractants
Repellents
Pheromones
Pathogens
Hormones
Parasites

Chemosterilants
Bactericides
Viricides
Fungicides
Algaecides
Herbicides
Nematicides
Amoebicides
Miticides
Acaricides
Predicides
Schistisomicides
Molluscicides
Feeding Stimulants

Growth Stimulants
Growth Regulators
Surface Films
Microbial Agents
Biological Agents
Pharmaceuticals
Medicaments
Antibiotics
Nutrients
Fragrances
Flavorants
Food Additives

Optional Ingredients

Diluents
Adjuvants
Dyes
Alcohols
Keytones
Oils
Surfactants
Water
Emulsifiers
Film-Forming Agents
Compatibility Agents
Wetting Agents
Sticking Agents
Catalysts
Co-Solvents

Salt
Hydrocolloids
Penetrants
Buoyancy Modifiers
Ultraviolet Absorbers
Photo-Protecting Agents
Suspending Agents
Elastomers
Deflocculating Agents
Dispersing Agents
Stabilizing Agents
Antifoaming Agents
Natural or Synthetic Polymers
Synergists
Solvents

Binding Agents

Sulfonated Polystyrene Homopolymers
Sulfonated Styrene Maleic Anhydride Polymers
Sulfonated Vinyl Toluene Maleic Anhydride Polymers
Vinyl Pyrrolidone Polymers/Copolymers
Poly (Isobutylene-Co-Disodium Maleate) Copolymers
Acrylamide Polymers/Copolymers
Acrylonitrile-Starch Graft Polymers/Copolymers
Acralate Polymers/Copolymers
Poly (Vinyl Alcohol) Polymers/Coploymers
Poly (Ethylene Oxide) Polymers/Coploymers
Acrylic Acid or Acrylic Ester Homopolymers/Copolymers
Methyl Vinyl Ether Malic Acid Ester Copolymers
Starches or Modified Starches
Synthetic Gums
Poly (Ethylene Glycol)
Plaster of Paris
Natural Gums
Wax
Paper
Gypsum
Cellulose
Latex
Clay

Target Pests

Mosquitoes

Cockroaches

Larval Mosquito Targets

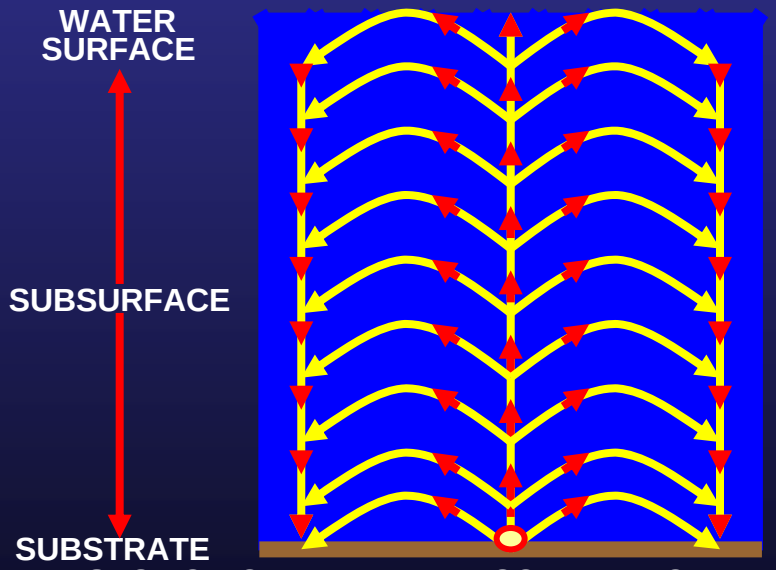
Surface-Active
(*Anopheles* spp.)

Subsurface-Active
(*Ochlerotatus* and *Culex* spp.)

Controlled Delivery of Mosquito Larvicides from Matricap® Granules

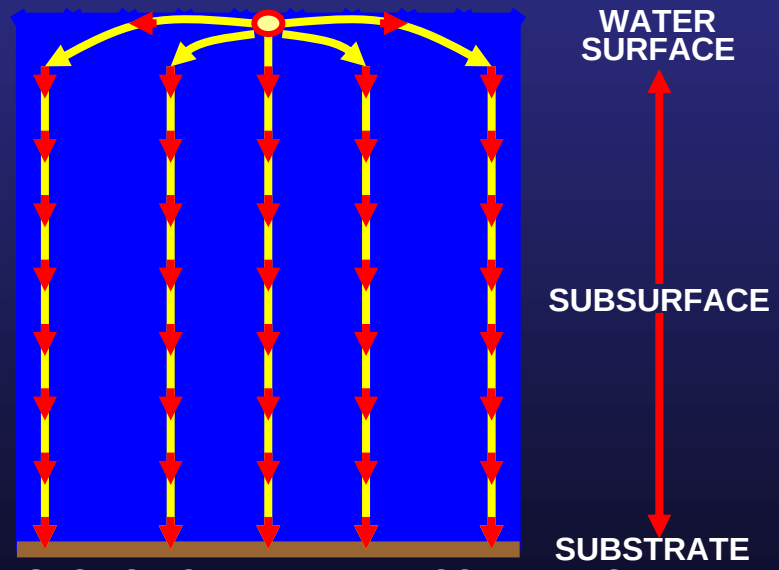
MATRICAP® Granule

A. SUBMERGED GRANULE

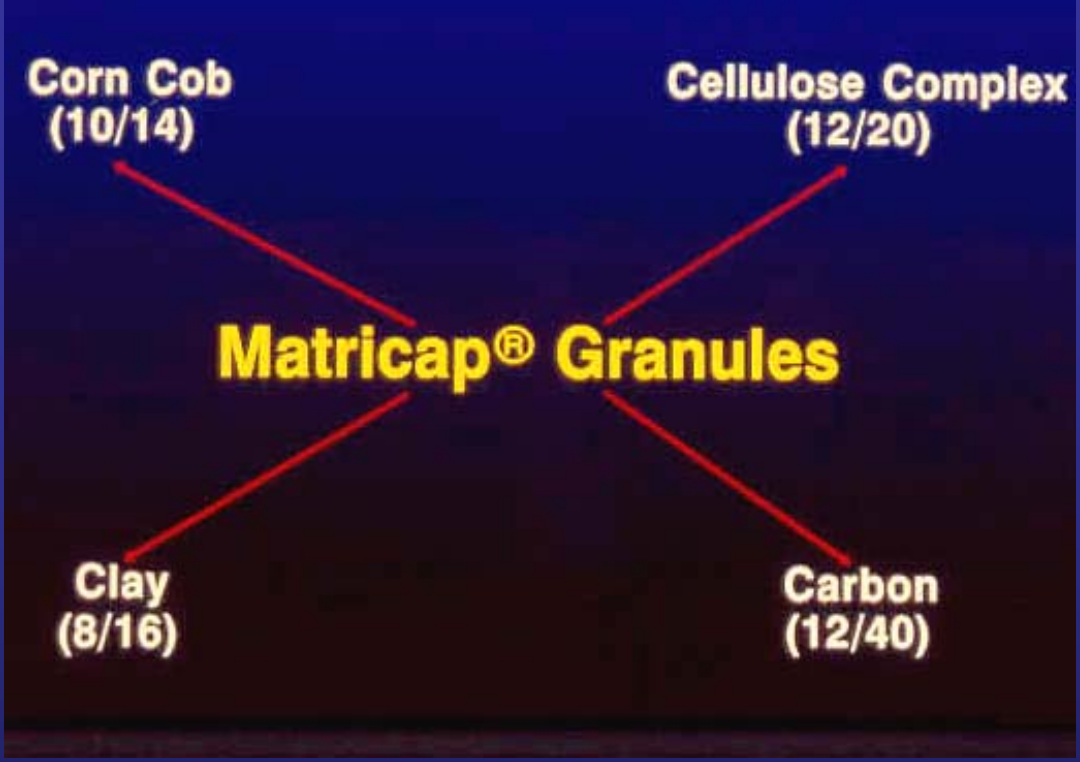


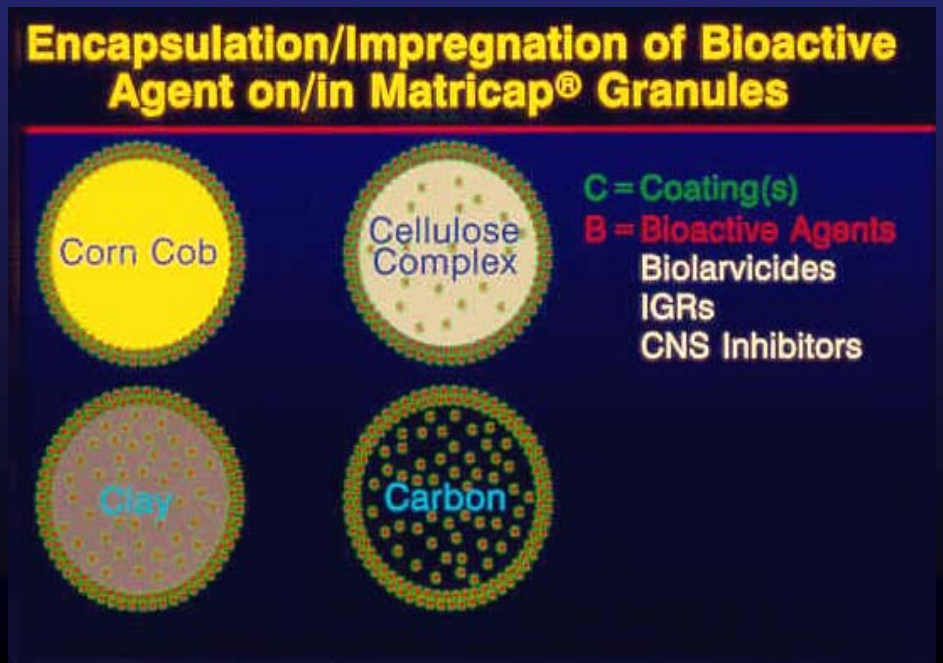
SECTION OF THE WATER COLUMUN OF A MOSQUITO HABITAT SHOWING VERTICAL AND LATERAL RELEASE PROFILE FROM A SUBMERGED GRANULE

