Pyraxalt™ active

Technical Bulletin

CORTEVA™
agriscience

I. OVERVIEW

DuPont™ Pexalon™ insecticide contains DuPont™ Pyraxalt™ active ingredient. It belongs to a novel mesoionic chemical class which is chemically distinct from any other existing class of insecticides. Pexalon™ provides outstanding and long-lasting control of planthoppers and leafhoppers in rice, providing excellent plant protection from direct pest damage and hopper transmitted virus diseases. Due to its unique mode of action, Pexalon™ is a useful tool in rice hopper insecticide resistance management programs.

Pexalon™* is a 106 g/L suspension concentrate (SC). The formulation is designed to maximize product coverage on leaves and local systemic movement within leaves to enhance the product's ability to reach rice hoppers at their feeding sites in plants, and thus enhance pest control.

Pexalon™ controls all damaging life stages of hoppers and has a relatively large margin of safety to non-target organisms, thus it helps to conserve natural enemies of rice and improves overall pest control.

Extensive studies have shown that Pexalon™ has a favorable environmental profile with low toxicity to birds, fish, aquatic invertebrates, earthworms and bees. Therefore, the product is an excellent fit in Integrated Pest Management (IPM) programs of rice ecosystems.

* The trademark of the 106 g/L SC formulation in Vietnam is Pexena™ 106 SC insecticide.

II. MODE OF ACTION

Pyraxalt™ active, the active ingredient of Pexalon™ insecticide, is a potent nicotinic acetylcholine receptor (nAChR) inhibitor that blocks neurotransmission in affected insects. Pyraxalt™ is the first insecticide that primarily interacts with nAChRs to inhibit rather than activate receptors. The inhibitory action of Pyraxalt™ is unlike other product acting at the acetylcholine-binding site and elicits a distinct physiological response at the α2-nAChR subunit. It is hypothesized that nAChR inhibition occurs due to rapid modification of the receptor to a desensitized state (Figure 1) resulting in reduced nerve stimulation, rapid cessation of pest feeding, increased mortality, and ultimately excellent control of important pests of agronomic crops. Pyraxalt™ provides excellent control of rice hoppers that are metabolically-resistant to various insecticides, including neonicotinoids.

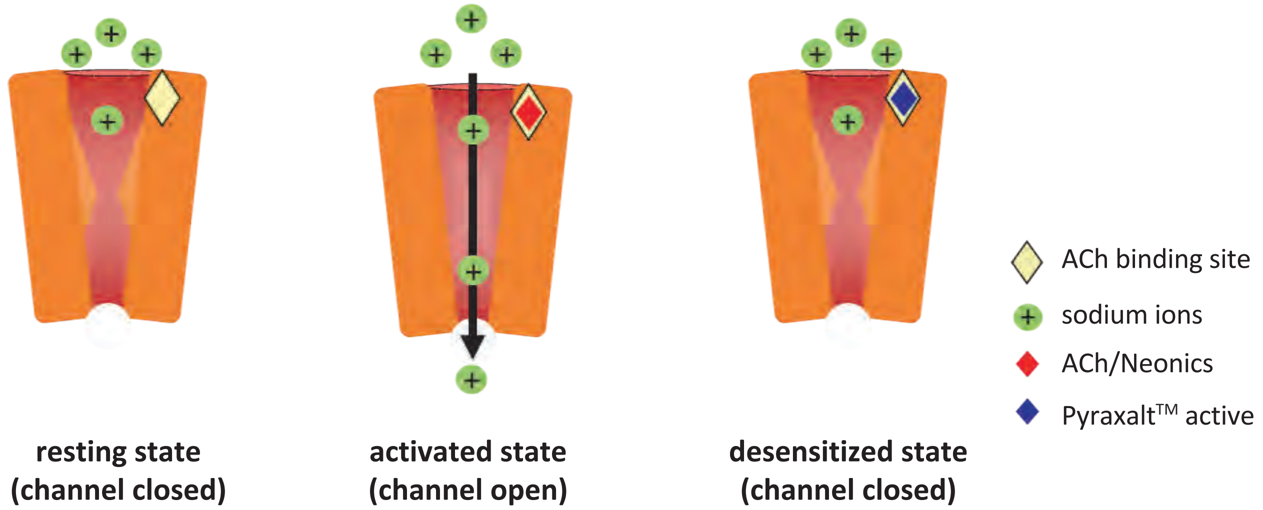

Figure 1. Illustrations of Pyraxalt™ active mode of action.

Source: DuPont Crop Protection, Stine-Haskell Research Center (SHRC), DE, USA

III. MOVEMENT IN PLANTS

A. Translaminar movement: After foliar application, Pyraxalt™ active is able to move across the plant cuticle and then penetrates into the leaf tissue and moves locally within the leaf (Figure 2). This allows the product to move and reach the pests where they are located. This bioavailability whether through ingestion or contact activity, ensures excellent and long lasting control of pest populations. In addition, the translaminar movement ensures rainfastness, which helps Pexalon™ insecticide and other Pyraxalt™ based products to record relatively better wash-off.

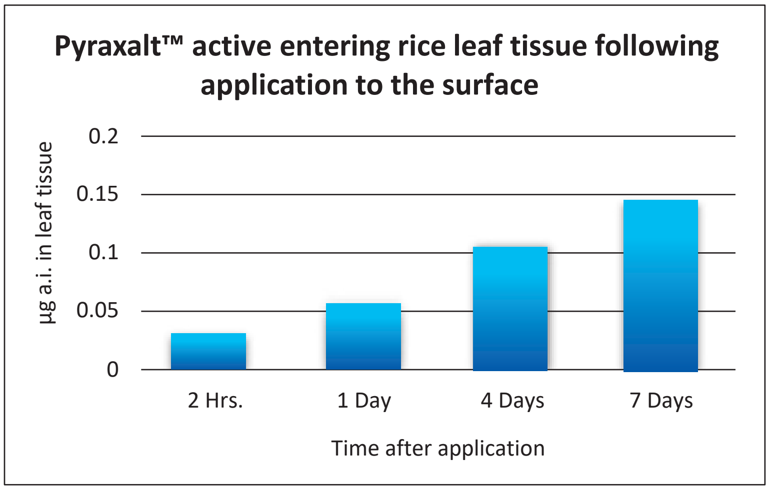

Figure 2. Pyraxalt™ active leaf penetration following application to the leaf surface

Source: DuPont Stine-Haskell Research Center (SHRC), DE, USA (2013)

As is typical of xylem mobile compounds, when Pyraxalt™ penetrates the leaf tissue the active ingredient is translocated via the xylem towards the leaf tip (Figure 3).

