DuPont™ Coragen®
insect control
powered by RYNAXYPYR®

TECHNICAL BULLETIN

DuPont™ Coragen® insect control compound is the first insecticide from a new class of chemistry, the anthranilic diamides, controlling almost all economically important Lepidoptera and selected other species. When used early in the pest life cycle, Coragen® prevents the build-up of pest populations, maximizing the yield potential of a crop. The high larvicidal potency and long-lasting activity of Coragen® provide excellent crop protection, even when circumstances prevent optimal application timing. The rapid cessation of feeding, strong residual activity and excellent rainfast properties of Coragen® deliver nearly immediate and long-lasting crop protection under a wide range of growing conditions.

Coragen® has a new mode of action, controlling pests resistant to other insecticides, while its selectivity to non-target arthropods conserves natural parasitoids, predators and pollinators. These attributes make Coragen® an excellent addition to Integrated Pest Management (IPM) programs and provide growers greater flexibility in field operations aimed at delivering high-quality produce that meets the demands of food retailers and consumers. Coragen® studies have demonstrated that it has remarkably low toxicity to mammals, fish and birds along with high insecticidal potency, setting a new standard for insect control. Its favorable environmental and toxicological profile, as well as recommended low use rates, make Coragen® a sound choice for growers, farm workers and the environment.




KEY CROP GROUPS

- BRASSICA VEGETABLES
- CUCURBIT VEGETABLES
- FRUITING VEGETABLES
- LEAFY VEGETABLES
- POTATOES[†]

PROFILE OF CORAGEN® INSECT CONTROL

SUPERIOR CROP PROTECTION
- Rapid feeding cessation
- Long-lasting control
- Excellent crop safety
- Highly efficacious at low use rates

LOW IMPACT ON MAMMALS AND THE ENVIRONMENT
- Favorable mammalian toxicological profile
- Short Re-Entry Intervals & Pre Harvest Intervals
- Low impact on fish and birds

COMPATIBILITY WITH IPM & IRM PROGRAMS
- New class of chemistry
- New mode of action
- Selective to beneficial arthropods

[†] *EPA registration pending for application to potatoes.*

NEW MODE OF ACTION

DuPont™ Rynaxypyr® is the technical active ingredient in DuPont™ Coragen®. Rynaxypyr® controls insect pests through a new mode of action, activation of insect ryanodine receptors (RyRs). These receptors play a critical role in muscle function. Contraction of muscle cells requires a regulated release of calcium from internal stores into the cell cytoplasm. Ryanodine receptors act as selective ion channels, modulating the release of calcium. Rynaxypyr® binds to the RyR, causing uncontrolled release and depletion of internal calcium, preventing further muscle contraction. Insects treated with Rynaxypyr® exhibit rapid cessation of feeding, lethargy, regurgitation and muscle paralysis, ultimately leading to death. Due to its unique chemical structure and breakthrough mode of action, Rynaxypyr® shows excellent control of pest populations resistant to other insecticidal products (see *Fig. 1*).

Rynaxypyr® binds to insect ryanodine receptors in muscle cells, causing the channel to open and release calcium ions (Ca^{2+}) from internal stores into the cytoplasm. Depletion of Ca^{2+} stores results in nearly immediate paralysis and crop protection.

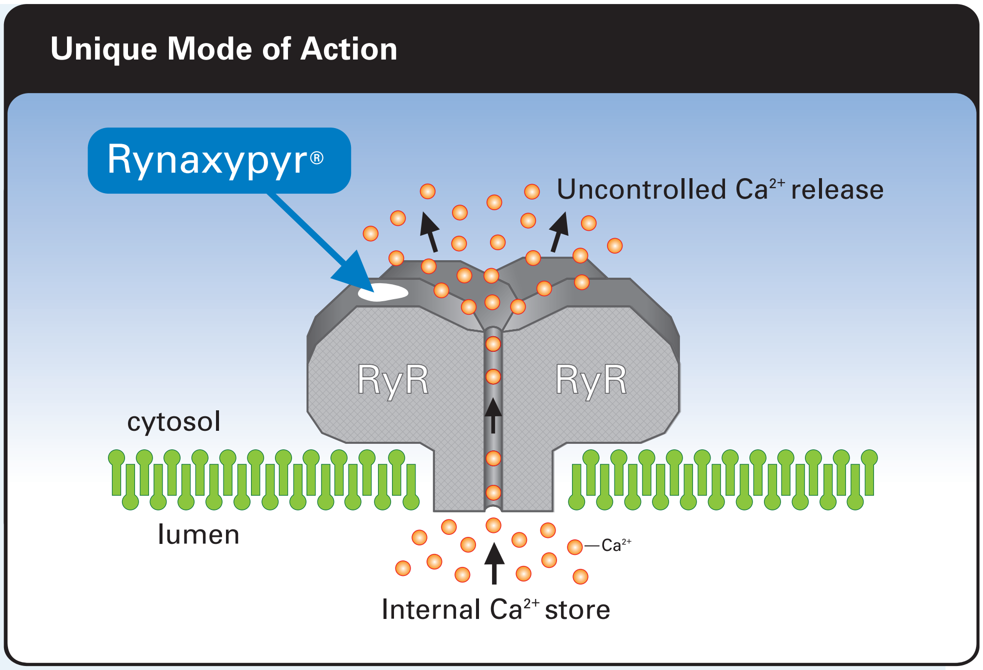
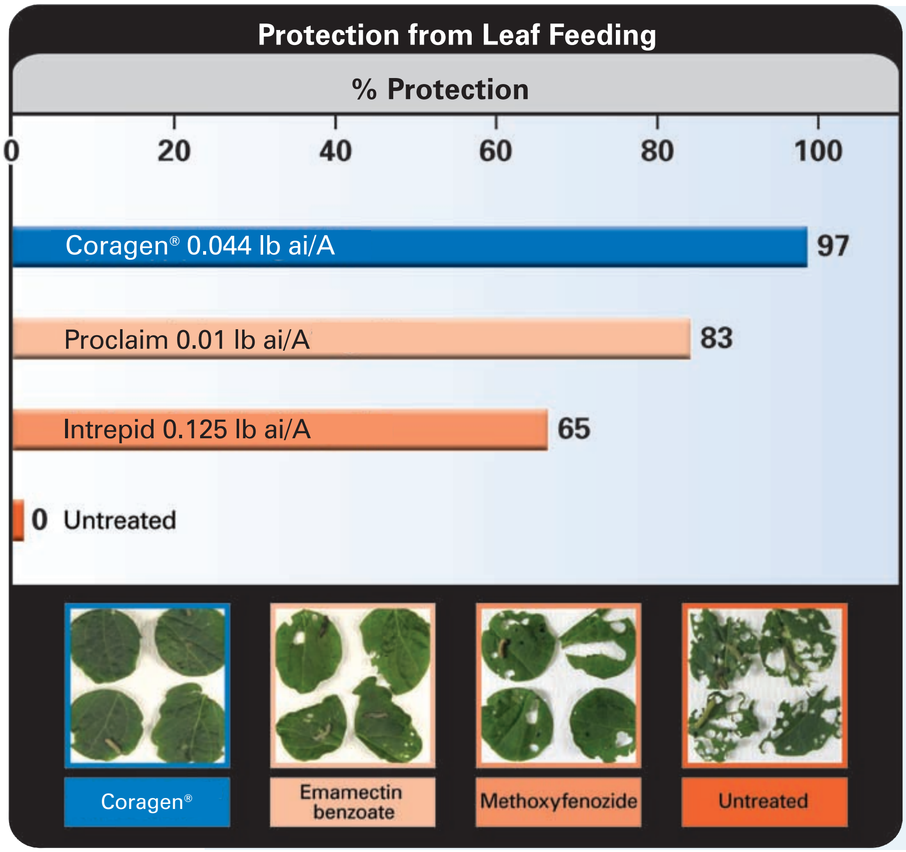