B. FLOATING GRANULE

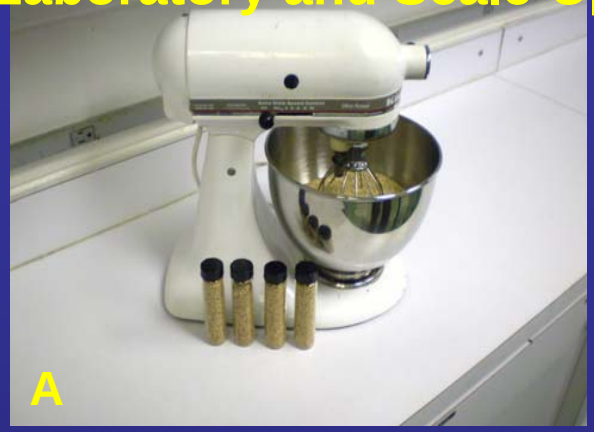


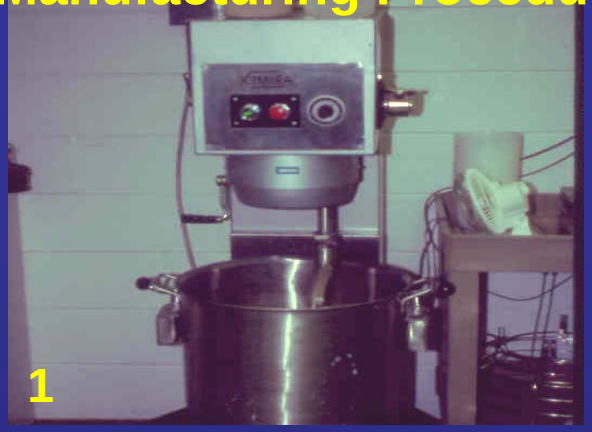
SECTION OF THE WATER COLUMUN OF A MOSQUITO HABITAT SHOWING LATERAL AND DOWNWARD RELEASE PROFILE FROM A FLOATING GRANULE

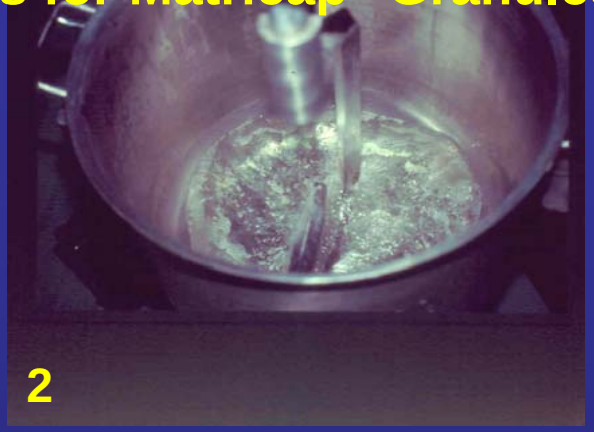

Corn Cob
(10/14)
Cellulose Complex
(12/20)
Matricap® Granules
Clay
(8/16)
Carbon
(12/40)


Encapsulation/Impregnation of Bioactive Agent on/in Matricap® Granules
Corn Cob
Cellulose Complex
Clay
Carbon
C = Coating(s)
B = Bioactive Agents
Biolarvicides
IGRs
CNS Inhibitors

Laboratory and Scale-Up Manufacturing Procedures for Matricap® Granules







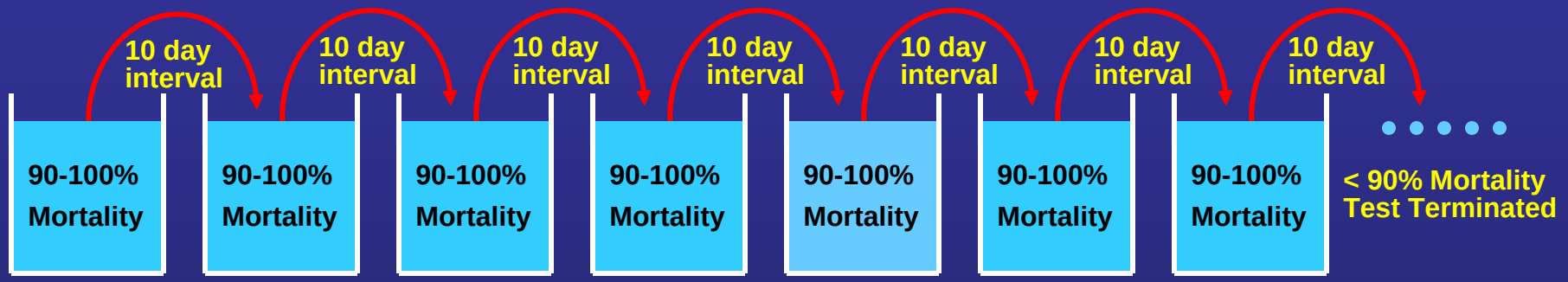
Experimental Pan-Granulated Matricap® Compositions

Experimental Pan-Granulated Matricap® Compositions

Experimental Matricap® Prills

Matricap® Granule-Transfer Bioassay Buckets

Matricap® Granule–Transfer Bioassays



Test Duration: 90 Days

Test Chambers: Plastic Buckets

No. Replications: 3 to 4

Water Quality: 17 Liters of 0% to 100% Artificial Seawater

No. Larvae / Bucket: 10 to 20 (Laboratory Strains of *Aedes*, *Culex, Anopheles, Ochlerotatus* spp.)

Larval Stage: 1st to 2nd Instar

Water Depth: 32cm

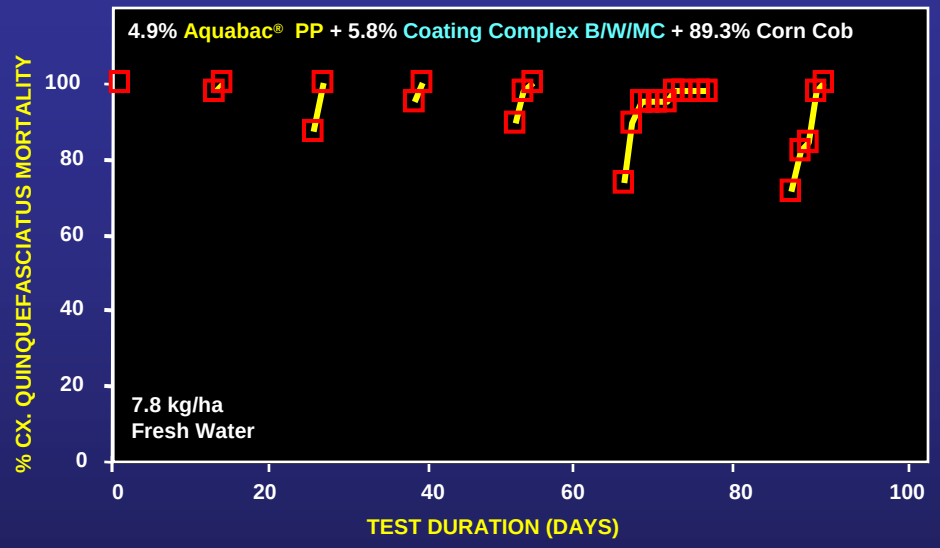
Larval Food: Ground Rabbit Chow Suspension @ 48hr Intervals