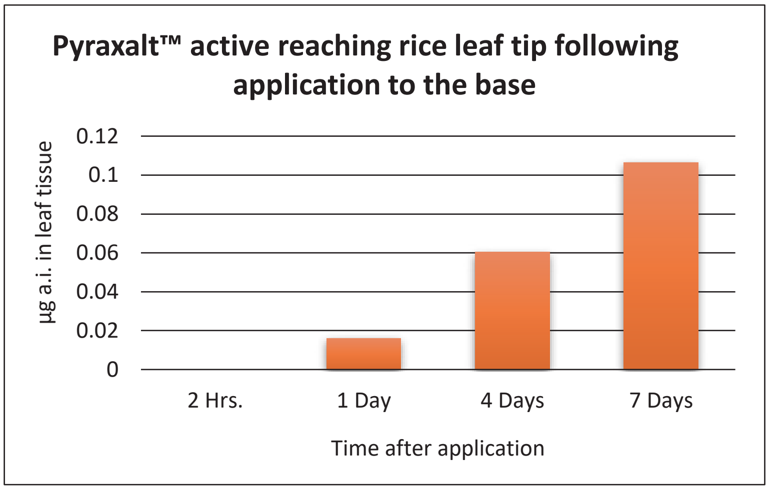

Figure 3. Pyraxalt™ active movement towards the leaf tip following application at base of the leaf.

Source: DuPont Stine-Haskell Research Center (SHRC), DE, USA (2013)

B. Root-uptake systemic movement: Application of products powered by Pyraxalt™ active to soil media in nursery boxes allows the rice seedling roots to take up the product and redistribute it throughout the plant. The bioavailability of Pyraxalt™ within the plant provides excellent and long-lasting protection of rice crop against damage by pests (Figure 4).

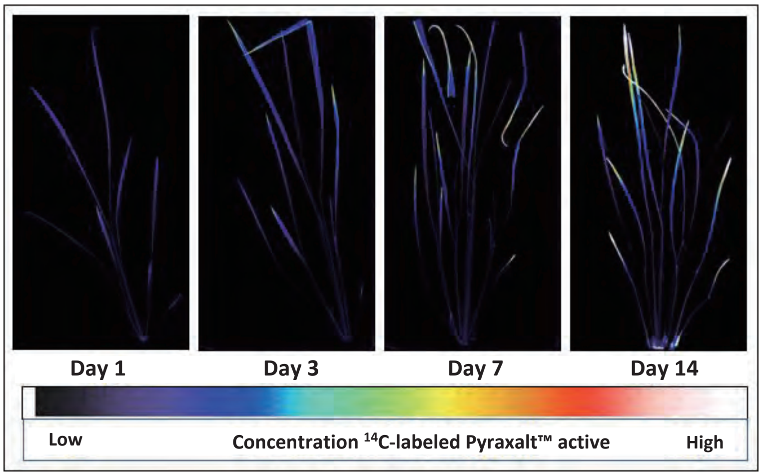

Figure 4. Distribution within rice leaves following soil application of ^{14}C-labeled Pyraxalt™ active to potted rice seedlings.

Source: ABC Laboratories, Inc., Columbia, MO, USA (2016)

IV. EXCELLENT EFFICACY AGAINST RICE HOPPER PROVIDES OUTSTANDING PLANT PROTECTION

A. Control of key hopper pests of rice: Pexalon™ insecticide has high intrinsic potency (Table 1A) and has demonstrated quick and excellent efficacy, and lasting controls against major rice hopper pests (Tables 1B-C). Coupled with the unique mode of action and relative safety to non-target organisms, Pexalon™ is a valuable tool in the management of difficult-to-control hoppers in rice.

Table 1A. Intrinsic potency of Pexalon™ insecticide on rice hopper pests of Asia-Pacific.

Insect Species	Test method	LC_{50}	LC_{90}
Nilaparvata lugens	Cabinet sprayer	1.8	8.4
Laodelphax striatellus	Cabinet sprayer	9.2	>100
Sogatella furcifera	Cabinet sprayer	1.9	11.9
Nephotettix virescens	Cabinet sprayer	0.8	11.9

Pexalon™ insecticide has demonstrated excellent intrinsic activity against all the major rice hoppers, namely: Nilaparvata lugens (brown planthopper, BPH), Laodelphax striatellus (small brown planthopper, SBPH), Sogatella furcifera (white-backed planthopper, WBPH), and Nephotettix virescens (green leafhopper, GLH).

Source: DuPont Malaysia Field Research Station (MFRS), Malaysia, DuPont Philippines Field Research Station (PFRS), Philippines, DuPont Guangzhou Development and Research Station (GDRS), China, and DuPont South Asia Field Experiment Station (SAFES), India (2011-13)

Table 1B. Efficacy profile of Pexalon™ insecticide on rice hoppers in comparison with selected insecticide standards with different mode of action groups.

Pest Species	Acronym	**Pexalon™ insecticide** Group 4E	**Dinotefuran** Group 4A	**Imidacloprid** Group 4A	**Pymetrozine** Group 9B	**Flonicamid** Group 29
Nilaparvata lugens	BPH	++++	++	-	+++	++
Laodelphax striatellus	SBPH	++++		-	++	
Sogatella furcifera	WBPH	++++	+++	++	+++	++
Nephotettix virescens	GLH	+++		++++		

**Ratings based on a composite of data across species from multiple DuPont field trials. Some exceptions may exist on a study-by-study basis.*

Rating	Designation	% Efficacy level
++++	Excellent	95-100
+++	Good	85-94
++	Moderate	75-84
-	Poor	<75
	No in-house DuPont data (i.e., not tested)	---

Source: DuPont. Summaries of multiple field trials data across the rice growing regions in Asia-Pacific (2009-2016)

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BPH 1st instar

BPH 4th instar

BPH 5th instar

BPH Gravid female

Table 1C. Time to kill (TTK) of adult brown planthopper vs. commercial products.