Figure 1

SUPERIOR CROP PROTECTION

Several features of Coragen® work together to provide crop protection that is superior to many commercial standards (see *Figures 2 and 3*).



This study demonstrated that Coragen® provides superior protection from leaf feeding. Test conducted using 3rd instar beet armyworm *(Spodoptera exigua)* larvae on tomato leaves.

Source: *DuPont Stine-Haskell Research Center – Delaware, USA.*

Figure 2

Coragen® is fast acting — causing target pests to stop feeding within minutes of ingestion, which results in nearly immediate crop protection (see *Fig. 3*).

Feeding Cessation of *Spodoptera exigua* (beet armyworm) 3rd Instar Larvae Exposed to Dry Insecticide Residues on Treated Tomato Leaves

Treatment	Rate (lb ai/A)	ET_{50}* (minutes)
Intrepid 2F	0.125	885 c**
Proclaim 5WG	0.01	170 b**
Coragen® 1.67 SC	0.044	7 a**

In this study, Coragen® was 24 to 126 times faster than commercial standards in eliciting feeding cessation.

* *ET=Average time to stop feeding.*
** *Values followed by the same letter within a column are not significantly different (P > 0.05).*
Source: *DuPont Stine-Haskell Research Center – Delaware, USA.*

Figure 3

HIGHLY EFFECTIVE

DuPont™ Coragen® is highly potent and efficacious against a wide range of economically important Lepidoptera species. Coragen® also effectively controls selected species from other orders such as Coleoptera, Diptera, Hemiptera and Isoptera *(see Insects Controlled)*.

Larvicidal Activity

Coragen® provides unprecedented larval control and is frequently one to two orders of magnitude more potent against target pests when compared to commercial standards (see *Fig. 4*).

Potency by Ingestion of Coragen® vs. Standards
(feeding bioassay against 3rd instar larvae on leaves)

Treatment	*H. virescens* Tobacco budworm LC_{50} (ppm)	*P. xylostella* Diamondback moth LC_{50} (ppm)
Cypermethrin	13.5 a*	2.1 a*
Indoxacarb	1.5 b*	0.5 b*
Coragen®	0.1 c*	0.05 c*

**Values followed by the same letter within a column are not significantly different (P > 0.05).*
Source: *DuPont Stine-Haskell Research Center – Delaware, USA.*

Figure 4

Ovicidal and Ovi-larvicidal Activity

Coragen® is particularly potent against neonates as they hatch from the eggs (ovi-larvicidal activity). In addition, significant ovicidal activity is observed at varying levels depending on the pest species. Ovicidal effects are enhanced when eggs are laid on treated surfaces. When applied at the time of egg lay, the long-lasting activity of Coragen® combined with its effects on eggs and larvae prevents the establishment and growth of pest populations at low use rates (see *Fig. 5*).

Target species are highly susceptible to Coragen® at early stages of development.