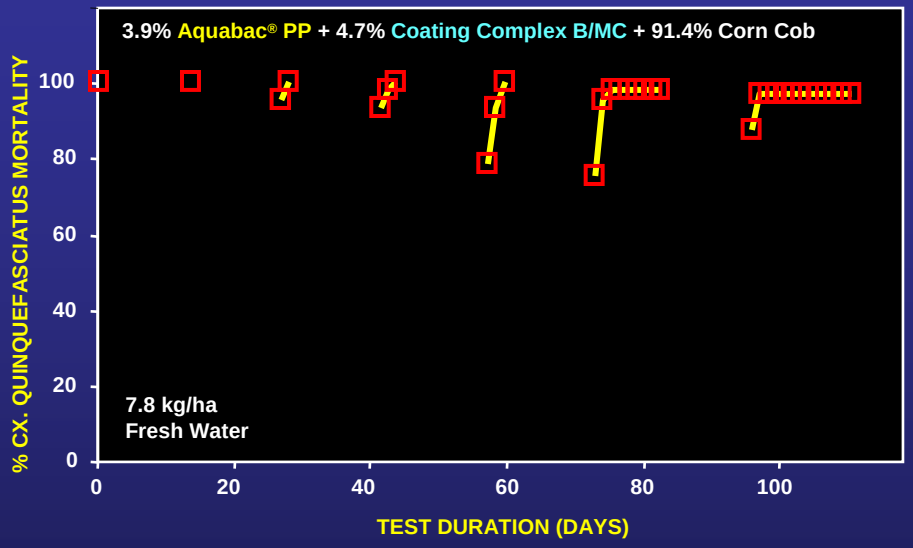
Application Rate: 5.6 to 11.2 kg/ha

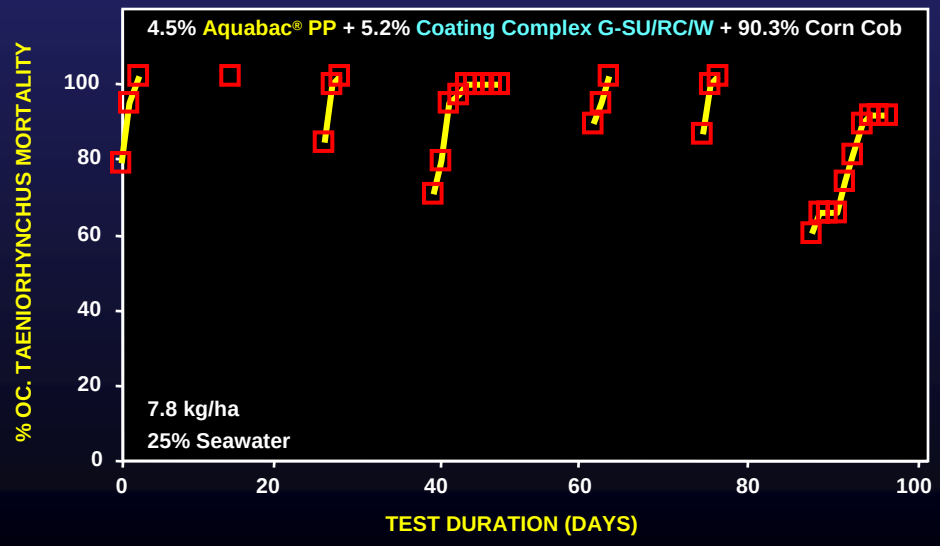
Test Temperature: Inside (26 – 27c) or Outside (3 – 35c)

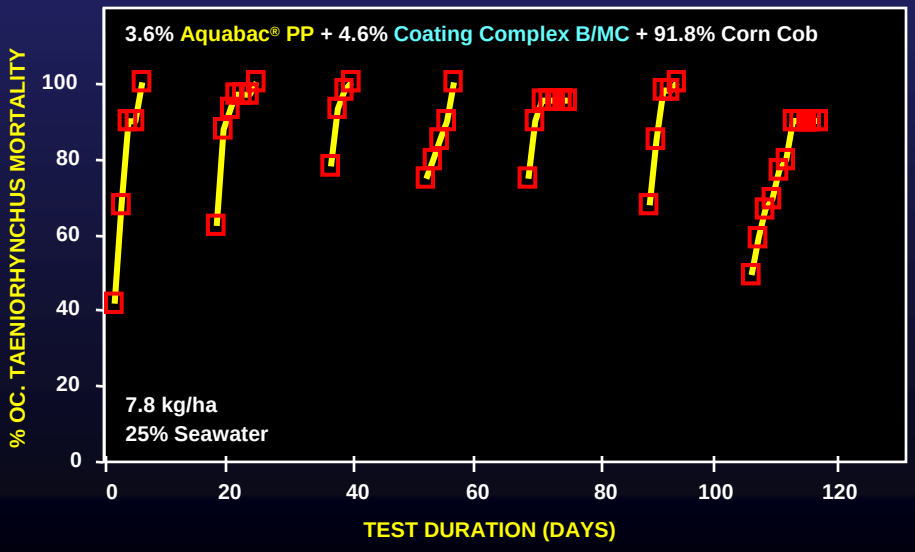
Mortality Parameters: % mortality at 24hrs posttreatment intervals; No motion when prodded with a probe

Controlled Delivery of Single-Action Formulations of a Biolarvicide from Corn Cob Granules

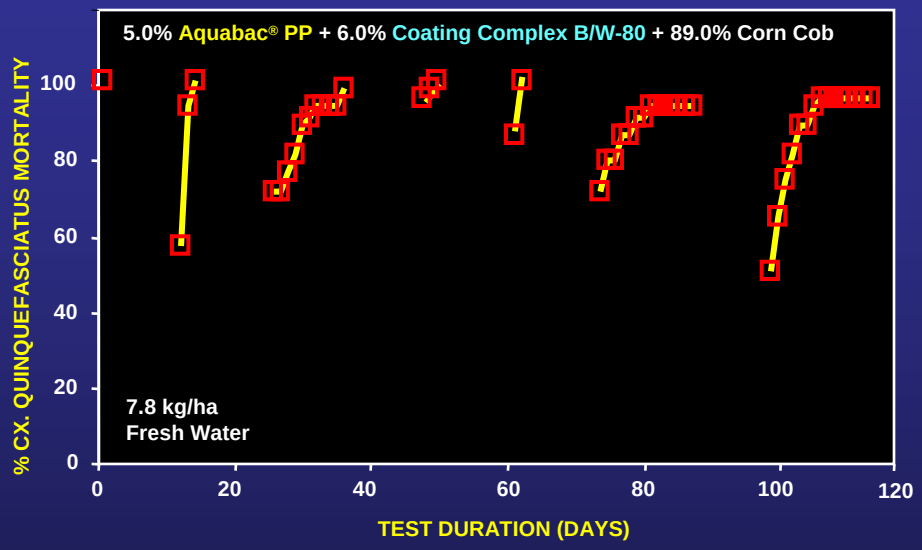


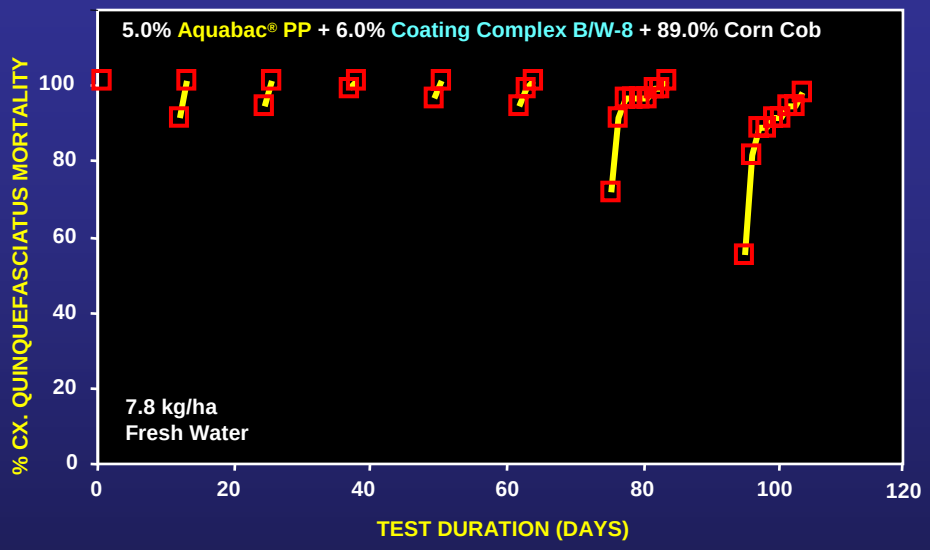


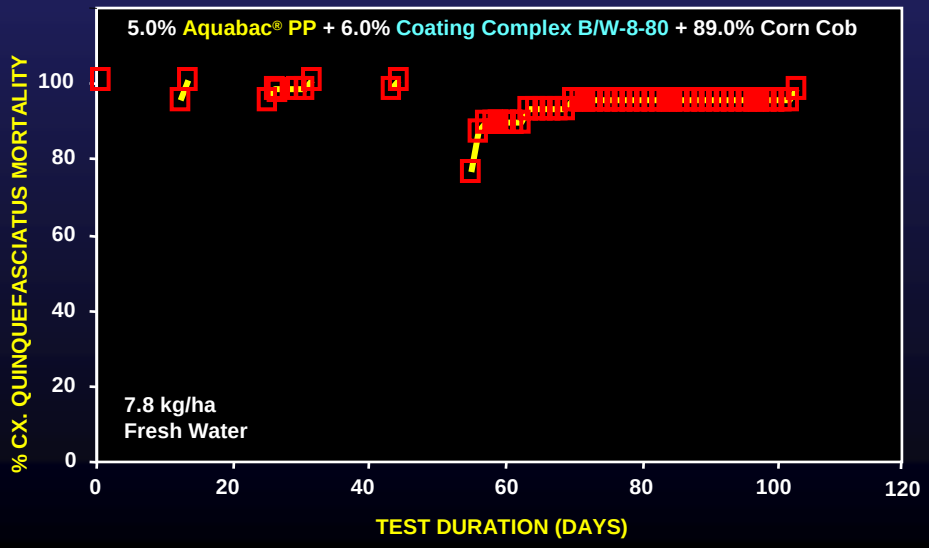




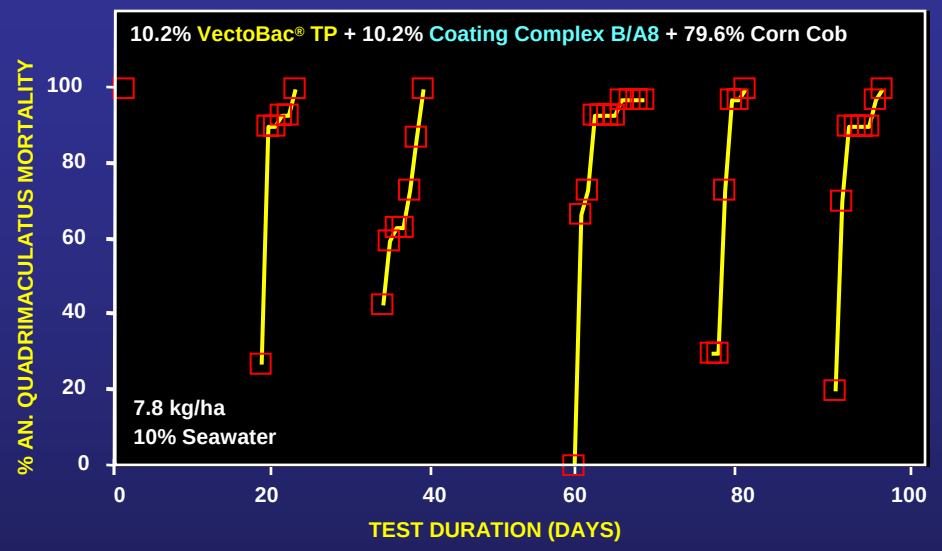
Controlled Delivery of Single-Action Formulations of a Biolarvicide from Corn Cob Granules: EPA List 4A / 4B Inerts

