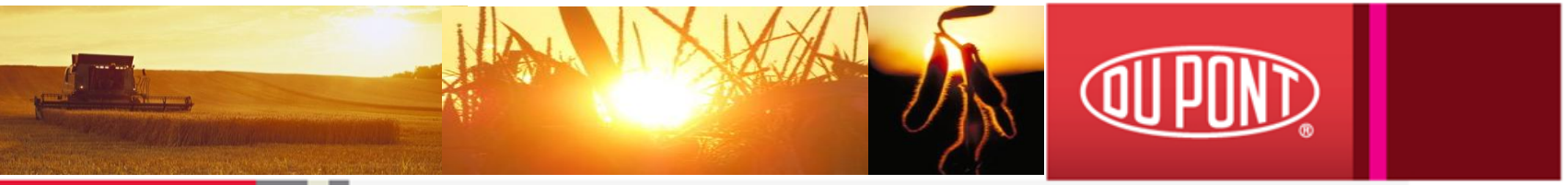

Emerging seed treatment technology
Introduction of the Anthranilic diamides

Seed Central Seminar
Feb. 12th 2014, Davis, CA

Presented by:
Dr. Alex Cochran
Director R&D
DuPont Seed Treatment Enterprise

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seed sense

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2. *History of Diamide seed treatment at DuPont*
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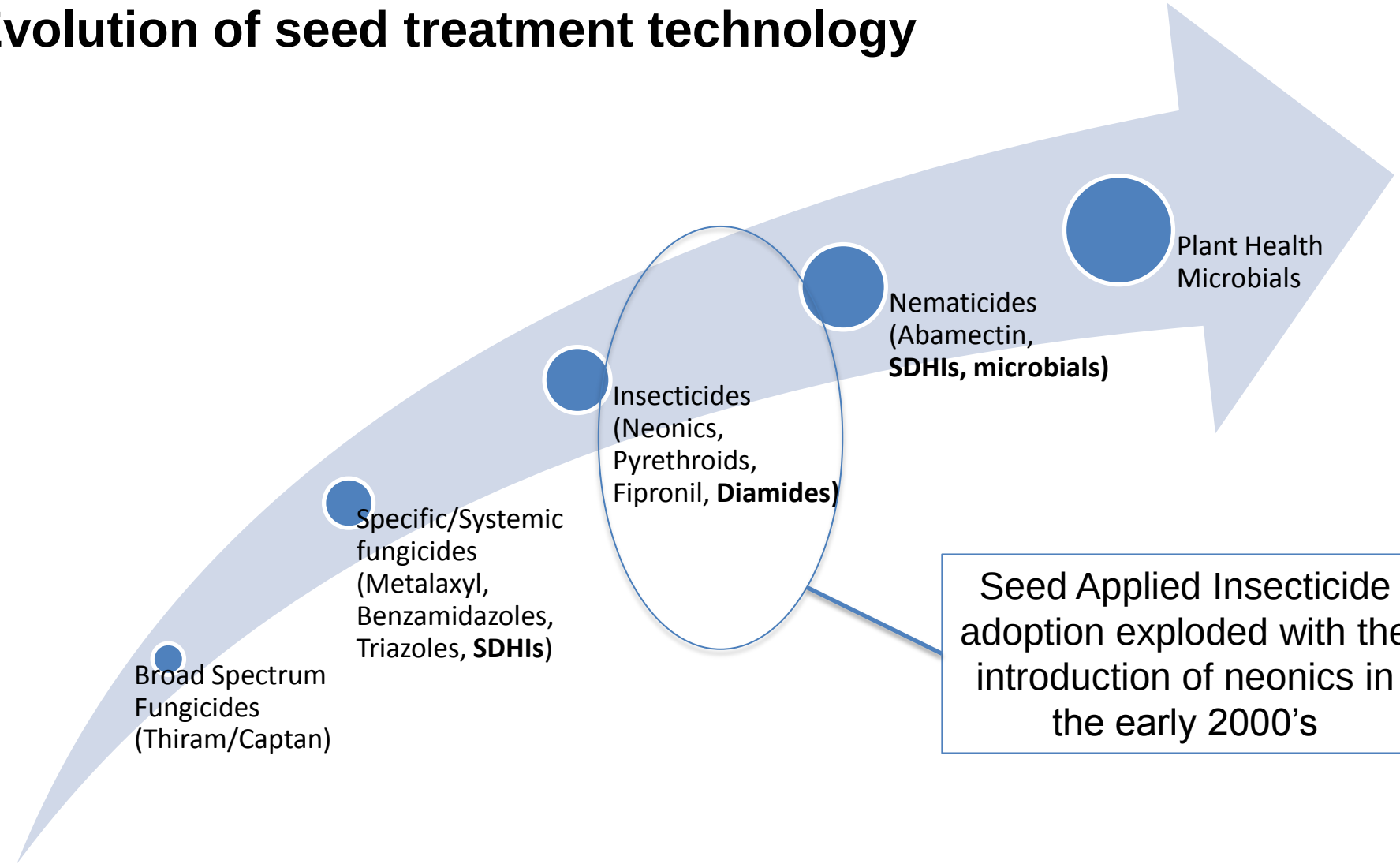
Evolution of seed treatment technology