Treatments	Rates (g *a.i.*/ha)	Adults	
		TTK_{50}	TTK_{90}
Pexalon™ insecticide 106SC	25	8.9	29.2
Pymetrozine 50WG	150	18.2	42
Dinotefuran 20SG	30	57	145

In this study conducted on brown planthopper, Pexalon™ insecticide provided faster mortality than other products. It was 2.1 to 6.4 times faster for TTK_{50} and 1.4 to 5.0 times faster for TTK_{90} vs. Pymetrozine 50 WG and Dinotefuran 20 WP, respectively. This feature coupled with rapid feeding cessation helps in crop protection from direct feeding damage and pest-transmitted virus diseases.

Source: DuPont South Asia Field Experiment Station (SAFES), India (2016)

B. Effective on different life stages of hoppers: Pexalon™ has exhibited excellent control of all damaging stages of target hopper species (Tables 2A-C).

Table 2A. Potency of Pexalon™ insecticide on different life stages of *Nilaparvata lugens* (BPH).

Product	LC estimates	Insect Life Stage					
		1st instar	2nd instar	3rd instar	4th instar	5th instar	Adults
Pexalon™ insecticide 106SC	LC_{50}	1.2	1.2	1.8	2.4	2.2	2.6
	LC_{90}	7.5	7.5	8.4	8.1	16.1	17.3
Dinotefuran 20SG	LC_{50}	0.9	2.1	4.9	6.8	4.6	5.9
	LC_{90}	10.3	28.0	493	1295	251	380
Pymetrozine 50WG	LC_{50}	1.7	3.0	7.8	3.7	5.4	6.5
	LC_{90}	60	434	1569	134	174	181
Flonicamid 50WG	LC_{50}	2.1	2.4	2.5	6.2	7.0	7.4
	LC_{90}	490	497	968	275	239	249

Pexalon™ insecticide was more potent on the nymphs and adults of brown planthopper and white-backed Planthopper and superior to the standard products tested.

Source: DuPont South Asia Field Experiment Station (SAFES), India (2012-15)

Table 2B. Potency of Pexalon™ insecticide on different life stages of *Sogatella furcifera* (WBPH).

Product	LC estimates	Life stage (s)					
		1st instar	2nd instar	3rd instar	4th instar	5th instar	Adults
Pexalon™ insecticide 106SC	LC$_{50}$	1.6	1.7	1.8	2.6	2.3	2.5
	LC$_{90}$	7.7	9.8	11.9	16.6	22	15.3
Dinotefuran 20SG	LC$_{50}$	1.1	1.3	2.1	2.9	3.8	4.5
	LC$_{90}$	14.9	15.3	97	168	306	256
Pymetrozine 50WG	LC$_{50}$	1.8	2.2	2.2	3.1	3.7	4.3
	LC$_{90}$	53	90	60	69	91	137
Flonicamid 50WG	LC$_{50}$	2.1	2.6	3.2	4.2	6.3	7.2
	LC$_{90}$	97	123	197	429	390	392

Source: DuPont South Asia Field Experiment Station (SAFES), India (2012-15)

Table 2C. Potency of Pexalon™ insecticide on different life stages of *Nephotettix virescens* (GLH).

Product	LC estimates	Life stage (s)					
		1st instar	2nd instar	3rd instar	4th instar	5th instar	Adults
Pexalon™ insecticide 106SC	LC$_{50}$	2.6	0.1	0.8	5.9	0.2	1.0
	LC$_{90}$	32.5	8.6	190	9.0	5.3	443
Imidacloprid 10 SL	LC$_{50}$	0.9	0.4	0.3	1.0	0.3	0.5
	LC$_{90}$	2.6	0.6	0.5	1.6	1.0	3.4

Pexalon™ insecticide showed greater potency on all the damaging stages (nymphs and adults) of green leafhopper, and comparable to Imidacloprid.

Source: DuPont Philippines Field Research Station (PFRS), Philippines (2011)

GLH 1st instar

GLH 2nd instar

GLH 3rd instar

GLH 4th instar

GLH 5th instar

GLH adult

SBPH 2nd instar

SBPH 3rd instar

SBPH 4th instar

SBPH 5th instar

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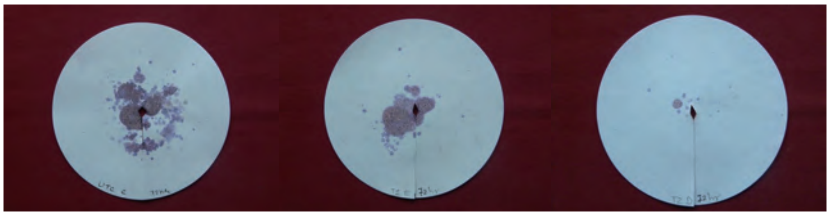
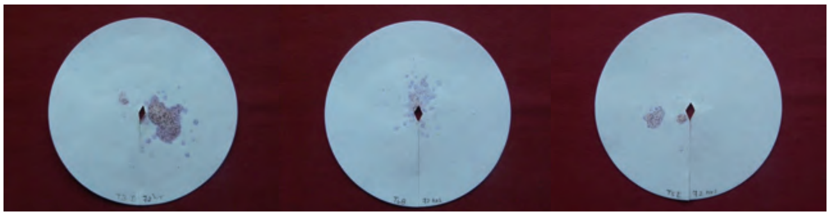
C. Quick feeding cessation provides plant protection from pest feeding damage: It was demonstrated in laboratory studies that hopper feeding was stopped quickly after exposure to Pexalon™ insecticide.

Using the quantification of honeydew excreted by the brown planthopper during feeding, it was observed that significantly less honeydew was produced by insects exposed to Pexalon™ compared to those exposed to untreated control or to the commercial standards tested. In comparison with other hopper control products, the effect of reducing honeydew excretion with Pexalon™ at the label rate was superior to that of pymetrozine and slightly better than both dinotefuran and flonicamid at their label rates (Figure 5).

72 hours post treatment



Untreated control — Pexalon™ 106SC @ 12.5GAH — Pexalon™ 106SC @ 25GAH



Pymetrozine 50WG @ 150GAH — Dinotefuran 20WP @ 30GAH — Flonicamid 10WG @ 75GAH

Pexalon™ insecticide significantly reduced honeydew excretion by BPH better than other hopper control products

Figure 5. Quantification of feeding cessation through honeydew excretion method for different hopper compounds.