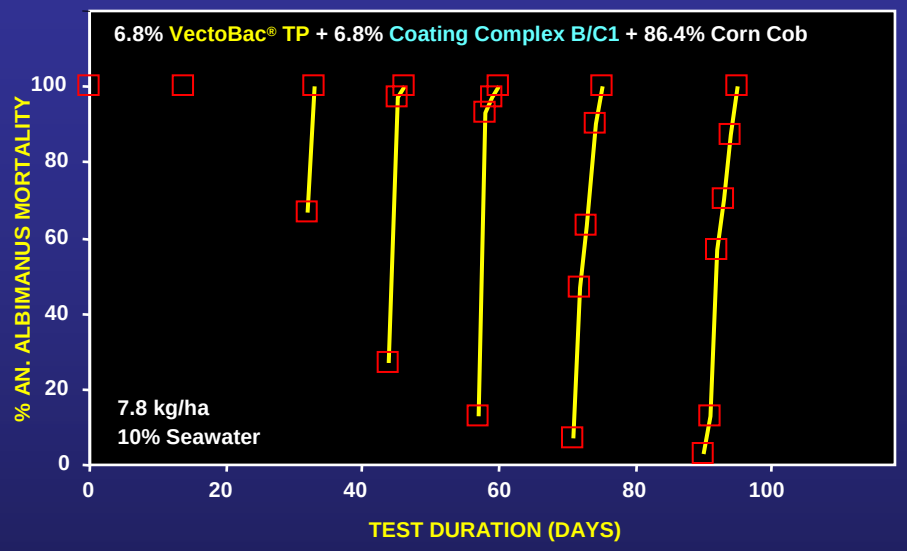


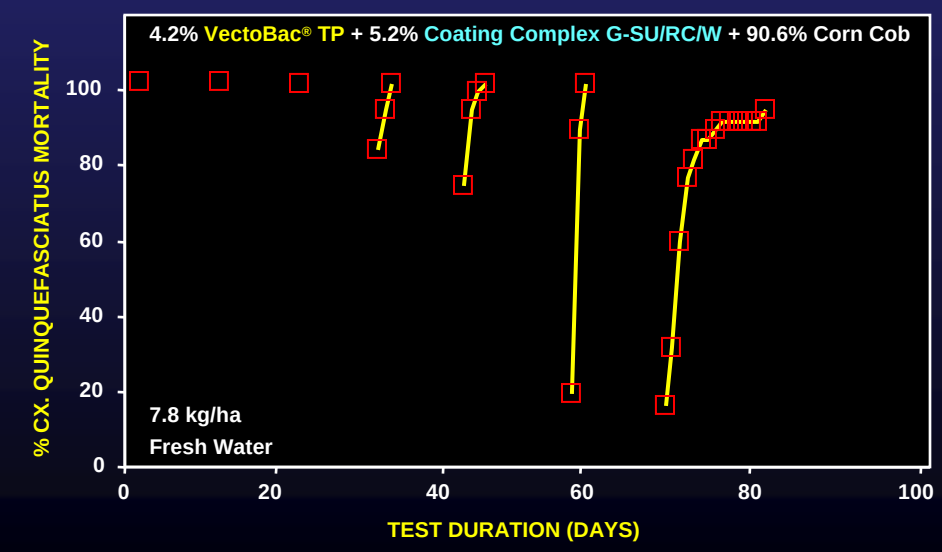


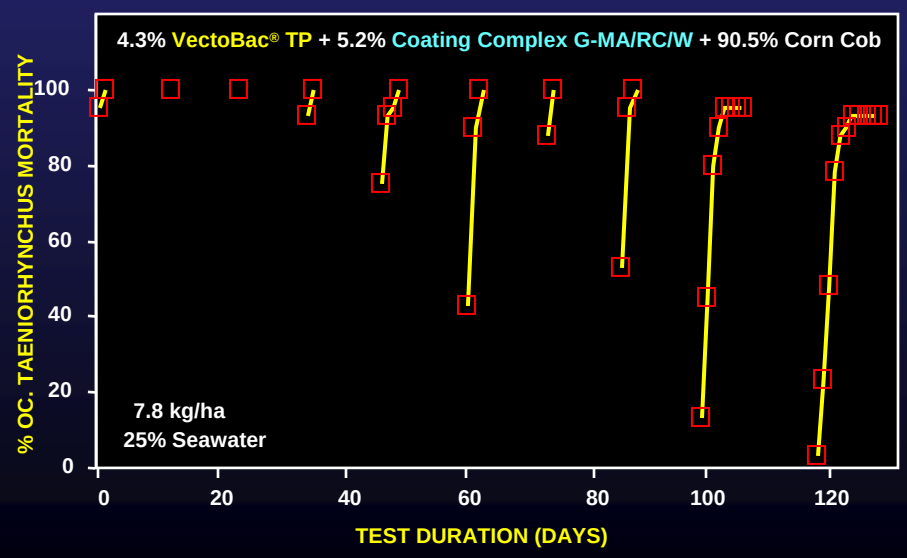


Controlled Delivery of Single-Action Formulations of a Biolarvicide from Corn Cob Granules