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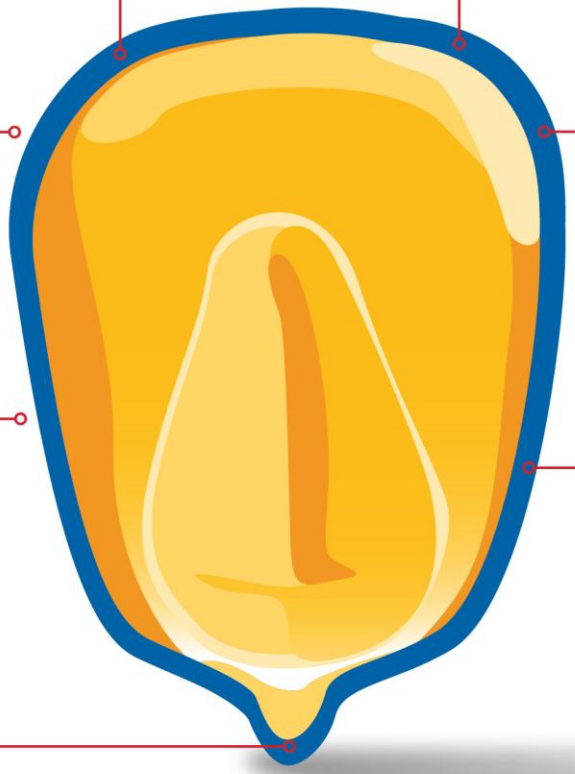
An Integrated approach: The total solution



Dye/Colorant
Seeds need to be colored by law so that they don't enter the food chain.

Polymer/Binder
Adheres active to the seed, controls release. Improves appearance, plantability and handling.

Micro-nutrients
Reduce fertilizer usage.

Inoculants
Enhances nitrogen fixation.

Biologicals
Enhance germination and vigor.

Insecticide
Protection from insect damage during storage, in the soil and/or during early stages of growth (post emergence).

Fungicide
Protection from disease damage during storage, in the soil and during growth of the plant.

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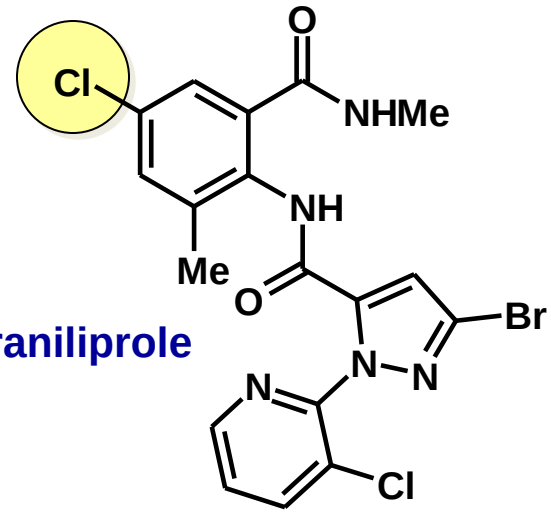
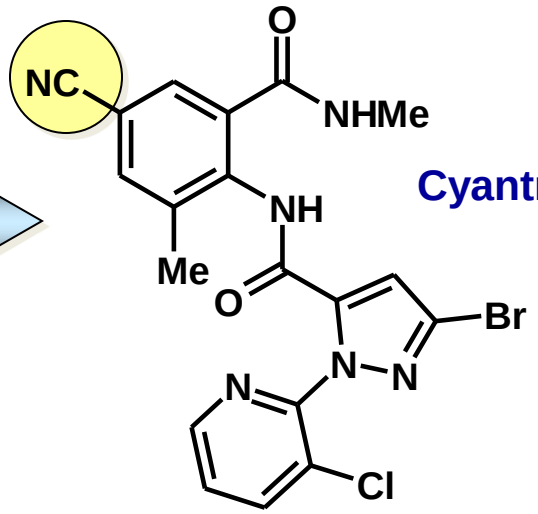
Anthranilic Diamides