Effects on Eggs and Emerging Neonate Larvae

1. Ovicidal: Larvae died inside the egg before hatching.

2. Ovi-larvicidal: Larvae died inside the treated egg after ingesting a small portion of the membrane.

3. Ovi-larvicidal: Larva died before completely exiting the egg.

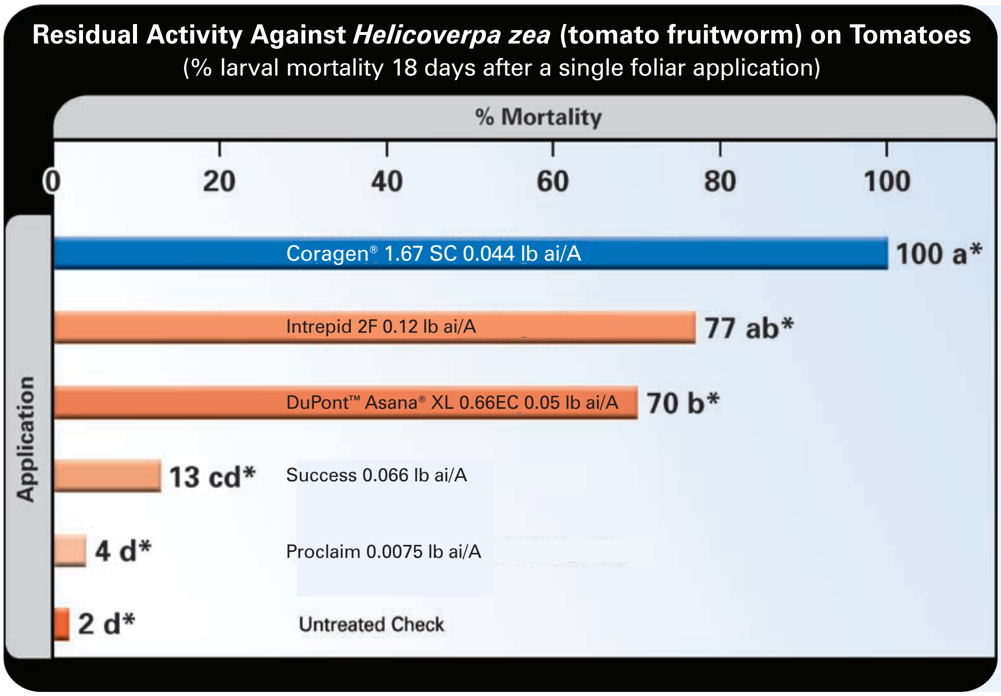
Source: *DuPont Paulínia Research Station – São Paulo, Brazil.*

Figure 5

LONG-LASTING CROP PROTECTION

Residual Activity

Coragen® moves into leaf tissue where it is protected from wash-off while remaining available to chewing insects feeding on either surface of the leaf. This translaminar activity, combined with rainfastness, insecticidal potency and resistance to photo-degradation are the basis for the long-lasting crop protection observed with Coragen® (see *Fig. 6*).



In this study, Coragen® continues to provide 100% larval control 18 days after a single foliar application. Test conducted using late 2nd instar tomato fruitworm larvae.

* *Values followed by the same letter within a column are not significantly different (P > 0.05).*

Source: *DuPont Rio Grande Valley Station – Texas, USA.*

Figure 6

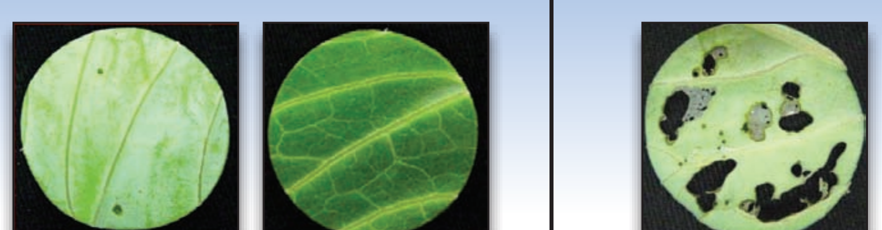
Translaminar Activity

Coragen® provides highly effective target insect control due in part to its translaminar activity. Translaminar activity is defined as the ability of the product to move from where it was deposited on the leaf surface into the leaf tissue: penetration into the cuticular and epidermial layers, and possibly further into the spongy mesophyll (see *Fig. 7*).

Translaminar activity of Coragen®
against *Plutella xylostella* (diamondback moth) larvae on cabbage

Translaminarly Active
Coragen® (50 ppm ai) + 0.5% Methylated Seed Oil

Untreated Control
Water + 0.5% Methylated Seed Oil



Coragen® at 50 ppm ai + 0.5% MSO provided 94% translaminar activity

Coragen® (50 ppm ai) + 0.5% methylated seed oil provided excellent translaminar activity against diamondback moth larvae on cabbage.

Source: *DuPont Stine-Haskell Research Center – Delaware, USA.*

Figure 7

The translaminar activity of Coragen® was verified using HPLC analysis. Translaminar activity against *Plutella xylostella* larvae on cabbage was enhanced by methylated seed oil adjuvant (MSO) (see *Fig. 8*).

When applied topically onto a leaf surface, a percentage of the applied Rynaxypyr® will move into the leaf tissue (i.e. 5%). In this study, the addition of methylated seed oil at 0.5% enhanced leaf penetration of Rynaxypyr® from 5% to 35% of the amount applied.

Source: *DuPont Stine-Haskell Research Center – Delaware, USA.*

Percentage of applied active ingredient recovered on the leaf surface vs. inside the leaf tissue, 2 days after topical treatment of cabbage leaves with Coragen® 20 SC (HPLC measurements):

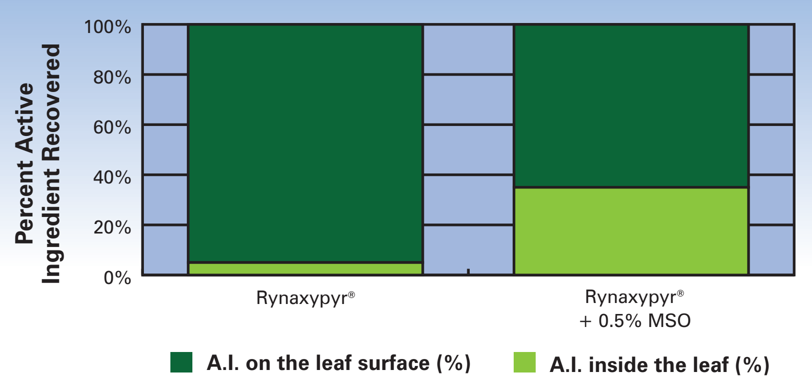


Figure 8

Soil Systemic — Plant Uptake and Translocation

Rynaxypyr®, the active ingredient in Coragen®, is xylem mobile, translocating to untreated plant parts and providing consistent control of many lepidopteran pests, as well as some coleopteran, dipteran and hemipteran pests (see *Fig. 9-11*).