Source: DuPont South Asia Field Experiment Station (SAFES), India (2016)

In separate studies analyzing Electrical Penetration Graph (EPG) waveforms of the feeding behavior of *Nilaparvata lugens* (brown planthopper, BPH), and *Sogatella furcifera* (white-backed planthopper, WBPH), further confirmed that Pyraxalt™ active significantly impaired the feeding behavior of those two important pests. Exposure of the test insects to Pyraxalt™ treatments significantly decreased their ability to salivate feed in and around phloem tissues, and also increased the non-penetration activity of the insect stylets (Table 3). The implication of these findings is that Pyraxalt™ is able to reduce the direct pest feeding damage i.e. “hopper burn” and excretion of honeydew on plants, as well as the ability of the insects to transmit pathogenic viruses on rice plants.

Table 3. Summary of electrical penetration graph (EPG) waveform recordings of brown planthopper (BPH) exposed to Pyraxalt™ active -treatments via ingestion exposure.

EPG waveforms	Untreated	LC_{10}	LC_{50}	LC_{90}	Variance analysis	
					F-value	*P-value*
N1: penetration initiation	18.0 ± 1.2a	15.7 ± 1.3a	17.8 ± 1.9a	16.7 ± 1.4a	0.55	0.65
NP: non-penetration of stylets	45.6 ± 3.0a	56.3 ± 4.1b	94.4 ± 4.7c	147 ± 8.3c	70.6	0.0001
N2: salivation and stylet movement	71.3 ± 5.6a	80.3 ± 5.6b	86.7 ± 6.4b	120 ± 7.3b	12.2	0.0001
N3: an extracellular activity near the phloem region	70.0 ± 4.3a	70.4 ± 5.6a	70.4 ± 6.0a	37.2 ± 4.5b	10.2	0.0001
N4a: an intracellular activity in phloem region b. phloem sap ingestion	171 ± 5.3a	153 ± 6.8a	107 ± 6.1b	56.4 ± 4.7c	79.8	0.0001
N5: activity in the xylem region	0.9 ± 0.2a	0.7 ± 0.3a	0.6 ± 0.3a	0.13 ± 0.1a	2.1	0.1

Note: df = 3.107. There is no significant difference (P<0.05) in the same row of data (mean + standard error).

Source: Zhejiang University, Hangzhou, China (2016)

In field, Pexalon™ insecticide reduces hopper feeding very quickly thereby provides immediate protection against a) direct feeding damage and b) hopper transmitted virus diseases.

a. Protection from direct feeding damage

Feeding cessation by Pexalon™ insecticide resulted in significant reductions in the incidence of "hopper burn" damage in rice compared to plots treated with competitive commercial products (Figure 6). In geographies having problem of only direct feeding damage, treatments with Pexalon™ from late vegetative to panicle initiation stage provided excellent protection from direct feeding damage caused by hoppers thereby helping the crop to attain its full potential.

Pexalon™ 106 SC @ 25 g a.i./ha

Buprofezin 25 SC @ 187.5 g a.i./ha

Untreated Check

In screen house studies in India, Pexalon™ insecticide provided better and long-lasting protection of rice plants against 'hopperburn', which was superior to the commercial standard product, and to the untreated control.

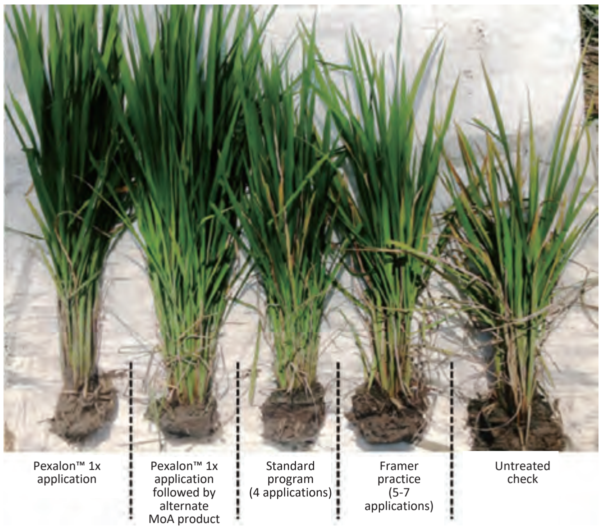
Figure 6. Pexalon™ insecticide protection of rice from "hopperburn" damage by white-backed planthopper.

Source: DuPont South Asia Field Experiment Station (SAFES), India (2013)

IV. EXCELLENT EFFICACY AGAINST RICE HOPPER PROVIDES OUTSTANDING PLANT PROTECTION

b. Protection of rice from diseases caused by hopper-transmitted plant viruses

Due to Pexalon™ insecticide effect on hopper feeding behavior, field plots treated with Pexalon™ as recommended generally show low incidence of hopper-transmitted plant virus diseases (Tables 4A-B, Figure 7). In geographies prone to hopper transmitted virus diseases, treatments with Pexalon™ at the early vegetative growth stages of rice resulted in reduction in the incidence of hopper-transmitted rice diseases. Such reductions of stress on the crop resulted in significant improvement in crop agronomic features.



Application programs that included DuPont™ Pexalon™ insecticide controlled brown planthopper, and provided the best plant protection against the rice grassy stunt virus (RGSV) and rice ragged stunt virus (RRSV) incidence, compared to programs with other hopper control products or the regular farmer practice programs that did not contain Pexalon™.

Figure 7. Protection of rice plants by Pexalon™ insecticide against BPH-transmitted rice grassy stunt virus (RGSV) and rice ragged stunt virus (RRSV) diseases.

Source: DuPont, Indonesia (2014-15)

Table 4A. Protection by Pyraxalt™ active granule formulation (Zexalon™ insecticide) against rice stripe virus (RSV) transmitted by the small brown planthopper (SBPH).

Treatment (s)	**Dose (g a.i./ha)**	**RSV Infected stems (%)**	
		18 days after insect inoculation	61 days after insect inoculation
Pyraxalt™ active GR	75	0	0
Pymetrozine GR	300	20.8	18.2
Fipronil GR	100	45.8	34.5
Dinotefuran GR	200	8.3	2.2
UTC	--	62.5	48

Source: Zen-noh Agricultural R&D Center, Kanagawa Prefecture, Japan (2014)

Table 4B. Protection by Pexalon™ insecticide against virus diseases vectored by the major rice hoppers in Asia-Pacific, when used as part of a virus management program.