Potent Broad-spectrum Insecticides



Chlorantraniliprole

Synthesis of Lower Log P Analogs



Cyantraniliprole

Outstanding Lepidopteran Control

Excellent Cross-spectrum Activity

G. Lahm et al., *Bioorg. Med. Chem. Lett.* **2007**, 17, 6274-6279 & **2005**, *15*, 4898-490

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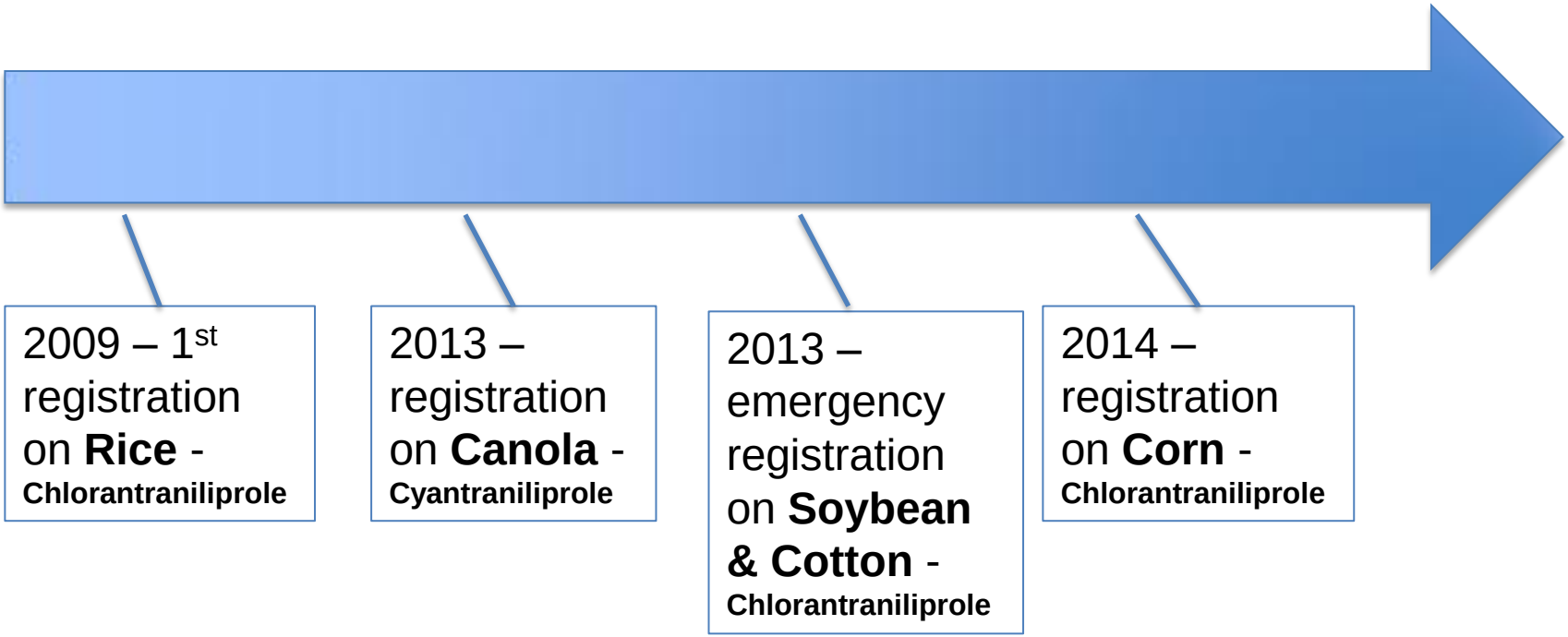
Development of a new Insecticide Seed Treatment tool



Future registrations anticipated for **Cyantraniliprole** on **OSR, Corn, Sunflower, and Soybean**

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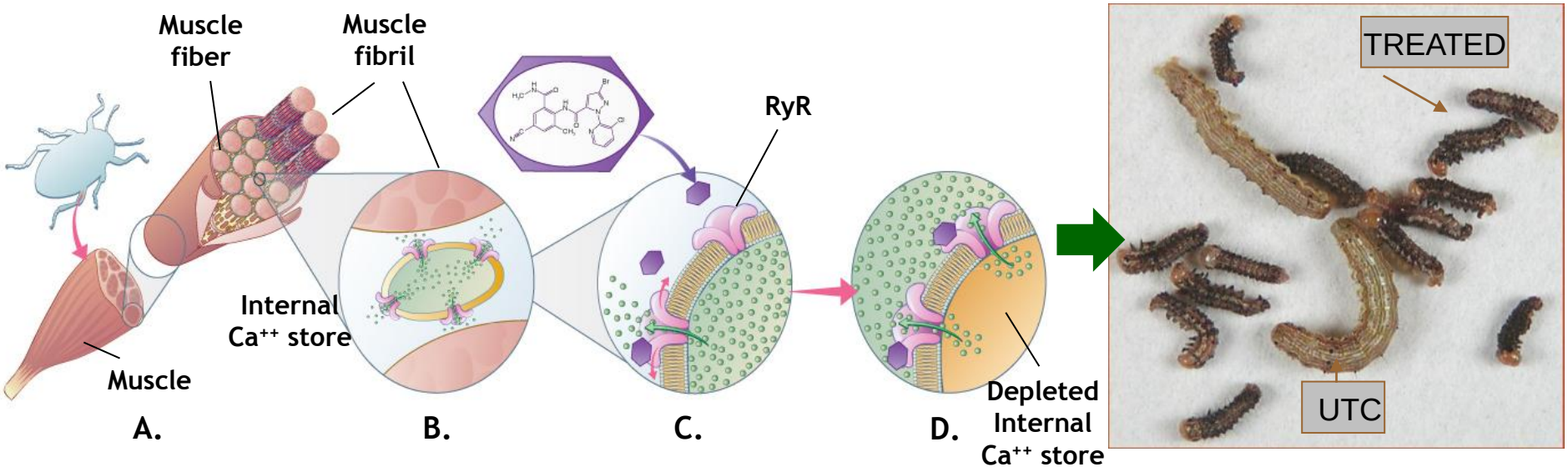
DuPont™ Chlorantraniliprole and Cyantraniliprole Mode of Action

Impacts insect behavior by impairing muscle function



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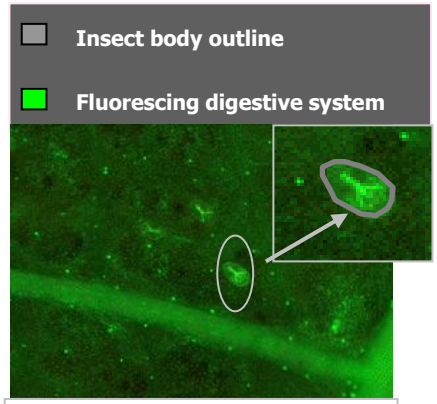
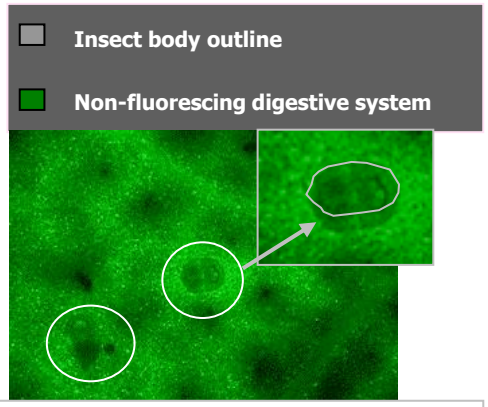
Rapid Cessation of Pest Feeding – Cyantraniliprole