Rynaxypyr® showed excellent root uptake and translocation in tomatoes. Chemical analysis by LC/MS/MS showed measurable root uptake and translocation 1 day after treatment. Rynaxypyr® continued to move from the roots to new growth throughout the length of the experiment, up to 28 days after treatment (see *Fig. 10*). Highest leaf concentrations were measured in the oldest leaves present at the time of treatment. Phosphor imaging confirmed the quantitative data and also showed higher Rynaxypyr® concentrations at the outer leaflet edges (see *Fig. 11*).

- Following a Coragen® soil treatment to the root zone, Rynaxypyr® was efficiently and uniformly taken up and translocated throughout the plant. Uptake from a single soil application continued up to 28 days.
- Further evidence of xylem mobility has been extensively demonstrated by consistent insecticidal activity of Rynaxypyr® when applied in the field through drip chemigation.

The systemic properties of Rynaxypyr® from soil applications to tomatoes are presented in Figures 9-11.

Source: *DuPont Stine-Haskell Research Center – Delaware, USA.*

Tomato plant growth stages at representative sampling points
(L1-L6 represent leaf positions on the tomato seedling at the time of treatment; DAT indicates days after treatment).

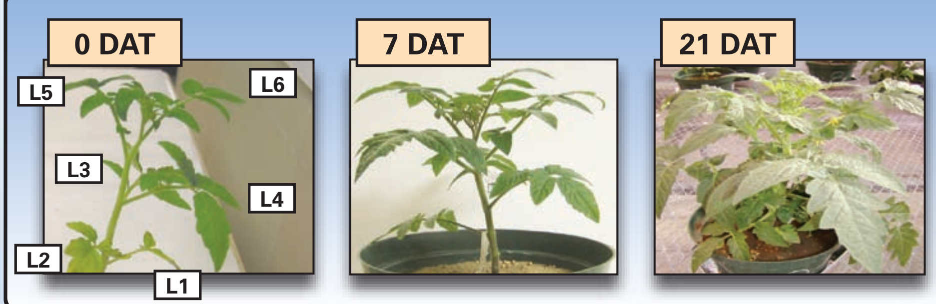
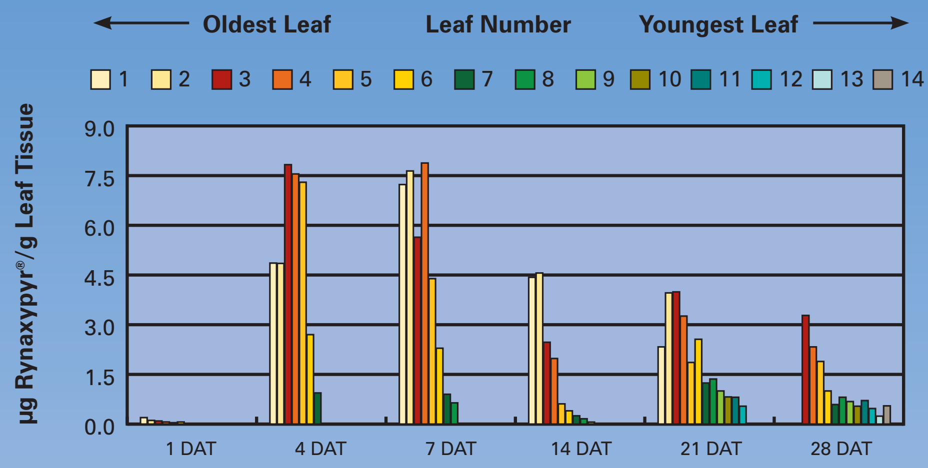