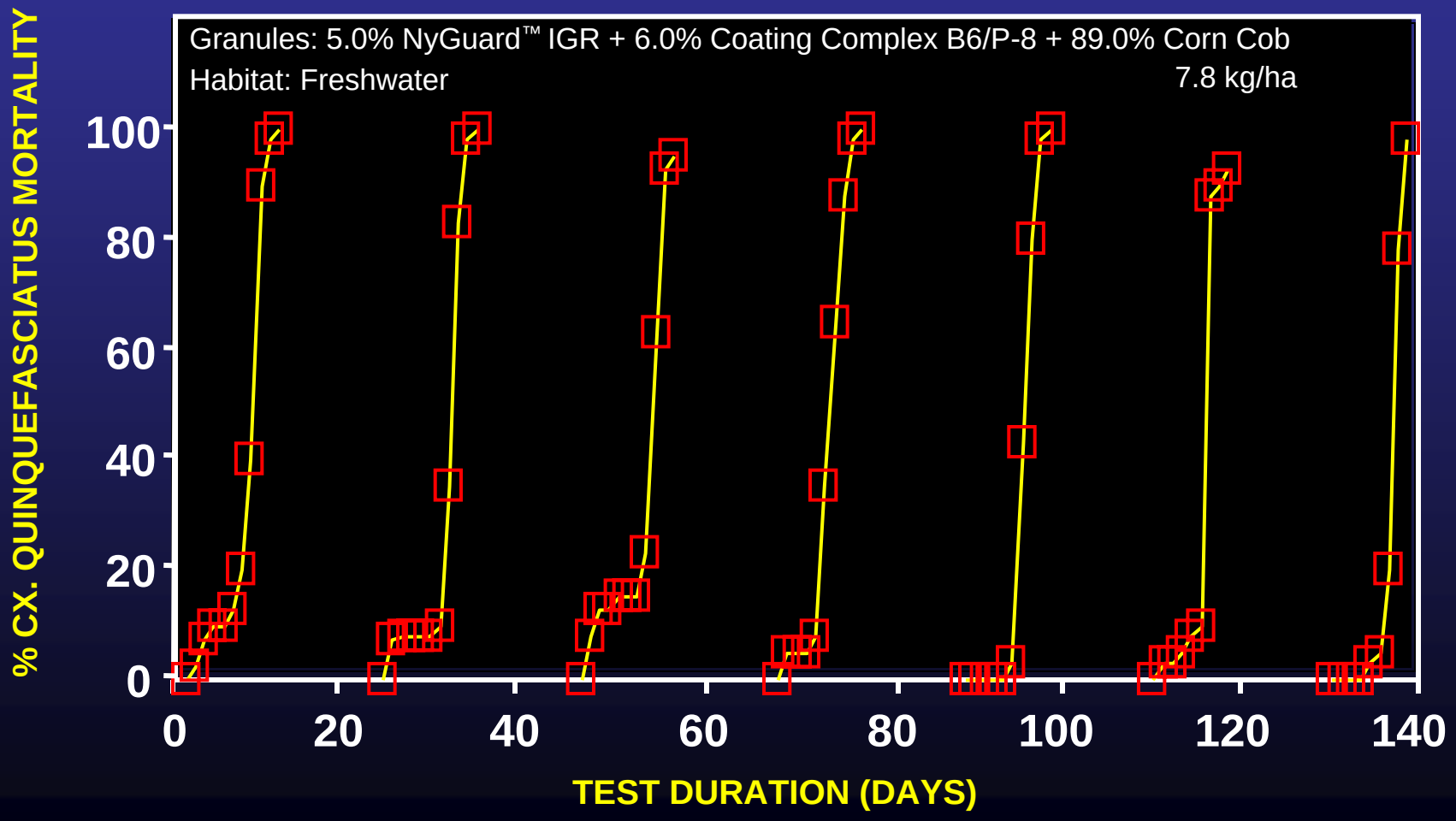




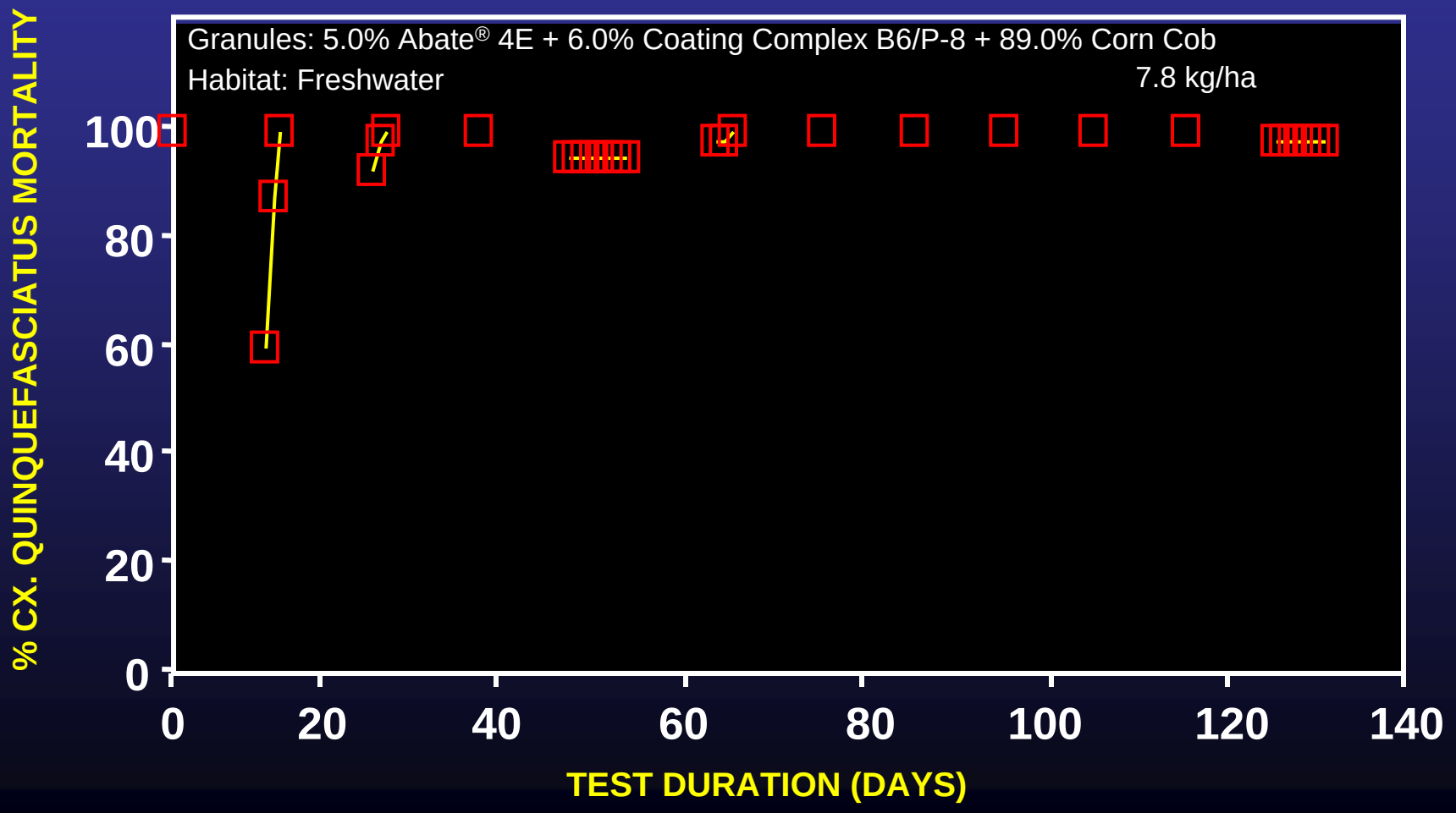




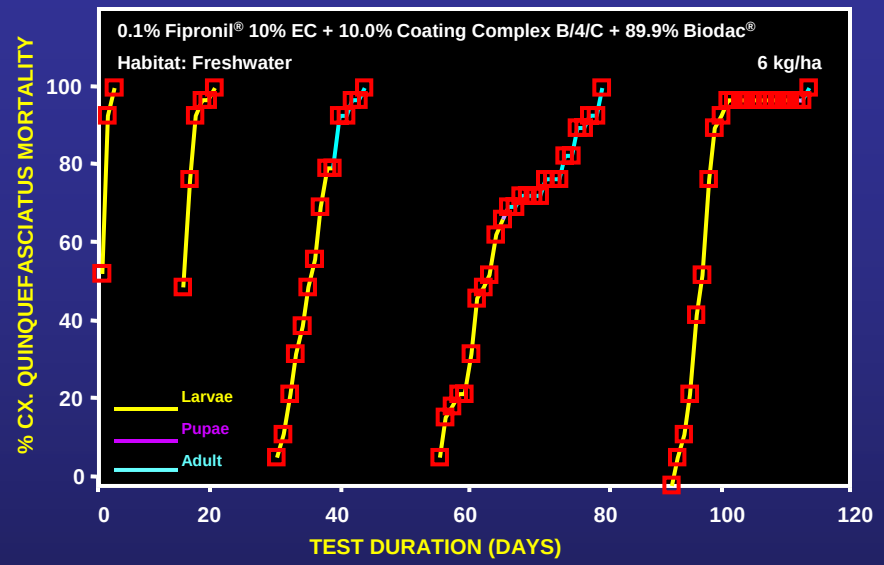
Controlled Delivery of an Insect Growth Regulator from Corn Cob Granules

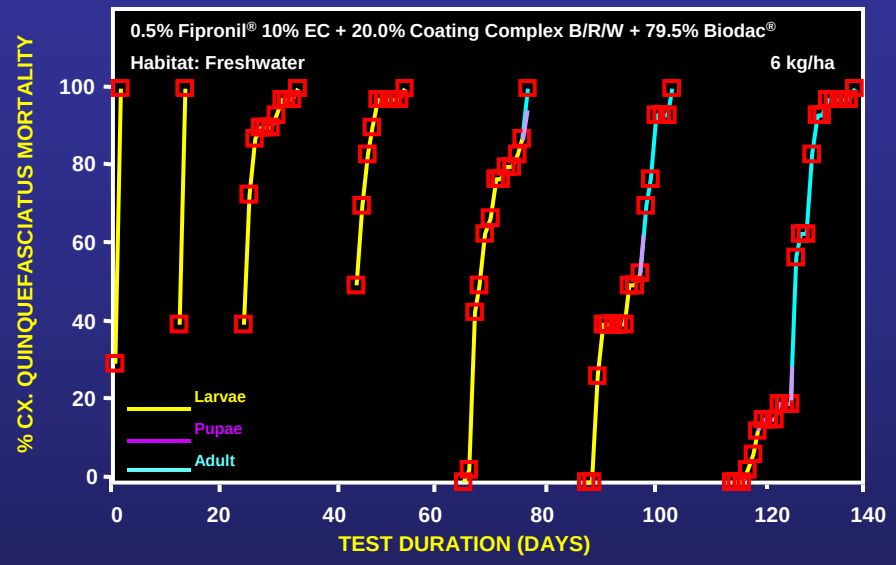


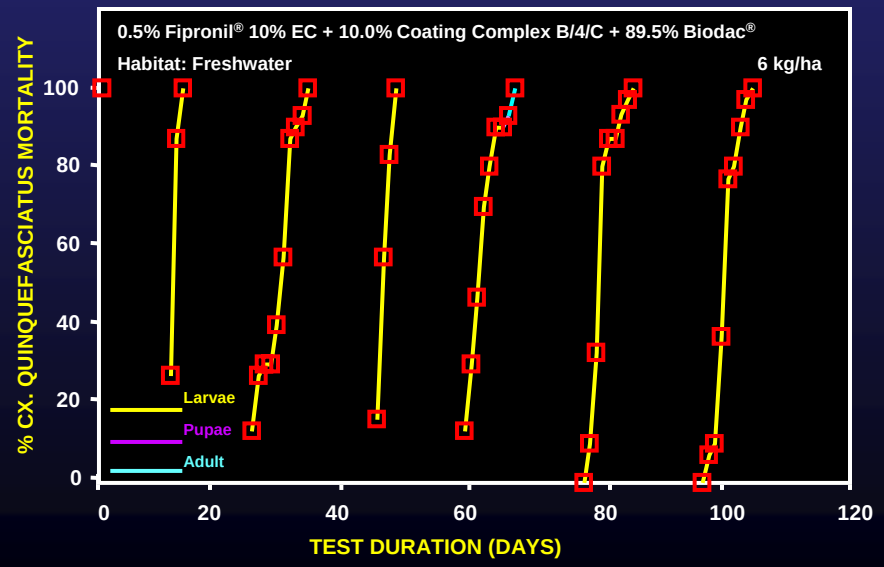
Controlled Delivery of a Central Nervous System Inhibitor from Corn Cob Granules