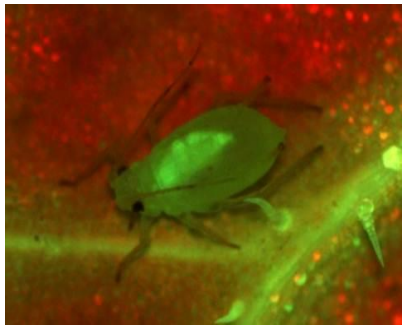
Fluorescein technique studies with *Bemisia tabaci* (sweetpotato whiteflies), *Myzus persicae* (green peach aphid), and *Frankliniella occidentalis* (western flower thrips)



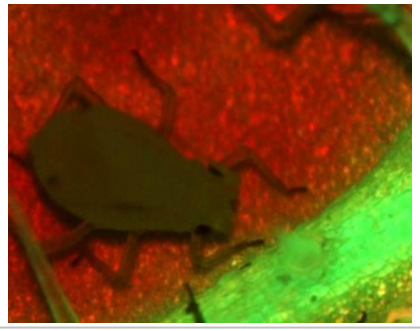
Untreated Control:
Digestive system fluorescing!ng



Treated with Cyantraniliprole
Digestive system NOT fluorescing!ng



Untreated Aphids



Aphids Treated with Cyantraniliprole: 24 h after exposure.

Untreated Thrips

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DuPont Chlorantraniliprole and Cyantraniliprole Technical Background

1. Broad spectrum control
2. Rapid protection
3. Resistance management
4. Excellent environmental profile
5. Flexible application

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seed sense

Tradename	Crops	Geography	Notes
Chlorantraniliprole			
Dermacor®	Corn/Soy	LATAM	Best Intrinsic activity for pest spectrum
Dermacor	Rice	USA	High intrinsic activity for key pest
Lumivia™	Rice	Italy	High intrinsic activity for key pest
Lumivia	Corn	USA	1st Launch in 2015
Cyantraniliprole			
Lumiderm™	Canola	Canada	Cutworm is main pest with enhancement for flea beetle
Lumiposa™	OSR/WOSR	EMEA	Flea Beetle/Cabbage Root Fly

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Lepidoptera & Coleoptera Activity

Chewing insects

EC_{50} (PPM) ← *Lepidoptera* → *Coleoptera*

Compound	*Spodoptera Fugiperda* (Fall Armyworm)	*Plutella Xylostella* (Diamond-back Moth)	*Heliothis Virescens* (Tobacco Budworm)	*Spodoptera Exigua* (Beet Armyworm)	*Trichoplusia Ni* (Cabbage Looper)	*Leptinotarsa Decemlineata* (Colorado Potato Beetle)
Cyantraniliprole	0.35	0.07	0.21	0.75	0.26	< 0.06
Chlorantraniliprole	0.06	0.05	0.04	0.1	0.06	< 0.1

Intrinsic activity has translated to performance differences against key pests and has driven active selection by market.

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Systemic movement of the diamides confers above and below ground protection

V2 STAGE – 14C E2Y45 ON CORN

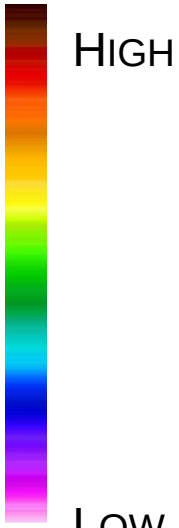

Figure 2. Phosphor images of distribution of 14C-DPX-E2Y45 within corn seedling (V2 stage) following seed treatment application of 250 µg a.i./seed

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seed sense

DuPont Lumivia insecticide seed treatment Selective against Target Corn Pests with minimal impact on beneficials

Laboratory and field studies show that Chlorantraniliprole has low to no significant impact on pollinators, parasitoids and predators when applied using Good Agricultural Practices

DuPont™ Lumigen™
seed sense

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FST/IST *plus* Lumivia™ Efficacy Summary

Insecticide Seed Treatments

Pest	FST/IST 250	FST/IST 250 *plus* Lumivia™
Wireworm	++	+++
White Grub	++	+++
Grape Colapsis	++	+++
Black Cutworm	+[1]	+++
Seed Corn Maggot	++	+++
Fall Armyworm (early season)	–	++++
Flea Beetle	+++	+++
Corn Rootworm	–	–
Corn Nematodes	–	–