Virus name	*Abbreviation*	*Insect vector*	*Type of transmission*
Rice ragged stunt virus	**RRSV**	***Nilaparvata lugens* (BPH)**	**Persistent**
Rice ragged stunt virus	**RGSV**	***Nilaparvata lugens* (BPH)**	**Persistent**
Southern rice black streaked dwarf virus	**SRBSDV**	***Sogatella Furcifera* (WBPH)**	**Persistent**
Rice stripe virus*	**RSV**	***Laodelphax striatellus* (SBPH)**	**Persistent**
Rice tungro bacillifrom virus	**RTBV**	***Nephotettix spp.* (GLH)**	**Non-Persistent**

**Zexalon™ insecticide data*

Source: Summary based on the composite of data from in-house DuPont trials and sponsored cooperator studies in the Asia-Pacific region (2011-2015)

IV. EXCELLENT EFFICACY AGAINST RICE HOPPER PROVIDES OUTSTANDING PLANT PROTECTION

D. Consistency in farm productivity: Above features combined makes Pexalon™ insecticide a very good crop protection tool for growers. When Pexalon™ programs are used in accordance with label, consistent crops can be achieved with reduced applications in areas suffering from high planthopper pressure and associated hopper transmitted viruses thereby help improving rice farm productivity (Figure 8).

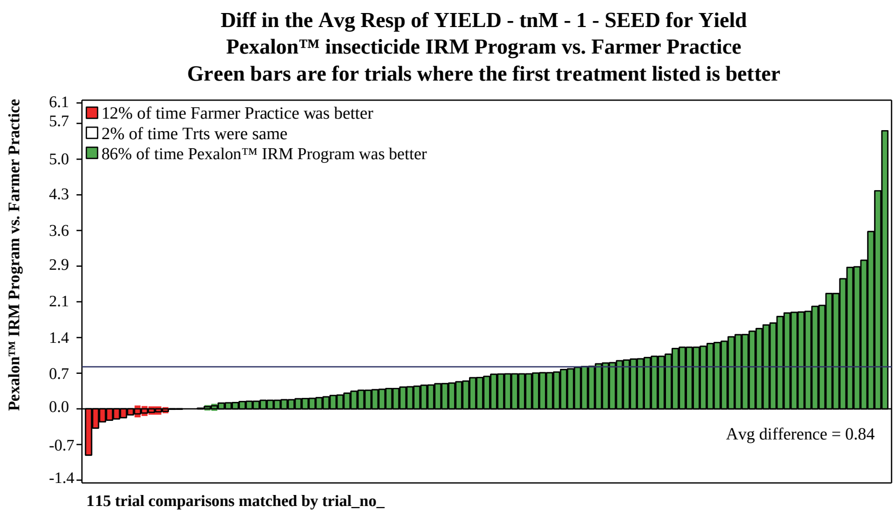
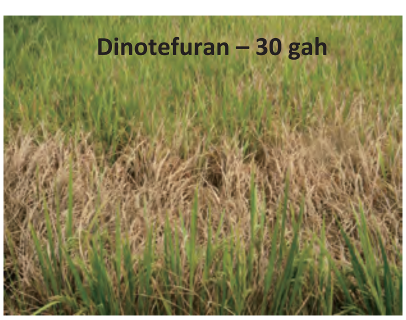


Figure 8. Yield protection comparison with Farmer Practice with multiple hopper applications versus only two hopper applications in Pyraxalt™ active program *i.e.* Pyraxalt™ followed by an alternate MOA application.

Source: DuPont Asia Pacific Large Plot Field Trials (2014-15)

Gangavati; Karnataka 2012



V. EFFECTIVE AS AN IRM / IPM TOOL

A. Unique mode of action: Laboratory and field studies indicated that Pexalon™ insecticide is equally effective in controlling both susceptible and resistant rice hoppers (Table 5).

Table 5. Summary of Pexalon™ insecticide performance against susceptible and resistant strains of the rice brown planthopper (BPH).

Mesoionic Insecticide Controls Neonic-R Pests

LD_{50} < 0.5 ppm

LD_{50} > 20 ppm

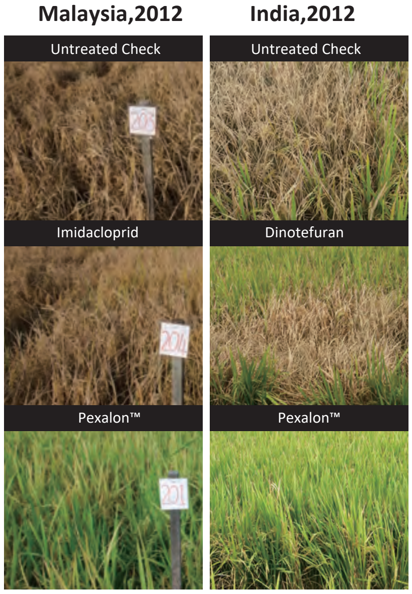
Brown Plant Hopper BPH Straim	Insecticidal Potency against *Nilaparvata lugens* (BPH) LD_{50} Valuse (ppm)	
	Imidacloprid	Pyraxalt™ active
Susceptible (Rothamsted lab)		
Field Strain 2 (Vietnam)		
Field Strain 3 (Thailand)		
Field Strain 4 (India)		

- Laboratory bioassay with imidacloprid resistant BPH strains collected from rice fields of Vietnam, Thailand, and India are clear evidence of lack of cross-resistance with Neonics.
- Pyraxalt™ active has shown excellent and consistent control of rice hoppers that are metabolically-resistant to various insecticides including neonics.
- Cytochrome P450 monooxygenases which detoxify imidacloprid & related neonicontinoids, were found to be ineffective against Pyraxalt™ because of its novel chemical structure.

Reference: Rothamsted Research Study (England, 2012)

Mesoionic Insecticide Controls Neonic-R Pests

Malaysia,2012 **India,2012**



Excellent Field Performance against *Nilaparvata lugens:*
Side-by-side comparisons at field rate.

Excellent Performance against Neonic-Resistant Field Populations:

- Direct side-by-side comparisons of insecticidal performance in field trails in Malaysia and India.(2012)
- Results show that Pexalon™ insecticide has excellent field performance against brown plant hopper populations that have developed resistance to commonly used neonicotinoids.