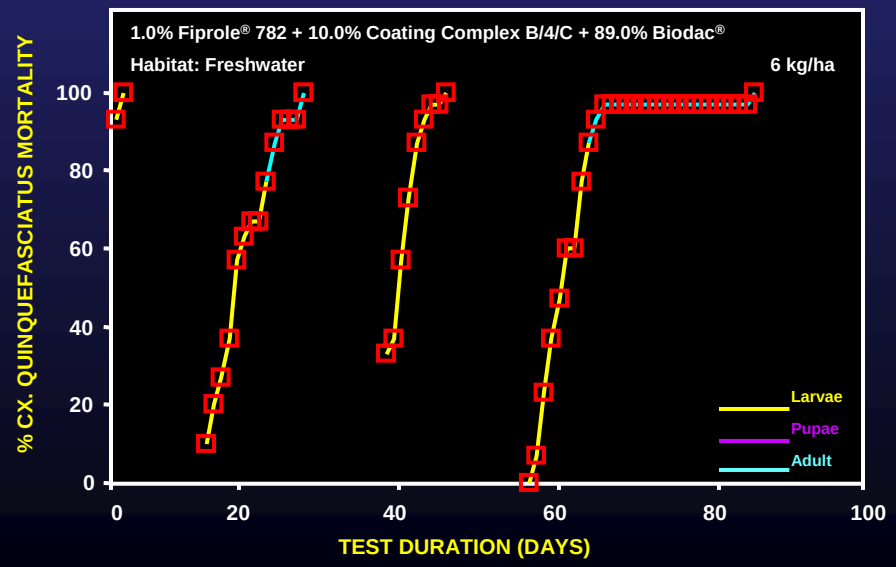


Controlled Delivery of Central Nervous System Inhibitors from Biodac® Granules

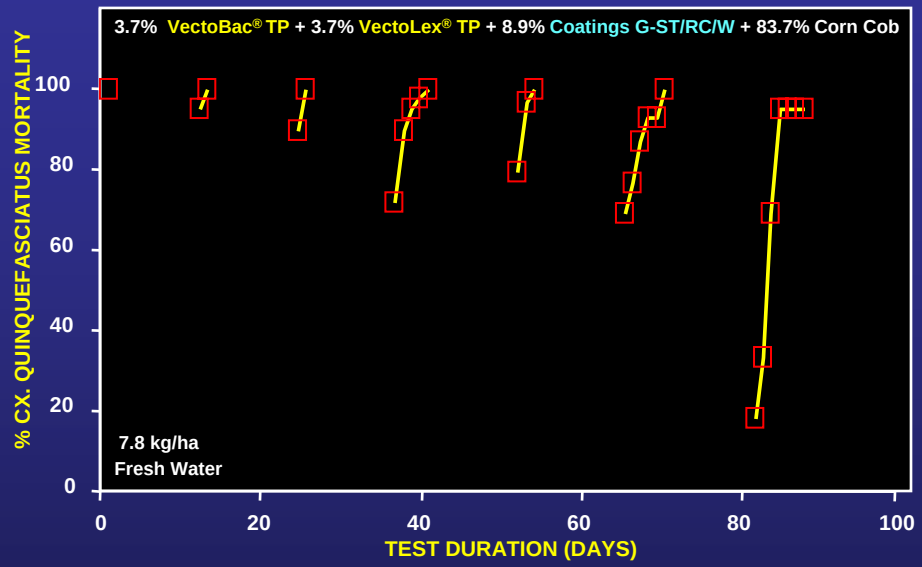


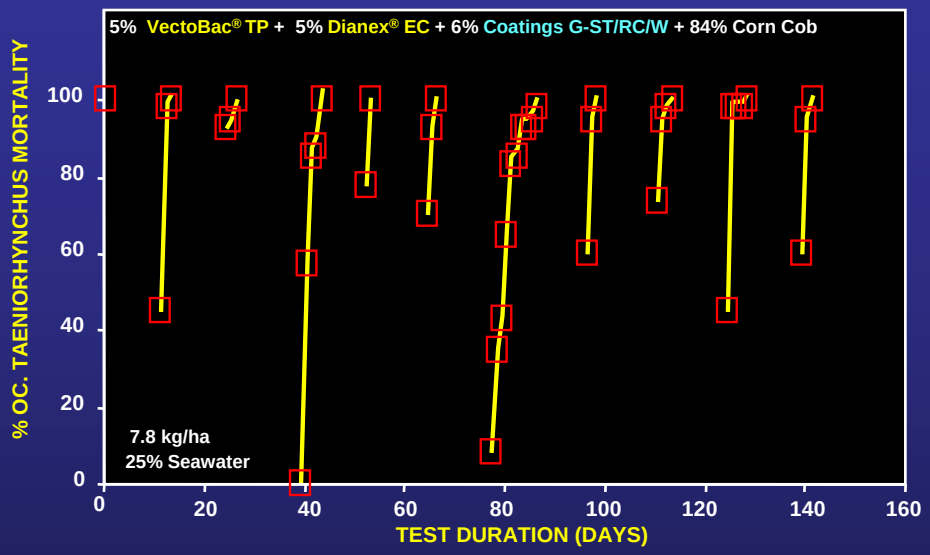


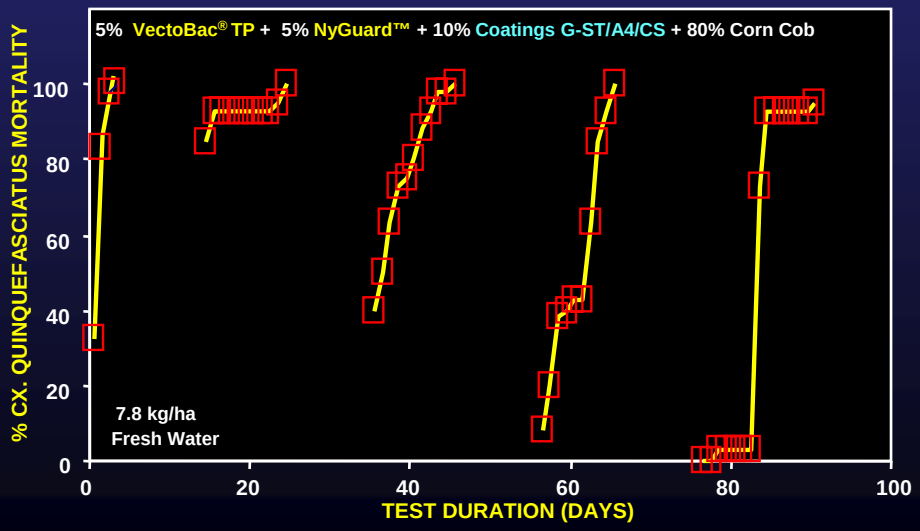


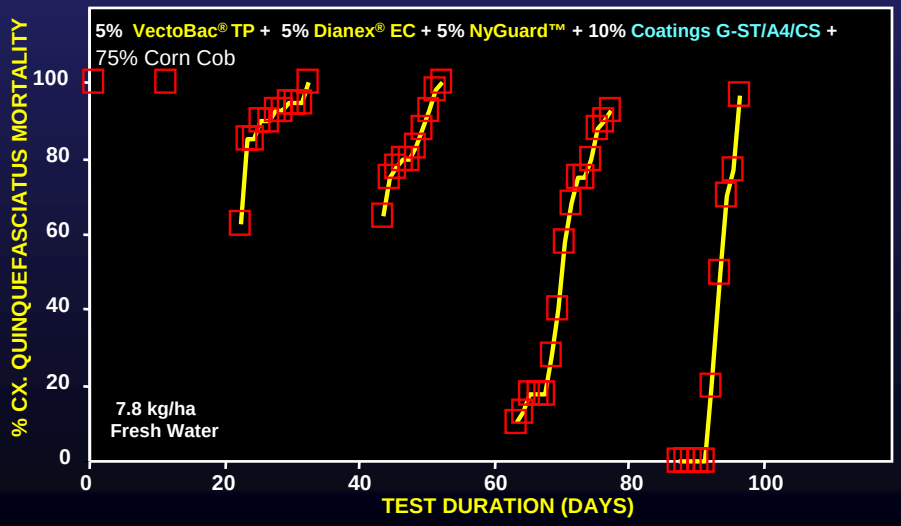


Controlled Delivery of Joint-Action Formulations of Biolarvicides and IGRs from Corn Cob Granules