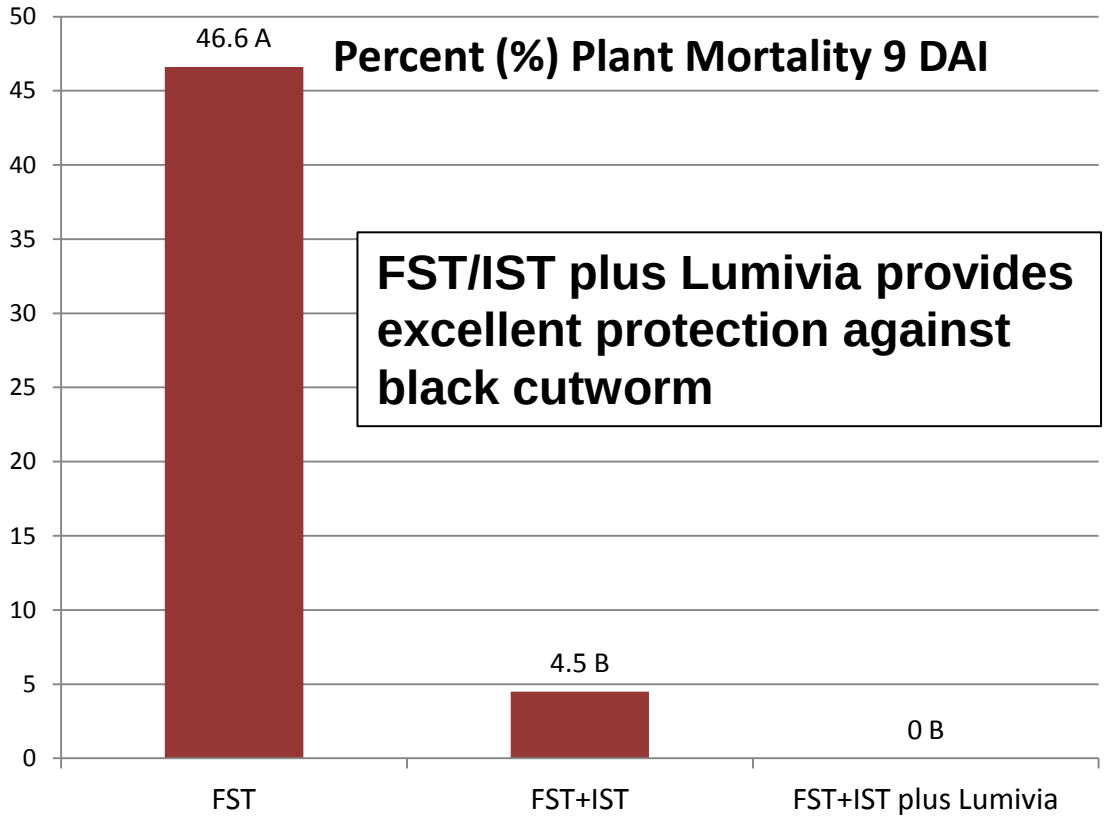
–	No Protection
+	Suppression
++	Protection
+++	Above Average Protection
++++	Excellent Protection

[1]labeled for protection

Source : STE Agronomy Research evaluations & product labels

DuPont™ Lumigen™ seed sense

Healthier Stand: Long residual for Seedling Protection against Black Cutworms (9 DAI)



STE. May 5, 2014. 19 DAP. McAllen, TX. 2014. All treatments included base fungicide treatment (FST). **Soil Texture**: Fine Clay Loam; **Insect species**: *Agrotis ipsilon;* **Planting date**: Apr 16, 2014; **Infestation**: 2, 3rd instar larva/plant; **Plot size**: 6 rows X 20 feet; **Seeding rate**: 39,000/acre; **Experimental design**: RCB; 9 trtms X 4 reps

Lumigen™
seed sense

Lumivia(TM) features and benefits for growers

***Efficacy:* Long residual for better seedling protection against Wireworms (29 DAP)**

FST/IST plus Lumivia

FST/IST

STE. May 22, 2014. 29 DAP. Jefferson City, MO. 2014. All treatments included FST. **Soil Texture**: Loam; **Insect species**: *Melanotus depressus;* **Planting date**: Apr 23, 2014; **Plot size**: 4 rows X 20 feet; **Seeding rate**: 40 seeds per row (20 feet); **Experimental design**: RCB; 9 trtms X 4 reps

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seed sense

Brazil soybeans : Lepidopteron pests

Untreated | **Standard 1** | **Standard 2**

Paraná, Brazil, Nov 2011

Dermacor™ insecticide seed treatment

DuPont™ Lumigen™
seed sense

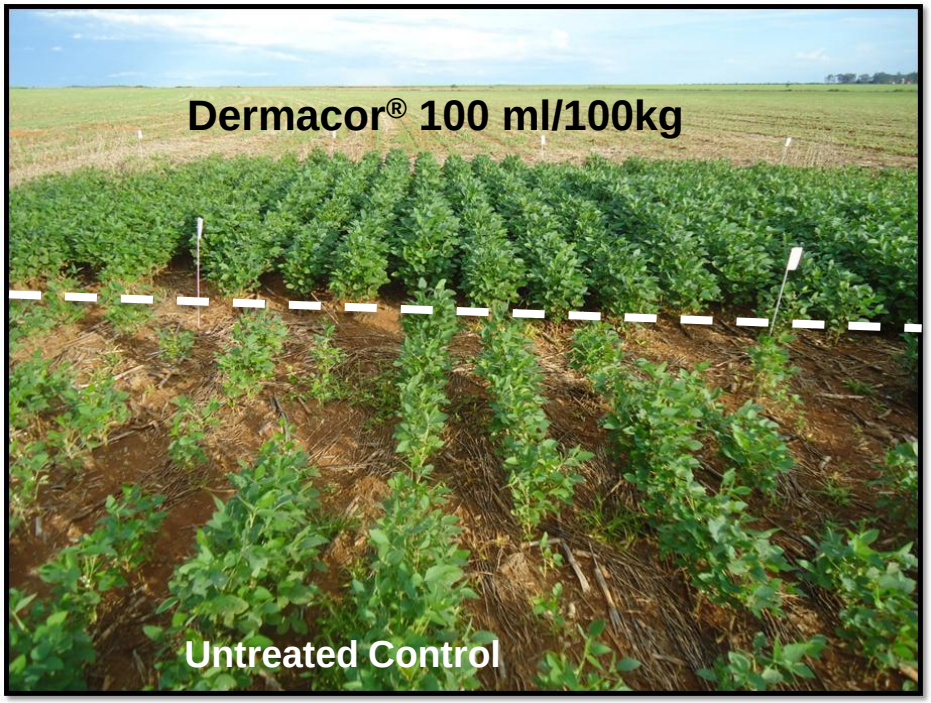
Brazil soybeans : Soil pests

DuPont Dermacor™* & Grubs in Soybeans

Source: Brazil Soy & Global R&D Seed Trt Brazil visit 02/2011: Main pests in test: grubs (*Lyogenis fuscus; Phyllophaga cuyabana*)