Figure 9. Performance of Pexalon™ insecticide under field conditions.

V. EFFECTIVE AS AN IRM / IPM TOOL

The unique mode of action of Pexalon™ insecticide and other Pyraxalt™ active containing products make them excellent tools to complement insecticide resistance management programs. DuPont has carefully prescribed the product use guidance in order to deliver the optimum levels of pest control, plant protection and other crop improvement benefits from Pexalon™(Figure 9). Pexalon™ must be used according to the extensive label instructions. Always consult your country agency or local authority for the most current guidelines and product use recommendations.

B. Conservation of natural enemies of rice hoppers: Pexalon™ insecticide shows very good relative safety to beneficial arthropods and other non-target organisms, such as spiders and coccinelid beetles that are important in rice ecosystems (Table 6). This contributes to a complete and outstanding pest control at field level, and thus brings significant value to rice IPM programs.

Table 6. Effect of DuPont™ Pexalon™ insecticide on the natural enemies of rice planthoppers.

S. #	Common name	Species	Stage tested	Year	Location	Location	Toxicity class (IOBC)	Remarks
1	Wolf spiders	*Pardosa spp*	Adults	2010	Lab	Eurofin Agroscience	Class 1	Harmless
		Pardosa pseudoannulata	Adult	2014	Lab	JPPA, Japan	Class 1	Harmless
		Pirata subpiraticus	Adult	2015	Lab	YUC, China	Class 1	Harmless
		Pardosa pseuoannulata	Adult	2015	Lab	YUC, China	Class 1	Harmless
2	Spider	*Ummelata insecticeps*	Adult	2015	Lab	YUC, China	Class 1	Harmless
3	Spider	*Theridion octomaculatum*	Adult	2015	Lab	YUC, China	Class 2	Slightly harmful
4	Small linyphiid spider	*Hylyphantes graminicola*	Adult	2015	Lab	YUC, China	Class 1	Harmless
5	Stingless wasps	*Trichogramma chilonis*	Adult-Contact Exposure	2012	Lab	SAFES, India	Class 1	Harmless
			Adults-Contact Exposure	2016	Lab	IRRI, Hyderabad, India	Class 1	Harmless
			Adult (dry residues leaf)	2014	Lab	SAFES, India	Class 2	Slightly harmful (1DAT)
							Class 1	Harmless (at 3 & 10 DAT)
				2016	Lab	IRRI, Hyderabad, India	Class 1	Harmless
6		*Trichogramma japonicum*	Adults-Contact Exposure	2016	Lab	IRRI, Hyderabad, India	Class 1	Harmless
			Adult (dry residues leaf)	2016	Lab	IRRI, Hyderabad, India	Class 1	Harmless
7	Polyphagous wasps	*Trichogramma dendrolimi*	Adult	2014	Lab	JPPA	Class 1	Harmless
8	Parasitoid wasp	*Anagrus nilaparvatae*	Adult	2015	Lab	YUC, China	Class 1	Harmless
				2016	Lab	IRRI, Hyderabad, India	Class 1	Harmless
9	Dyinids	*Dryinids*	Adult	2015	Field	Tamilnadu, India	Class 1	Harmless
10	Lady bird beetle	*Cheilomenes sexmaculata*	Adult	2012	Lab	SAFES, India	Class 1	Harmless
			Grubs	2012	Lab	SAFES, India	Class 1	Harmless
		Harmonia octomaculata	Adult	2016	Lab	IRRI, Hyderabad, India	Class 1	Harmless
			Grubs	2016	Lab	IRRI, Hyderabad, India	Class 1	Harmless
11	Rove beetle	*Paederus fuscipes*	Adult	2015	Lab	YUC, China	Class 1	Harmless
12	Predatory Mirid Bug	*Cyrtorhinus lividipennis*	Adult	2012	Lab	PFRS, Philippines	Class 2	Slightly harmful
			Adult	2016	Lab	IRRI, Hyderabad, India	Class 4	Harmful
			Adult	2017	Lab	PFRS, Philippines	Class 2	Slightly harmful
			Adult	2015	Lab	YUC, China	Class 1	Harmless (Residual)
13	Minute pirate bug	*Orius strigicollis*	2nd instar	2014	Lab	JPPA	Class 1	Harmless
14	Dragonfly	*Diplocodes trivialis*	Naiads/Adult	2014	Semi field	SAFES, India	Class 1	Harmless

Harmless [<30%]	Slightly harmful [30-79%]	Moderately harmful [80-99 %]	Harmful [>99 %]

Source: DuPont. Summaries of multiple trials data across rice growing countries in Asia (2011-2015)

VI. HIGHLY OPTIMIZED FORMULATION FOR FOLIAR APPLICATIONS IN RICE

Pexalon™ insecticide is a 106 g/L aqueous suspension concentrate formulation designed to optimize spray coverage, leaf penetration, improved rain fastness and local systemic movement to ensure excellent control of key hopper pests in rice. It also provides excellent plant protection (Figure 10). Pexalon™ is designed for foliar applications and should not be used in soil applications. Consult your DuPont representative if you have any question.

Pexalon™ insecticide 106SC: Formulation Profile

Pexalon™ insecticide is designed for foliar applications to optimize spray coverage, foliar penetration and local sysemic movement within leaves

- 106 g/L (10.6% w/v or 10% w/w), Aqueous Suspension Concentrate = SC
- Optimized for foliar applications
- Excellent pest control with extended plant protection

Figure 10. Pexalon™ insecticide 106SC formulation.

Source: DuPont Stine-Haskell Research Center (SHRC), DE, USA, and DuPont South Asia Field Experiment Station (SAFES) (2015-16)

A. Highly optimized for handling and spraying features: The Pexalon™ insecticide formulation is designed to deliver excellent re-suspension in the packaging container, and handling characteristics such as pouring into spray tanks, and mixing and blooming in tanks, as well as rinsing of spray tanks. The product must be handled according to label instructions. Consult the appropriate agency in your country, if there are any questions.

VI. HIGHLY OPTIMIZED FORMULATION FOR FOLIAR APPLICATIONS IN RICE

B. Tank stability: Pyraxalt™ active is hydrolytically stable at pH conditions ranging from 3 to 10, and temperatures of 21°C to 54°C (Figure 11). Also, under various field pH and temperature conditions, Pyraxalt™ in the Pexalon™ formulation has been chemically stable and has delivered consistent biological performance at high pH conditions (pH >9) and temperature regimes (>40°C), when used according to label directions.