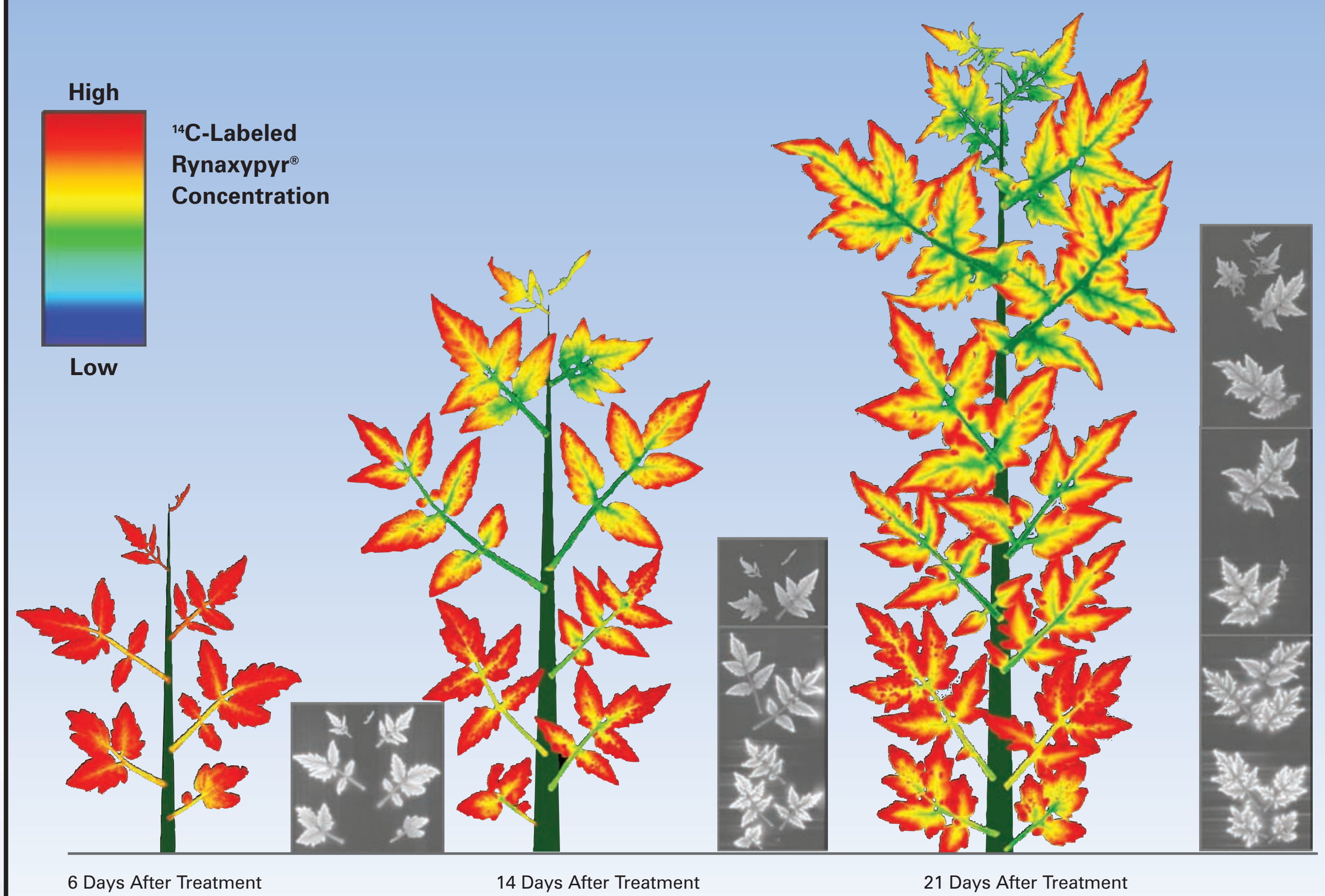
Figure 9

Soil Application Root Uptake and Translocation



Rynaxypyr® concentration in tomato leaves, following a single soil drench application of 3.5 mg ai per tomato plant.

Figure 10



Phosphor images of distribution of 14C-labeled Rynaxypyr® within tomato leaves following a single soil drench application of 3.5 mg ai per tomato plant.

Figure 11

EXCELLENT FIT WITH IPM & IRM PROGRAMS




- **New chemical class and mode of action**
- **Highly efficacious at low use rates**
- **Selective to beneficial arthropods**
- **Excellent environmental profile**
- **Low impact on fish, birds and mammals**

Toxicity to Bees

Coragen® has demonstrated low to no impact on honeybees and bumblebees based on scientific studies conducted to date. Field studies have shown Coragen® to have low toxicity to honeybees and bumblebees directly exposed to spray applications, and once the foliar residues have dried the hazard is insignificant. Although field studies have shown low to no impact on bees directly sprayed with Coragen®, best practices are to avoid direct application of any pesticide to actively foraging bees. In actively blooming crops the best time for treatment is either early morning or evening.

Selective to Beneficial Arthropods

Results of extensive multi-year laboratory and field studies show that Coragen® has negligible impact on key parasitoids, predators and pollinators at field use rates. This impressive selectivity to beneficial arthropods, along with its robust pest control and favorable environmental profile, establishes Coragen® as a strong tool for Integrated Pest Management programs, where a combination of chemical and biological control techniques is preferred (see *Fig. 12*).

Evaluation of Coragen® on Key Predators, Parasitoids and Pollinators

GROUP	ORDER	FAMILY	SPECIES	RESULT
PREDATORS	Neuroptera	Chrysopidae	*Chrysoperla carnea* [1]	■
			Mallada signatus [2]	■
	Coleoptera	Coccinellidae	*Hippodamia convergens* [1]	■
			Hippodamia variegatta [2]	■
			Harmonia axyridis [3]	■
	Hemiptera	Nabidae	*Nabis kinbergii* [2]	■
		Anthocoridae	*Orius insidiosus* [1]	■
			Orius laevigatus [8]	■
			Anthocoris nemoralis [4]	■
			Anthocoridae [8]	■
		Miridae	*Deraeocoris brevis* [16]	■
		Lygaeidae	*Geocoris punctipes* [1]	■
	Acari	Phytoseiidae	*Amblyseius herbicolus* [5]	■
			Amblyseius andersoni [6]	■
			Kampimodromus aberrans [4]	■
			Euseius citrifolius [5]	■
			Iphiseiodes zulugai [5]	■
			Typhlodromus occidentalis [7]	■
			Typhlodromus pyri [8]	■
PARASITOIDS	Hymenoptera	Trichogrammatidae	*Trichogramma pretiosum* [3]	■
			Trichogramma chilonis [9]	■
		Braconidae	*Aphidius rhopalosiphi* [8]	■
			Bracon hebetor [3]	■
			Dolichogenidea tasmanica [10]	■
		Encyrtidae	*Ageniaspis citricola* [3]	■
		Aphelinidae	*Aphelinus mali* [2]	■
POLLINATORS	Hymenoptera	Apidae	*Apis mellifera* [11,12,13,14,15,17]	■
			Bombus impatiens [17]	■
			Bombus terrestris [18]	■

■ = **Low to No Impact** (0–30% mortality). Rating according to the International Organization for Biological Control.