DuPont™ Lumigen™
seed sense

Dermacor results in recent trialing



DuPont™ Lumigen™
seed sense

Broad spectrum control

Lumiposa™ provides protection against many different insect species, including the cabbage root fly *(Delia radicum)* which is known to be a significant pest across Europe. Lumiposa™ is an ideal choice to start your oilseed rape crop protection programme.

Psylliodes spp.

Phyllotreta spp.

Delia radicum

Athalia rosae

Lumiposa (TM) - Excellent control of *Delia brassicae on Oil Seed Rape*

- Laboratory studies
- Field results

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Lab Study

- **Study n° 1** : Close-up photos of representative OSR plants

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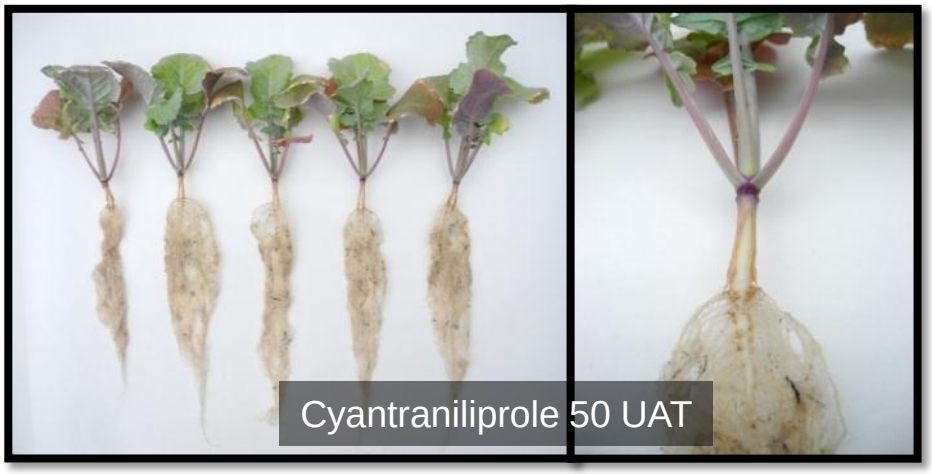
seed sense

Lab Study

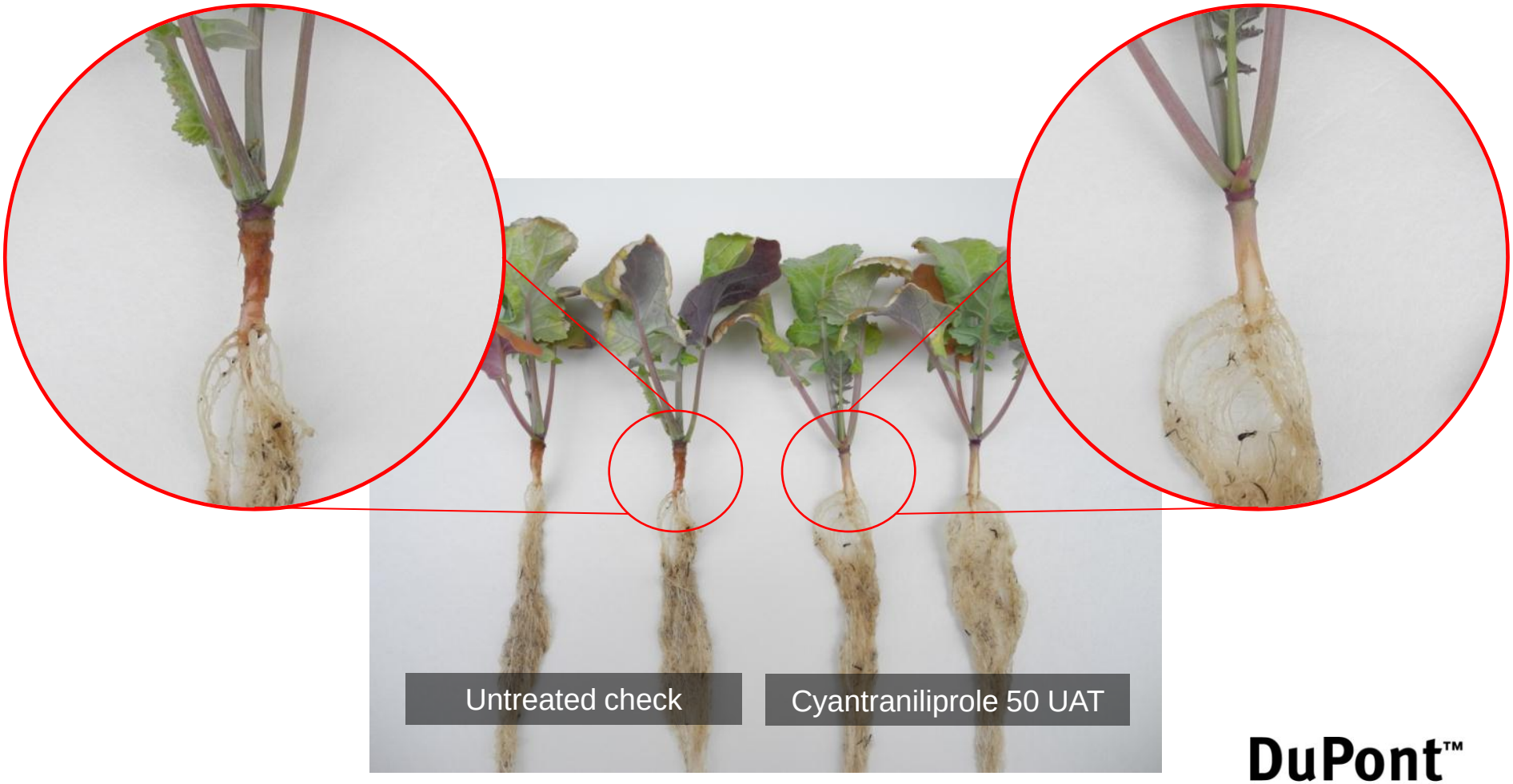
- **Study n° 2** : Close-up photos of all OSR plants tested