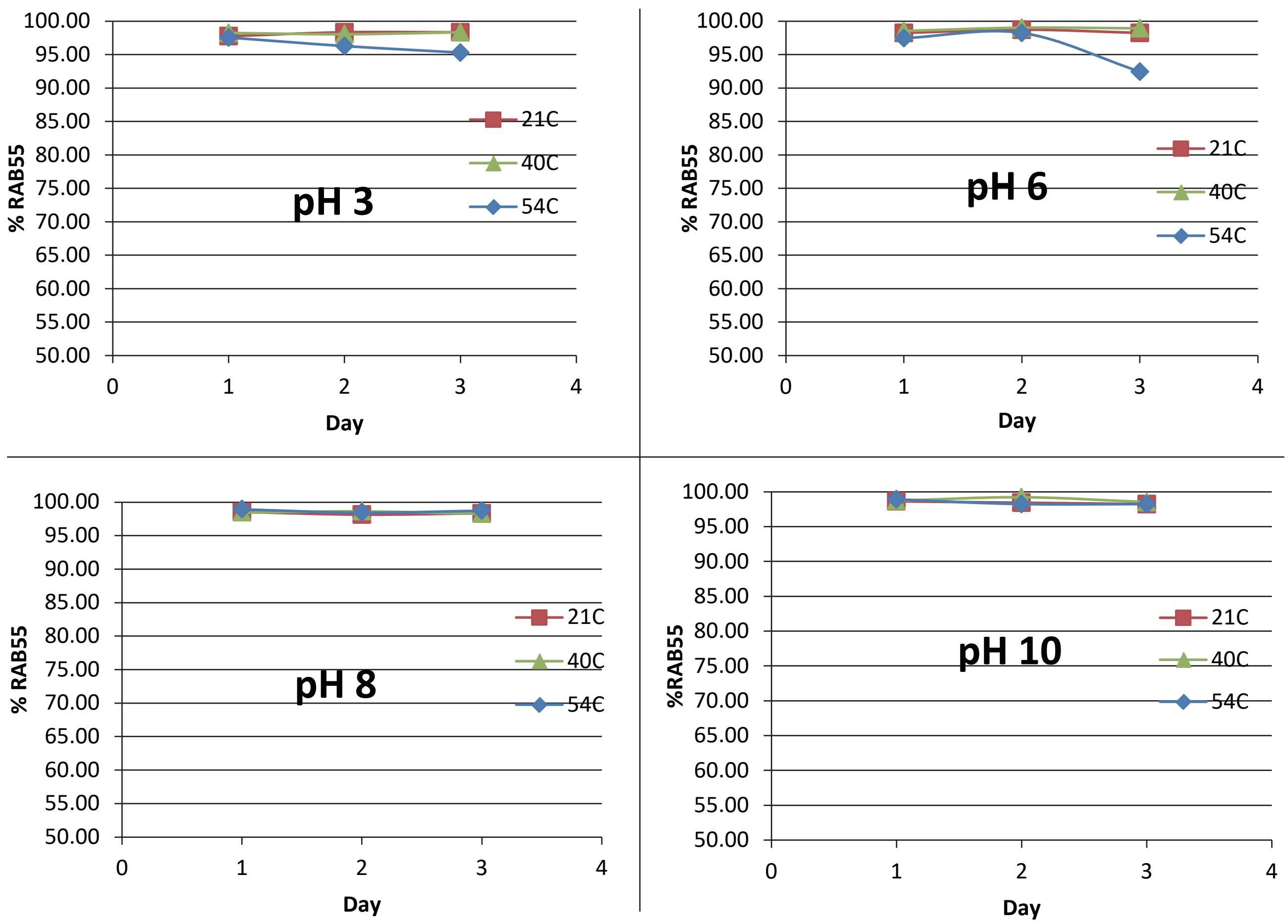


Figure 11. Stability of Pyraxalt™ active 106 SC formulation at pH 3, 6, 8 and 10

Source: DuPont Stine-Haskell Research Center (SHRC), DE, USA (2015)

C. Pexalon™ insecticide is effective through variety of foliar application methods: Data from extensive studies by DuPont™ indicates excellent delivery and product performance of Pexalon™ when applied through various foliar application methods, including manual and mechanized. The performance of Pexalon™ is maximized when applied with sufficient spray volume as specified for respective foliar application equipment to ensure adequate coverage of the foliage. Always consult the appropriate agency in your country for the current approved label for directions by a local agronomic system and application method.

VII. TOXICOLOGICAL, ENVIRONMENTAL AND PHYSICO-CHEMICAL PROPERTIES OF PYRAXALT™ ACTIVE

A. Favorable mammalian toxicology profile: In all acute, sub-chronic and chronic toxicology studies conducted, Pyraxalt™ active showed low toxicity to test animals (Table 7). This indicates a good fit in crop management by allowing the establishment of a short pre-harvest interval (PHI) and short re-entry interval (REI) specifications.

Always consult the agency in your country or local jurisdiction for the product labels and recommended use guidelines to become familiar with the PHI, REI and PPE requirements for specific crop markets.

Table 7. Mammalian Toxicity profile of Pyraxalt™ active.

Mammalian Toxicity profile of Pyraxalt™ active	
Acute oral LC_{50}:	4930 mg/kg
Dermal LD_{50}:	>5000 mg/kg
Inhalation LC_{50}:	>5.04 mg/L
Dermal irritation:	Not a dermal irritant
Eye irritation:	Slight eye irritation
Ames mutagenicity:	Negative
In-vitro chromosomal aberration:	Negative
In-vivo micronucleus:	Negative

Source: DuPont Crop Protection, Stine-Haskell Research Center (SHRC), Newark DE, USA

VII. TOXICOLOGICAL, ENVIRONMENTAL AND PHYSICO-CHEMICAL PROPERTIES OF PYRAXALT™ ACTIVE

B. Product degradation profile: Pyraxalt™ active breaks down under a variety of field and laboratory conditions. Under field conditions, Pyraxalt™ remained mainly in the upper soil horizon. Pyraxalt™ poses low risk for bio-accumulation or bio-magnification in the soil (Table 8).