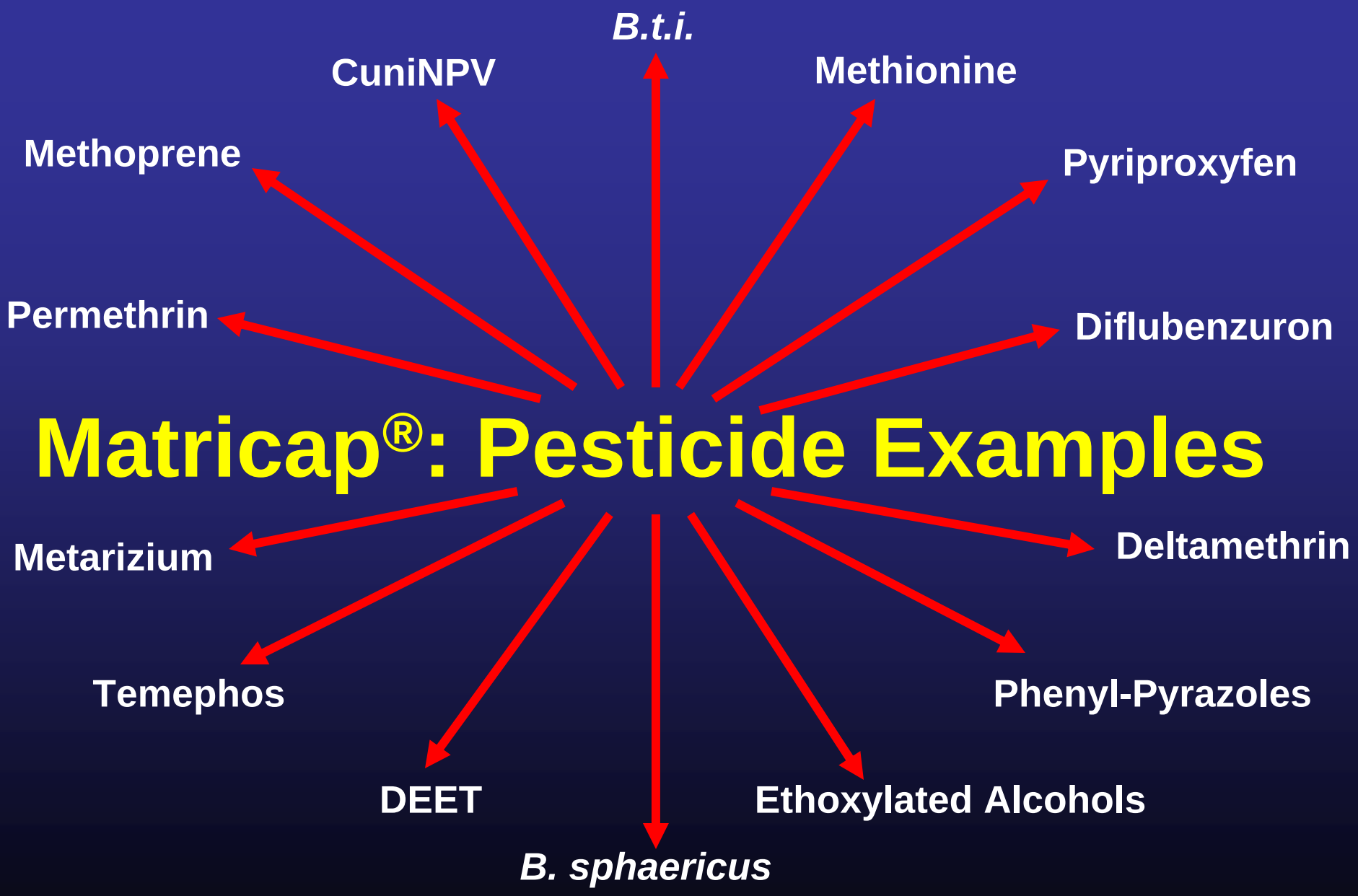






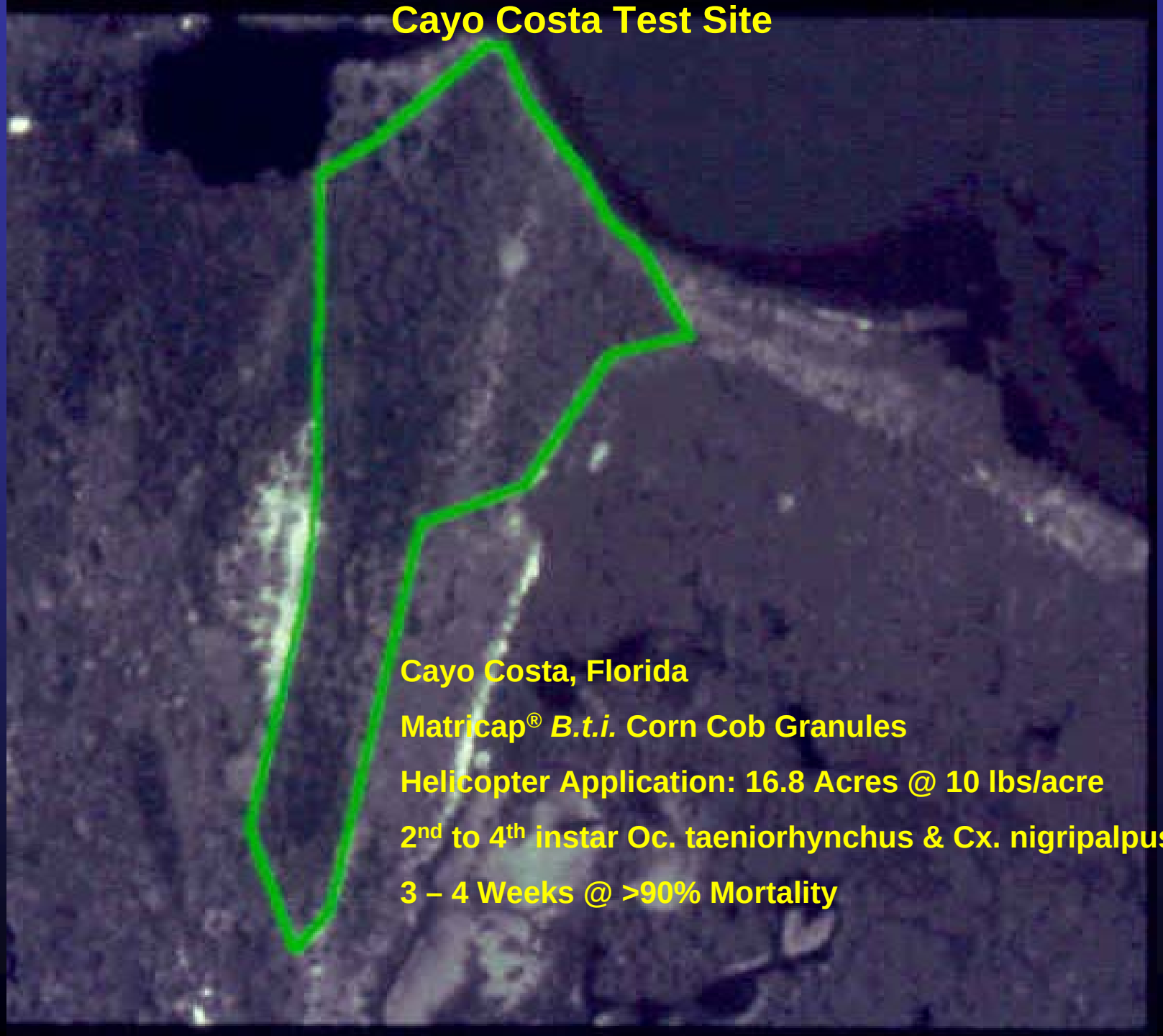


Matricap®: Pesticide Examples



Ground and Aerial Matricap® Application Techniques

Cayo Costa Test Site



Cayo Costa, Florida

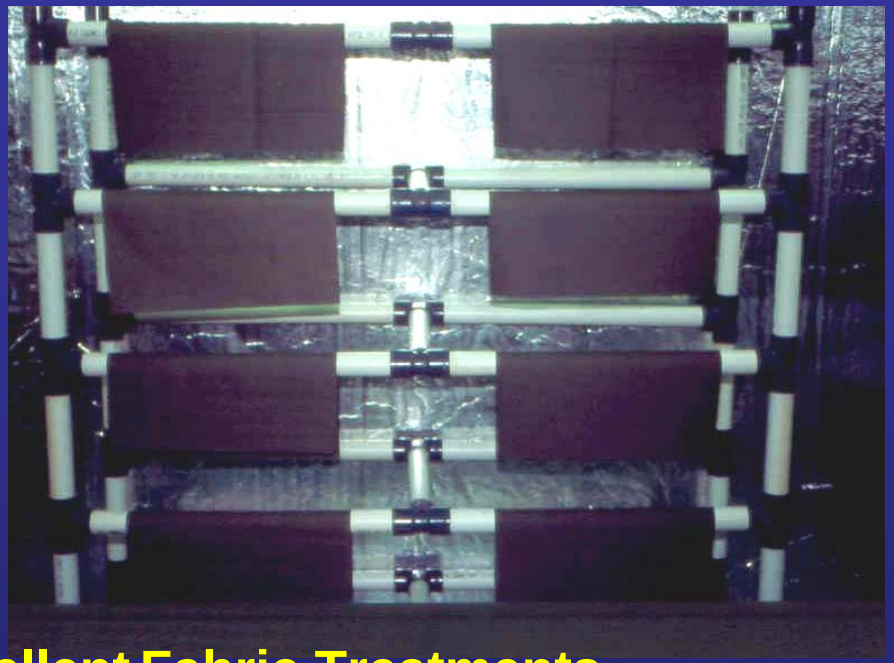
Matricap® *B.t.i.* Corn Cob Granules

Helicopter Application: 16.8 Acres @ 10 lbs/acre

2nd to 4th instar Oc. taeniorhynchus & Cx. nigripalpus

3 – 4 Weeks @ >90% Mortality

Cayo Costa Test Site



Matricap® Adulticide / Repellent Fabric Treatments

Cockroach Bait Station Formulations

Polymer / Copolymer Matrix + Bait Complex + Coating / Coating Complex + Insecticide ± Optional Binder / Formulation Aid

Matrix Components

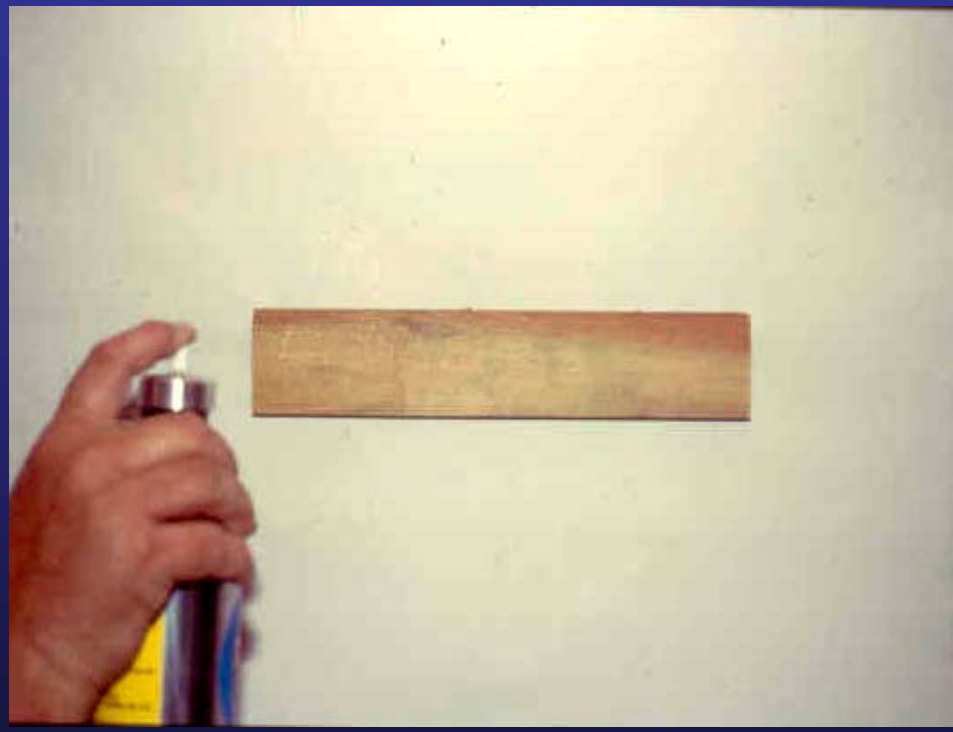
Polyvinyl Alcohol
Methyl Hydroxy Propyl Cellulose
Polyethylene Oxide
Cellulose