SOURCES:
(1) *Cameron et al. 2005–2006, DuPont Stine-Haskell Research Center, USA.*
(2) *Cole et al. IPM Technologies Pty Ltd 2005–2006, Australia.*
(3) *Parra et al. 2004–2005, ESALQ University of São Paulo, Brazil.*
(4) *V. Girolami et al. Padua University and AGREA Agenzia Regionale per le Erogazioni n Agricoltura 2006, Italy.*
(5) *Rebelles et al. 2005, EPAMIG-CTSM/EcoCentro, Brazil.*
(6) *G. Angeli et al. 2006, Instituto Tecnico Agrario Michele, Italy.*
(7) *Beers et al. 2006, Washington State University, USA.*
(8) *Warmers et al. 2006, GAB Biotechnologie, Germany.*
(9) *Sharma et al. 2005, DuPont Southeast Asia Field Experimental Station, Gujarat, India.*
(10) *Newman et al. Horticultural Research Hawkes' Bay 2006, New Zealand.*
(11) *Beuschel et al. 2006, GAB Biotechnologie, France.*
(12) *Giffard et al. 2006, TESTAPI, France.*
(13) *Schur et al. 2005–2006, GAB Biotechnologie, Spain.*
(14) *Sinderman et al. 2005, Wildlife International Laboratory, USA.*
(15) *Szinicz et al. 2006, GAB Biotechnologie, Germany.*
(16) *A. Waltson & H. Riedl, Oregon State University (MCAREC), Hood River, OR - USA*
(17) *C. Scott Dupree et al. 2008, University of Guelph, Guelph, Ontario Canada.*
(18) *Sigrun Bocksch et al. 2008, Diplo. Agr. Biol., Eurofins-GAB GmbH, Niefern-Öschelbronn, Germany.*

Figure 12

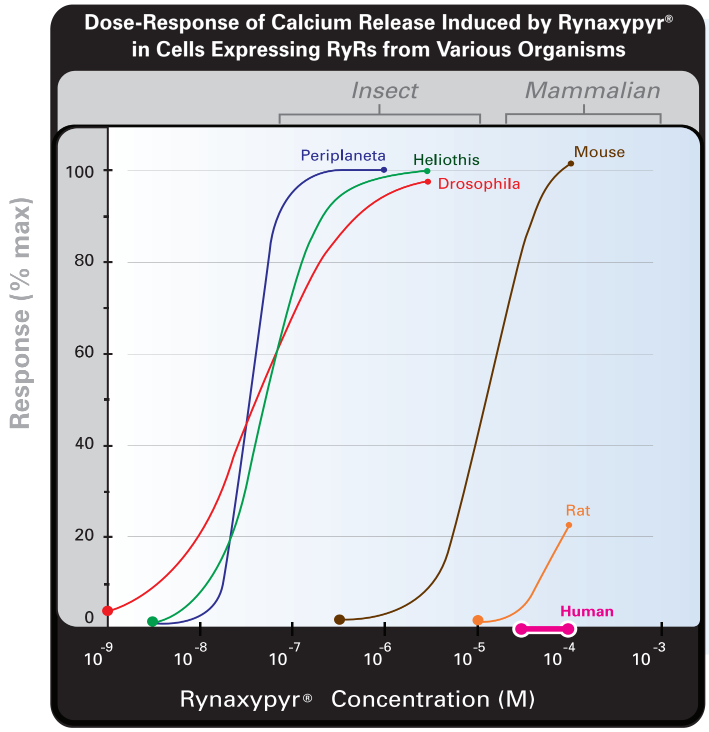
Strong Resistance Management Tool

Coragen® is in a new chemical class with a new mode of action [Group 28, Insecticide Resistance Action Committee (IRAC)]. In more than 5,000 field development trials around the world and numerous laboratory experiments in 20 countries, no evidence has been found of cross-resistance between Rynaxypyr® in Coragen® and existing insecticides. These results show that Coragen® will control insect populations that have developed resistance to other insecticides, thus creating a fit for Coragen® as a rotational partner in Insect Resistance Management (IRM) programs. DuPont supports strategies recommended by IRAC to minimize the selection of resistance genes and delay the development of resistance. Refer to product labels for specific IRM guidelines.

FAVORABLE TOXICOLOGICAL PROFILE

Rynaxypyr® showed very low toxicity to mammals in all acute, subchronic and chronic animal studies performed, allowing the establishment of short Re-Entry (REIs) and Pre-Harvest Intervals (PHIs) to fit cultural needs while minimizing Personal Protective Equipment (PPE) requirements. Always refer to product labels for REI, PHI and PPE requirements for specific countries and crops.

The basis for this remarkable selectivity is a structural difference between insect and mammalian ryanodine receptors (RyRs). Rynaxypyr® is highly effective in activating insect RyRs, but not mammalian RyRs. This results in insect RyRs being 400 to 3,000 times more sensitive to Rynaxypyr® compared to mammalian RyRs (see *Fig. 13*).



No response was observed in the human cell line IMR32 treated with Rynaxypyr®.

Source: *DuPont Stine-Haskell Research Center – Delaware, USA.*

Figure 13

This exceptional toxicological profile has been verified in all tests required by regulatory agencies.

Rynaxypyr® Toxicological Profile

Representative Test	Result	Representative Test	Result
Acute oral toxicity, rat LD$_{50}$	> 5,000 mg/kg	Dermal sensitization	Not a sensitizer
Acute dermal toxicity, rat LD$_{50}$	> 5,000 mg/kg	Mutagenicity	Not mutagenic
Sub-acute and subchronic toxicity (mouse, rat, dog)	No adverse effects	Carcinogenicity	Not carcinogenic
		Neurotoxicity	Not neurotoxic
Acute inhalation toxicity, rat LC$_{50}$	> 5.1 mg/L	Immunotoxicity	Not immunotoxic
Skin irritation	Not irritating	Developmental toxicity	No adverse effects
Eye irritation	Slight, clearing in 72 hours	Reproductive toxicity	No adverse effects

Coragen® Toxicological Profile

Representative Test	Result	Representative Test	Result
Acute oral toxicity, rat LD$_{50}$	>5,000 mg/kg bw	Skin irritation	Not irritating
Acute dermal toxicity, rat LD$_{50}$	>5,000 mg/kg bw	Eye irritation	Slight irritation, clearing within 48 hrs
Acute inhalation toxicity, rat LC$_{50}$	>6.2 mg/L	Dermal sensitization	Not a sensitizer (mouse local lymph node assay)

LOW IMPACT ON THE ENVIRONMENT

Studies show that Coragen®, powered by Rynaxypyr®, has low impact on the environment when applied according to label recommendations.