Table 8. Environmental fate profile of Pyraxalt™ active.

Environmental Fate Characteristics of Pyraxalt™ insecticide		
Aqueous hydrolysis (25°C): pH	hydrolytically stable at each pH measured	
Aqueous photolysis:		
pH 7 buffer	DT_{50}: 2.1 days	DT_{90}: 7.0 days
Natural water	DT_{50}: 2.8 days	DT_{90}: 9.3 days
Soil photolysis (lab):	DT_{50}: 12.1 days	DT_{90}: 40.1 days
Aerobic soil degradation (lab, 4 soils):	DT_{50}: 52.9-133.4 days	DT_{90}: 175.6-443.2 days
Anaerobic soil degradation (lab):	DT_{50}: 302.7 days	DT_{90}: 1005.6 days
Aerobic aquatic degradation (total system - lab):	DT_{50}: 282.9-319.8 days	DT_{90}: 939.7-1062.5 days
Anaerobic aquatic degradation total system - (lab):	DT_{50}: 512-692.1 days	DT_{90}: 1700.9-2299.2 days
Soil sorption:	K_D = 0.907-11.99 mL/g K_{OM} = 31.6-362 mL/g K_{OC} = 54.3-629 mL/g	

Source: DuPont Crop Protection, Stine-Haskell Research Center (SHRC), Newark DE, USA

C. Low toxicity to non-target organisms: Data from several studies indicate that Pyraxalt™ active has low impact on non-target organisms such as fish, *Daphnia* and earthworms, and beneficial arthropods such as pollinators and arthropod natural enemies of rice hoppers (Table 9). The low risk to non-target organisms coupled with the degradation in the environment makes Pyraxalt™ and branded products containing Pyraxalt™ ideal for rice production systems.

Table 9. Environmental Toxicology profile of DuPont™ Pyraxalt™ active.

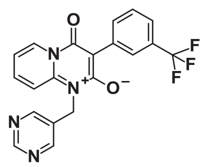
Environmental Toxicology of Pyraxalt™ active	
Species/Measurement	**End point**
Bobwhite quail – Acute oralLD_{50}:	2109 mg/kg
Bobwhite quail - dietary LC_{50}:	>5620 ppm
Bobwhite quail – reproduction NOEC:	50.7 mg/kg/day
Rainbow trout -96 hrs. LC_{50}:	>107 mg/L
Carp – 96 hrs. LC_{50}:	>100 mg/L
Daphnia magna – 48 hrs. EC_{50}:	>122 mg/L
Honeybee acute oral - LD_{50}:	0.51 µg a.i./bee
Earthworm acute — LC50 at 7 d & 14 d	->1000 mg/kg soil

Source: DuPont Crop Protection, Stine-Haskell Research Center (SHRC), Newark DE, USA

VII. TOXICOLOGICAL, ENVIRONMENTAL AND PHYSICO-CHEMICAL PROPERTIES OF PYRAXALT™ ACTIVE

D. Physical and chemical properties: Pyraxalt™ active possesses ideal physical-chemical properties (Table 10). Those characteristics, coupled with high intrinsic potency on rice planthoppers and leafhoppers, and a unique mode of action make the products powered by Pyraxalt™ superior additions to rice pest management programs and successful crop production.

Table 10. Physical and chemical properties of Pyraxalt™ active.

Physical and Chemical Properties of Pyraxalt™ active technical active ingredient	
Common name:	Triflumezopyrim
DuPont-branded name of active ingredient:	Pyraxalt™
DuPont development code:	DPX-RAB55
Structure:	
Structural formula:	$C_{20}H_{13}F_3N_4O_2$
Molecular weight:	398
CAS Number:	1263133-33-0
CAS Name:	2,4-dioxo-1-(5-pyrimidinylmethyl)-3-[3-(trifluoromethyl) phenyl]-*2H*-pyrido[1,2-*a*]pyrimidinium inner salt
IUPAC Name:	2,4-dioxo-1-(pyrimidin-5-ylmethyl)-3-[3-(trifluoromethyl) phenyl]-3,4-dihydro-*2H*-pyrido[1,2-*a*]pyrimidin-1-ium-3-ide
Chemical Class:	Mesoionic; Pyridopyrimidine-dione compound
Physical state:	Solid
Color:	Yellowish
Odor:	Odor-free
Melting point:	189.1 - 189.4 º C
Boiling point:	Not determined
Bulk Density:	835 kg/m^3 (pour density) 913 kg/m^3 (tap density)
Relative Density:	1.4235 - 1.4502
Solubility: Water Dichloromethane Acetone Acetonitrile	 0.23 g/L at 20 º C (230ppm) 64.6-76.1 g/L 71.89-116.5 g/L 65.9-91.5 g/L
Partition coefficient in octanol/water (Log P_{ow}):	1.24
Volatility:	Non-volatile

Source: DuPont Crop Protection, Stine-Haskell Research Center (SHRC), Newark DE, USA

VIII. PEST CONTROL PROFILE

Pest species controlled and use rates: When used according to label guidance, Pexalon™ insecticide controls all the major planthopper and leafhopper pests of rice at low use rates (Table 11).

Table 11. Summary of target pests and use rates of Pexalon™ insecticide.

Biology – Crop/Pest/Rate summary for Pexalon™ insecticide*				
Pest species/grouping				**Crop: RICE**
Pest Scientific name	**Pest common name**	**Common name abbreviation**	**Pest family**	**Foliar application rate (g *a.i.*/ha)**
Nilaparvata lugens	Brown planthopper	BPH	Delphacidae	25
Laodelphax striatellus	Small brown planthopper	SBPH	Delphacidae	
Sogatella furcifera	White-backed planthopper	WBPH	Delphacidae	
Nephotettix virescens	Green leafhoppers	GLH	Cicadellidae	35

**actual species and use rates may vary by country and use of Pexalon™ is meant only for FOLIAR spray applications* corteva.com

Disclaimer

DuPont™ Pexalon™, Zexalon™, Pexena™ and Pyraxalt™ insect control products are not registered for sale or use in all countries. No offer for sale, sale or use of this product is permitted prior to issuance of the required country level registrations.

The information contained in this technical bulletin is based on the latest-to-date technical information available to DuPont, and DuPont reserves the right to update the information at any time.