Insecticide Components (IGRs)

Pyriproxyfen
Methoprene

IGR - Bait Complex Used in Cockroach Bait Stations

Surface Applications of Experimental Matricap® Cockroach - Bait Compositions



Nylar® 10% EC Bait Stations

Nylar® 10% EC Twisted Wing Effects

Matricap® Bait Station-Transfer Bioassay

Test Chambers: Plastic Trays (46x24x13 cm)

Bait Stations: Wax Coated Cardboard Containers with 4 Inverted V-Shape Openings (7.6 x 1.3 cm)

No. Replications: 3

No. Cockroaches: 25 (Laboratory Strain of *Blattella germanica*)

Developmental Stage: 6 th Instar Nymphs (7 to 10 mm)

Supplimental Food: Rabbit Chow + Water

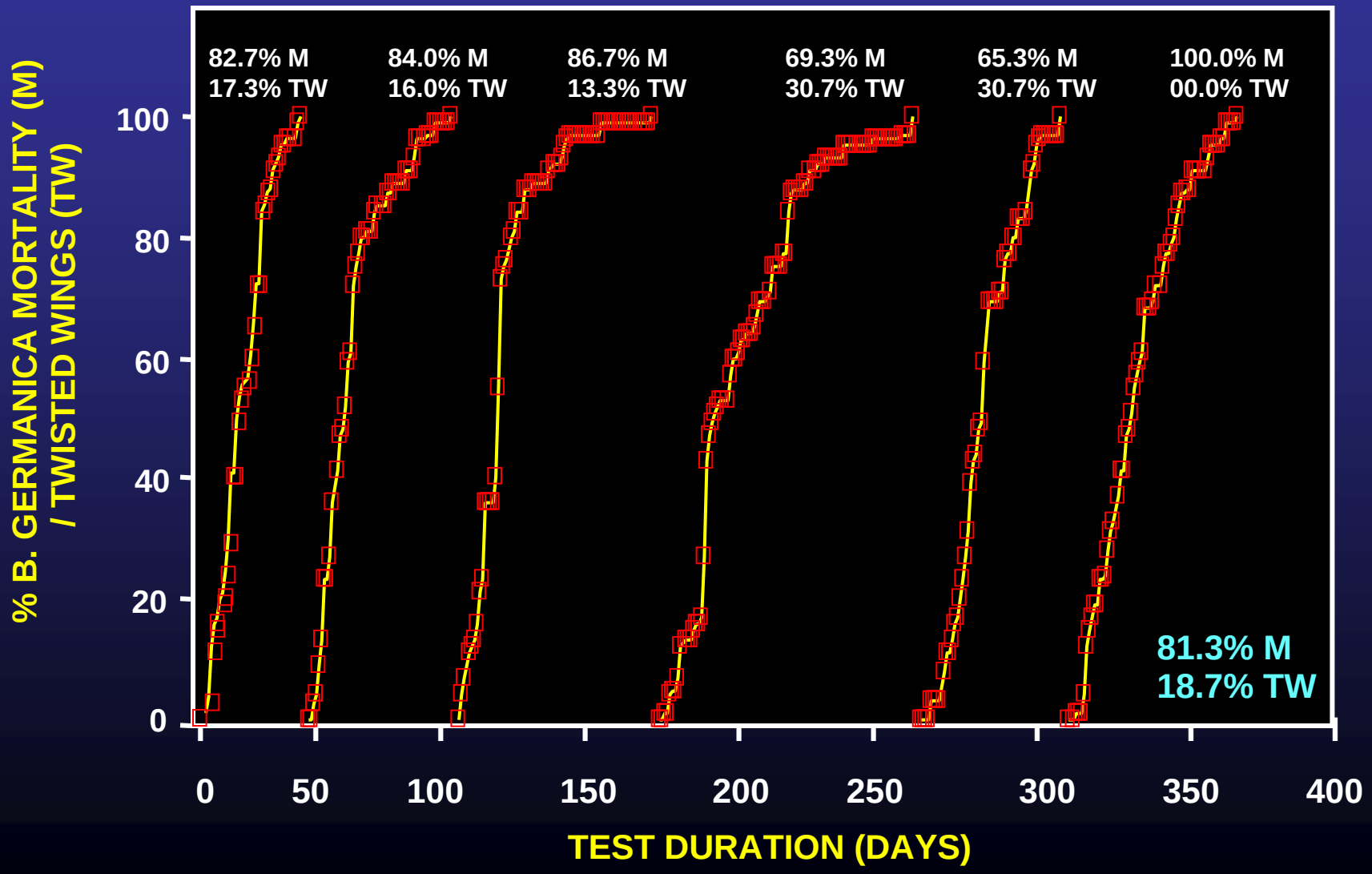
Application Rate: 0.92 g Composite Insecticide Formulation / Bait Station (Observations @24 hr Post-Treatment Intervals)

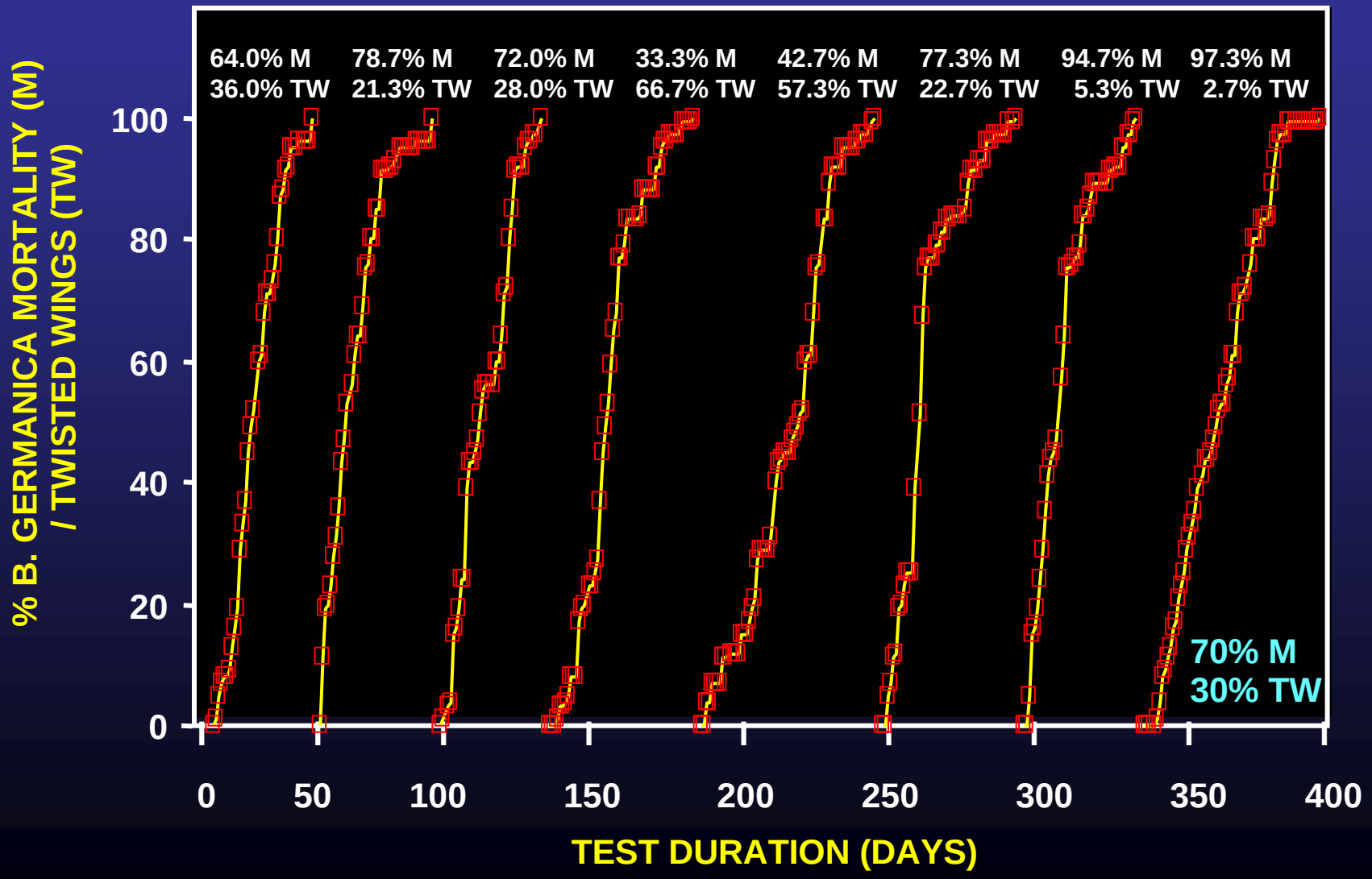
Test Temperature: 26 to 29 C

Test Humidity: 56 to 79 % RH

Controlled Delivery of Pyriproxyfen from PVA-Based Bait Stations

Bait Stations:0. 5% Nylar® 10% EC + 1% Coating C2 + 98.5% PVA/Cellulose/Bait Complex



Controlled Delivery of Pyriproxyfen from MHPC-Based Bait Stations

Bait Stations: 0.5% Nylar® 10% EC + 1% Coating C2 + 98.5% MHPC/Cellulose/Bait Complex