Lumigen™
seed sense

Lab Study

- **Study n° 2** : Plants comparison between UTC and Cyantraniliprole at 50 UAT



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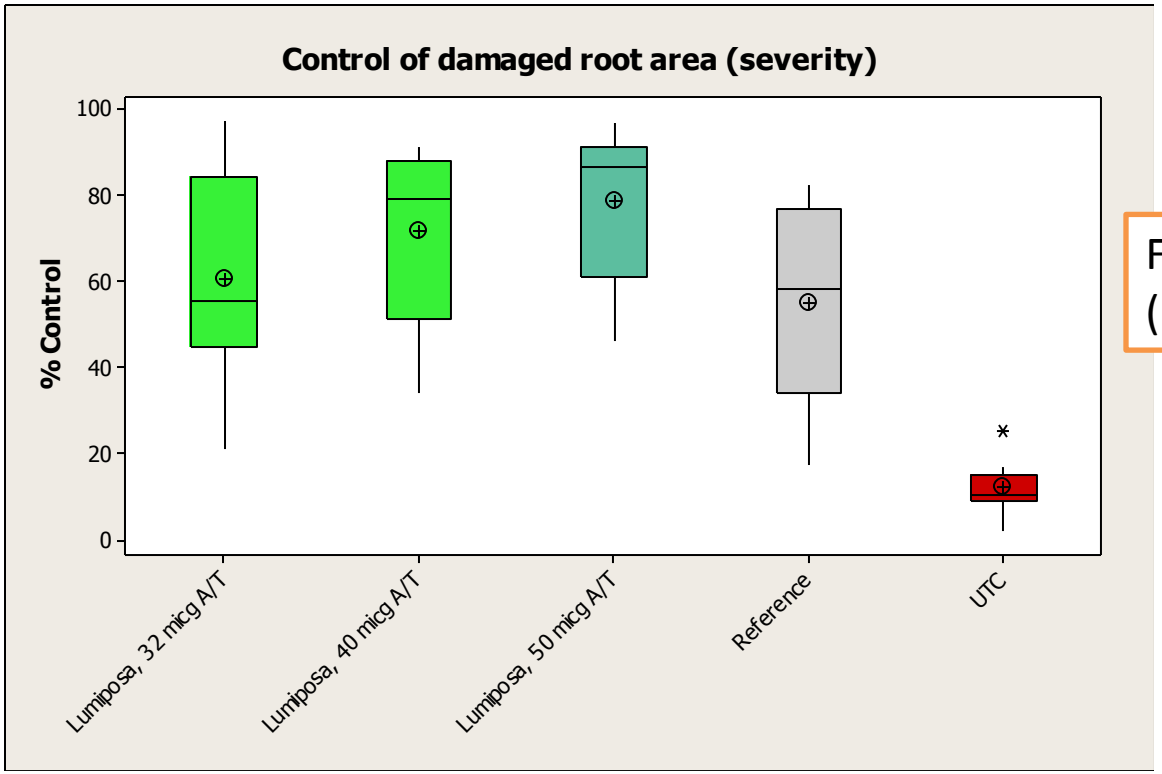
Field Studies

Control of *Delia brassicae*



Field Studies
(12 locations)

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seed sense

DuPont Lumiderm™

insecticide seed treatment

- ***A new mode-of-action insecticide containing the active ingredient – cyantraniliprole – a unique, proprietary IRAC group 28 insecticide***
- ***First seed treatment product to deliver BOTH early season cutworm (lepidoptera) & flea beetle protection***
- ***Residual control – up to 35 days protection from flea beetle & cutworms***
- ***Improved early season stand establishment & vigor of canola***