The rate of degradation of Rynaxypyr® in the environment varies depending on soil and water conditions. High temperature, alkaline pH and ultraviolet light enhance degradation, producing nontoxic degradation products. The sequestration of Rynaxypyr® in the soil matrix, its low water solubility and its nonvolatility indicate low potential for movement toward surface or groundwater.

Eco-Toxicological Profile

Rynaxypyr® has low impact on nontarget organisms such as birds, fish, mammals, earthworms, micro-organisms, algae and other plants, and many nontarget arthropods. Rynaxypyr® has minimal potential for bio-accumulation and bio-magnification in animals. Some aquatic invertebrates, such as Daphnia, are sensitive to Rynaxypyr®. However, studies show selectivity of Rynaxypyr® to estuarine invertebrates.

Species	Result
Bobwhite quail	LD_{50} > 2,250 mg/kg body weight LC_{50} > 5,620 ppm in diet
Mallard duck	LC_{50} > 5,620 ppm in diet
Rainbow trout	LC_{50} > 13.8 mg/L (solubility limit)
Bluegill	LC_{50} > 15.7 mg/L (solubility limit)
Catfish	LC_{50} > 13.4 mg/L (solubility limit)
Sheepshead minnow	LC_{50} > 12.0 mg/L (solubility limit)
Mysid shrimp	LC_{50} = 1.15 mg/L
Crayfish	LC_{50} > 1.42 mg/L (solubility limit)
Algal inhibition test:	
Selenastrum capricornutum	EC_{50} > 2.0 mg/L (solubility limit)
Aquatic plant:	
Lemna gibba	EC_{50} > 2.0 mg/L (solubility limit) NOEC > 2.0 mg/L (solubility limit)
Honey bee	
Acute oral	LD_{50} > 104 µg/bee
Acute contact	LD_{50} > 4 µg/bee (solubility limit)
Wasp parasitoid:	
Aphidius rhopalosiphi	LR_{50} > 750 g/ha
Phytoseid mite:	
Typhlodromus pyri	LR_{50} > 750 g/ha
Earthworm	
Acute	LC_{50} > 1,000 mg/kg soil
Reproductive	NOEC > 350 mg/kg soil
Soil microorganism	NOEC > 0.7 mg/kg soil
Sewage sludge	NOEC > 100 mg/L

FORMULATION

The Coragen® formulation is a 1.67 pound ai per gallon suspension concentrate that has been developed and optimized for superior crop protection and improved handling properties (ease of mixing, re-suspension and tank clean-out). This formulation shows excellent crop selectivity and compatibility with commonly used tank-mix partners.

Coragen®	1.67 pound ai per gallon suspension concentrate

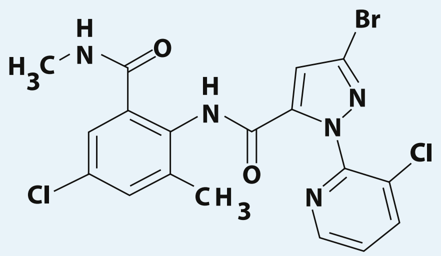
Registered formulations of Coragen® may vary by country.

Tank Stability

The Coragen® formulation has proven to be chemically stable in the spray tank over a wide range of conditions and temperatures (4-40° C), pH (5-7-9) and time (up to 72 hours). Pesticides should be applied as soon as possible following preparation to avoid the possibility of product degradation. However, equipment breakdown, sudden rain, high winds and other environmental factors can delay or interrupt insecticide applications. When an application must be postponed, the unused spray solution may be left sitting in the equipment until the situation improves enough to continue with the application.

Only normal agitation is required to re-suspend any material that may have settled. Then application can be performed.

PHYSICAL AND CHEMICAL PROPERTIES

ISO Common Name	Chlorantraniliprole
Trade Name (Technical)	Rynaxypyr®
Chemical Name (CAS)	3-bromo-*N*-[4-chloro-2-methyl-6-[(methylamino)carbonyl] phenyl]-1-(3-chloro-2-pyridinyl)-1H-pyrazole-5-carboxamide
Experimental Code	DPX-E2Y45
Chemical Class	Anthranilic diamide
CAS Registry Number	500008-45-7
Structural Formula	
Empirical Formula	$C_{18}H_{14}BrCl_2N_5O_2$
Molecular Weight	483.15 g/mole
Physical Form	Fine crystalline powder
Melting Point	208–210°C (P)*; 200–202°C (T)*
Color	Off-white (P)*; Brown (T)*
Odor	None
Relative Density	1.51 g/mL at 20°C
Solubility in Water	1.0 mg/L at 20°C
Vapor Pressure	6.3×10^{-12} Pa at 20°C
Volatility	Not volatile
Henry's Law Constant (20°C)	3.2×10^{-9} Pa-M^3/mole
Octanol/Water Partition Coefficient (20°C, LogP_{ow} pH 7)	2.86
Dissociation Constant (pKa) (20°C)	10.88

* P *(pure active ingredient)*; T *(technical grade active ingredient)*.
All other values were generated with the pure active ingredient.

INSECTS CONTROLLED

The following is a representative global list of insect species against which Rynaxypyr® has demonstrated effective control. Refer to product labels for specific pest insects controlled by crop and appropriate directions for use.