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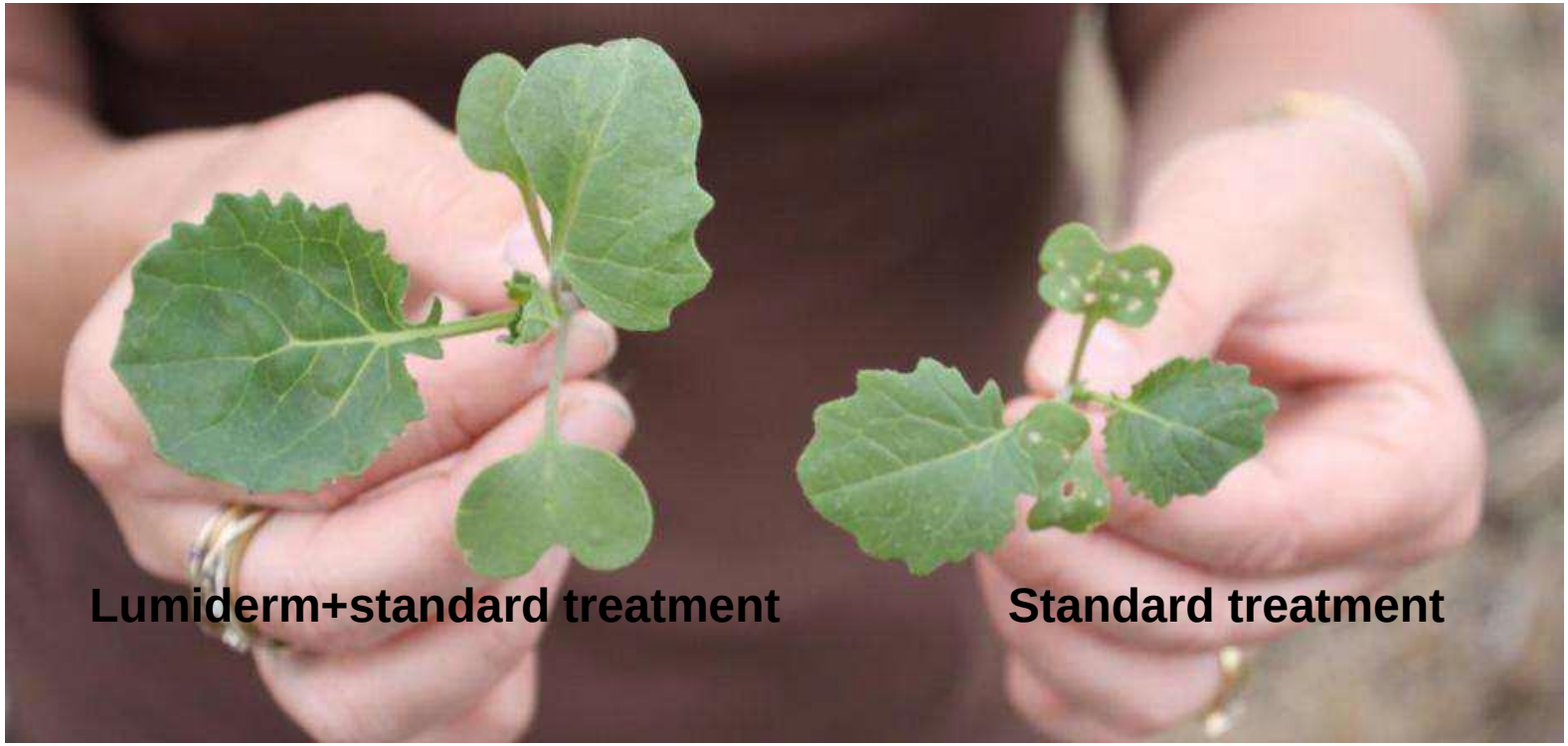
seed sense

Lumiderm™ enhancement of standard performance

- ***Alberta - Keller - Flea Beetle Site 21 Days after seeding Low Pest Pressure***



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ST Registration – Approved

Country	Active Substance	Product	Crops	Registration Date
Italy	Chlorantraniliprole	Lumivia	rice	Oct-13
Mexico	Chlorantraniliprole	Dermacor	corn	Oct-11
Argentina	Chlorantraniliprole	Dermacor	corn	Oct-12
Argentina	Chlorantraniliprole	Dermacor	soybean	Feb-14
Brazil	Chlorantraniliprole	Dermacor	soybean, cotton, emergency registration	Nov-13
Brazil	Chlorantraniliprole	Dermacor BR (blue, on-farm)	soybean, cotton, emergency registration	Nov-13
USA	Chlorantraniliprole	Dermaco X-100	rice	Feb-10
USA	Chlorantraniliprole	Dermacor X-101	corn	Sep-11
Canada	Cyantraniliprole	Lumiderm	canola, mustard (oil seed group)	Aug-13
USA	Cyantraniliprole	Lumiderm	canola, mustard (oil seed group)	Jan-14

Approval in 2014

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ST Registration – Submitted and Pending Approval

Country	Active Substance	Product	Crops/Uses	Actual Submission Date	Current Projection Date for Approval (50% Case)
Thailand	Chlorantraniliprole	Lumivia	corn	MAR-2014	APR-2016
Spain, Greece	Chlorantraniliprole	Lumivia	Rice	Nov 2012 / Jun 2013	Jun-2014
Brazil	Chlorantraniliprole	Dermacor	corn, soybean, full registration	SEP-2011	Apr-2015
Brazil	Chlorantraniliprole	Dermacor BR (blue, on-farm)	soybean, full registration	DEC-2012	Aug-2016
Canada	Chlorantraniliprole	Dermacor	Corn	FEB-2014	DEC-2015
Germany (RMS), FR, UK, PL, HU, RO, AT	Cyantraniliprole	Lumiposa	WOSR	Dec-13	2019

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Questions

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seed sense

DuPont Lumiderm and Lumivia insecticide seed treatments are developmental product s for which an application has not yet been filed with EPA. These developmental product are not registered for use and sale in the United States and no sale, offer for sale or use of these products may be made unless and until all necessary federal and state registrations have been obtained.

DUPONT®

The miracles of science™