INSECTS CONTROLLED

Order	Family	Scientific Name	Common Name
Coleoptera	Chrysomelidae	*Leptinotarsa decemlineata*	Colorado potato beetle
	Curculionidae	*Lissorhoptrus oryzophilus*	rice water weevil
		Listronotus maculicollis	annual bluegrass weevil
		Oryzophagus oryzae	rice water weevil
		Sphenophorus spp.	billbug
	Scarabaeidae	*Ataenius spretulus*	black turfgrass ataenius
		Aphodius spp.	scarab beetles
		Cotinis nitida	green June beetle
		Cyclocephala spp.	masked chafers
		Exomala orientalis	oriental beetle grub
		Maladera castanea	Asiatic garden beetle
		Phyllophaga spp.	June beetles
		Popillia japonica	Japanese beetle
		Rhizotrogus majalis	European chafer
Diptera	Agromyzidae	*Chromatomyia horticola*	garden pea leafminer
		Liriomyza spp.	leafminers
Hemiptera	Aleyrodidae	*Bemisia spp.*	whitefly*
		Trialeurodes abutiloneus	bandedwing whitefly*
	Cicadellidae	*Typhlocyba pomaria*	white apple leafhopper*
Isoptera	Rhinotermitidae	*Heterotermes tenuis*	sugar cane termite
	Termitidae	*Microtermes obesi*	sugar cane termite
		Odontotermes obesus	sugar cane termite
Lepidoptera	Arctiidae	*Estigmene acrea*	saltmarsh caterpillar
	Crambidae	*Achyra rantalis*	garden webworm
		Desmia funeralis	grape leaffolder
		Ostrinia nubilalis	European corn borer
	Gelechiidae	*Anarsia lineatella*	peach twig borer
		Keiferia lycopersicella	tomato pinworm
		Phthorimaea operculella	potato tuberworm
		Tuta absoluta	S. American tomato pinworm
	Geometridae	*Operophthera brumata*	winter moth
	Gracilaridae	*Phyllocnistis citrella*	citrus leafminer
		Lithocolletis ringoniella	apple leafminer
		Phyllonorycter blancardella	spotted tentiform leafminer
	Lyonetidae	*Leucoptera spp.* (ie: *malifoliella, coffeella*)	coffee leafminer/ pear leaf blister moth
	Noctuidae	*Agrotis ipsilon*	black cutworm
		Alabama argillacea	cotton leafworm
		Amphipyra pyramidoides	humped green fruitworm
		Anticarsia gemmatalis	velvetbean caterpillar
		Autographa gamma	common silver Y moth
		Barathra brassicae	cabbage armyworm
		Earias spp. (ie: *huegeliana, insulana, vitella*)	rough, spiny, northern rough bollworm
		Helicoverpa spp. (ie: *armigera, punctigera, zea*)	bollworms/budworms/fruitworms
		Heliothis virescens	tobacco budworm
		Lithophane antennata	green fruitworm
		Mamestra brassicae	cabbage moth

* Suppression only

INSECTS CONTROLLED *(cont.)*

Order	Family	Scientific Name	Common Name
Lepidoptera *(cont.)*	Noctuidae *(cont.)*	*Orthosia hibisci*	green fruitworm
		Phalaenoides glycinae	grape vine moth
		Phytometra acuta	tomato semi-looper
		Pseudoplusia includens	soybean looper
		Spodoptera spp. (ie: eridania, *exigua, frugiperda, littoralis*)	beet armyworm, fall armyworm, Egyptian cotton leafworm, southern armyworm, yellowstriped armyworm and western yellowstriped armyworm
		Trichoplusia ni	cabbage looper
	Pieridae	*Pieris spp.* (ie: *brassica, rapae*)	large white, imported cabbageworm
	Plutellidae	*Plutella xylostella*	diamondback moth
	Pyralidae	*Amyelois transitella*	navel orangeworm
		Chilo spp. (ie: *infuscatellus, polychrysus, suppressalis*)	sugar cane/rice stem borers
		Cnaphalocrocis medinalis	rice leafroller
		Crambus spp.	sod webworm
		Crocidolomia binotalis	cabbage cluster caterpillar
		Diaphania spp. (ie: *hyalinata, nitidalis*)	melonworm, pickleworm
		Diatraea saccharalis	Brazilian sugar cane borer
		Elasmopalpus lignosellus	lesser stalk borer
		Evergestis rimosalis	cross-stripped cabbageworm
		Hedylepta indicata	soybean leaffolder
		Hellula spp. (ie: *hydralis, undalis*)	cabbage centre grub, cabbage webworm
		Leucinodes orbonalis	eggplant shoot and fruit borer
		Maruca spp.	pod borer
		Neoleucinodes elegantalis	tomato small borer
		Scirpophaga spp.	sugar cane/rice stem borer
		Sesamia spp. (ie: *inferens, nonagrioides*)	pink stem borer/corn stalk borer
	Sphingidae	*Manduca spp.* (ie: *quinquemaculata, sexta*)	tomato/tobacco hornworm
	Tortricidae	*Adoxophyes orana*	summer fruit tortrix
		Argyrotaenia spp. (ie: *pulchellana, velutinana*)	grape tortrix, redbanded leafroller
		Bonagota cranaodes	Brazilian apple leafroller
		Carposina spp. (ie: *niponensis, sasaki*)	peach fruit borer, peach fruit moth
		Choristoneura rosaceana	obliquebanded leafroller
		Cryptophlebia leucotreta	false codling moth
		Cydia pomonella	codling moth
		Ecdytolopha aurantiana	citrus borer
		Endopiza vitana	grape berry moth
		Epiphyas postvittana	light brown apple moth
		Eupoecilia ambiguella	European grape berry moth
		Grapholita molesta	Oriental fruit moth
		Lobesia botrana	European grapevine moth
		Pandemis spp. (ie: *cerasana, heparana, limitata, pyrusana*)	barred fruit tree tortrix, apple brown tortrix, three-lined leafroller, apple pandemis
		Platynota spp. (ie: *idaeusalis, stultana*)	tufted apple bud moth, omnivorous leafroller
	Zygaenidae	*Harrisina spp.* (ie: *americana, brillians*)	grapeleaf/western grapeleaf skeletonizer

Asana® XL and Proclaim are restricted-use pesticides.

† EPA registration pending for application to potatoes.

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