BENEFICIALS

ISOCLAST™
ACTIVE

Dow AgroSciences
Solutions for the Growing World
Isoclast™ active is a new foliar-applied insecticide for control of a wide range of sap feeding pests. It belongs to a new class of chemistry the sulfoximines, which has a novel and unique mode of action.

Numerous studies have been conducted to measure the impact of Isoclast™ on beneficial arthropods. There are 3 types/categories of beneficial arthropods: predatory mites, predatory insects and insect parasitoids. Predatory mites are voracious predators of pest mites. Some of the most important of these are the phytoseiids *Typhlodromus pyri* and *Amblyseius spp.* Predatory insects as adult or adolescent insects (larvae or nymphs), act as predators by devouring other insects. They include ladybugs, lacewing, bugs and spiders. Parasitic insects develop in, or on a host, from eggs or larvae deposited by the adult female parasite normally killing the host. Common insect parasites are tachinid flies, braconid wasps and those belonging to other wasp families.
INTRODUCTION

The studies with Isoclast™ active have been conducted globally on a wide range of beneficial insects including predatory and parasitic arthropods, such as: predatory mites, assassin bugs, big-eyed bugs, braconid wasps, green lacewings, lady beetles, minute pirate bugs and spiders. The studies encompassed laboratory, greenhouse observations, semi-field, small field plots (in conjunction with efficacy studies), full-fauna studies and from large field plot trials.

The reference resource for measuring the impact to beneficials is the IOBC (international Organisation for Biological and Integrated Control of Noxious Animal and Plants). It has a classification system for the side effects of plant protection products to beneficial and non-target arthropods as shown in Table 1 (Hassan 1992), and serves as a standard for international organizations.

Table 1: IOBC classification system for side effect of plant protection products

<table>
<thead>
<tr>
<th>Classification</th>
<th>% Effect observed</th>
<th>Laboratory studies</th>
<th>All other studies*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class 1</strong></td>
<td>Harmless</td>
<td>&lt; 30%</td>
<td>&lt; 25%</td>
</tr>
<tr>
<td><strong>Class 2</strong></td>
<td>Slightly Harmful</td>
<td>30-79%</td>
<td>25-50%</td>
</tr>
<tr>
<td><strong>Class 3</strong></td>
<td>Moderately Harmful</td>
<td>80-98%</td>
<td>51-75%</td>
</tr>
<tr>
<td><strong>Class 4</strong></td>
<td>Harmful</td>
<td>&gt; 99%</td>
<td>&gt; 75%</td>
</tr>
</tbody>
</table>

* Study types are extended laboratory, semi-field and field tests
When new pesticides are developed, the initial studies to identify the impact of pesticides on beneficial insects is to use a range of laboratory techniques. This is especially important for insecticides, as they normally pose a greater inherent risk of being harmful to other insects that we want to preserve. Laboratory work gives a good first indication before moving into the next phase of testing. The initial Isoclast™ laboratory studies showed low toxicity to predatory insects and mites with parasitoids being more sensitive.

**PREDATORY MITES**

Testing was carried out on key predatory mites; *Amblyseius swirskii*, *Amblyseius cucumeris* and *Phytoseiulus persimilis*. The results showed negligible mortality to adult mites 48 hours exposure on treated leaves at 24 and 48 g a.i./ha and was assigned IOBC class 1 = Harmless. Figure 1 shows how safe Isoclast™ is on the 3 predatory mites.

![Amblyseius swirskii](image1.png) ![Amblyseius cucumeris](image2.png) ![Phytoseiulus persimilis](image3.png)

**Figure 1: Mortality of Isoclast™ active compared to dimethoate**

- Isoclast 48 g/ha
- Dimethoate 40 g/ha

Exposure to fresh residues on bean plants
When the effects of fresh residues of Isoclast™ on the predatory mite *Typhlodromus pyri*, were evaluated under laboratory test conditions, the 7-day LR50 was found to be higher than 400 g a.i./ha. Isoclast™ also had no effects on the reproductive capacity of the mites (i.e. less than 50% reduction, relative to the control) at the highest treatment rate evaluated, i.e. 400 g a.i./ha.

In Figure 2, laboratory trials showed the selectivity of Isoclast™ active another predatory mite *Typhlodromus pyri*, based on mortality and reproduction and how it compares with Dimethoate (toxic standard).

**Figure 2: Typhlodromus pyri Mortality & Reproduction**

- Isoclast™ 50 g/ha
- Dimethoate 6 g/ha
- Untreated

0 20 40 60 80 100
% Mortality

0 20 40 60
Eggs/Female
LABORATORY

PREDATORY INSECTS
On the predators Chrysoperla carnea (larvae), Macrolophus caliginosus and Orius laevigatus the studies with Isoclast™ active on treated leaves at 24 and 48 g a.i./ha indicated a high degree of selectivity.
In Figure 3 exposures to fresh residues on bean plants, 7-day aged residues of Isoclast™ at 48 g a.i./ha was classified as "harmless" to M.caliginosus (IOBC) as compared with Dimethoate (toxic standard); initial laboratory studies showed it to be slightly harmful.

Figure 3: Lab mortality on predatory insects

<table>
<thead>
<tr>
<th></th>
<th>Isoclast™ 48 g/ha</th>
<th>Dimethoate 40 g/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Corrected Mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrolophus caliginosus</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Orius laevigatus</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

Exposure to fresh residues on bean plants

M. caliginosus
IOBC class
2=Slightly harmful

Chrysoperla carnea
(larvae) IOBC class
1=Harmless

Orius laevigatus
IOBC class
1=Harmless
Laboratory trials were carried out in Turkey for three beneficial groups: predatory insect *Chilocorus bipustulatus*, predatory mites *Amblyseius swirskii* and the parasitoids *Aphytis melinus*, and *Anagyris pseudococci*. Rates tested were 3.6–4.8 g a.i./hl which are needed for citrus mealybug (*Planococcus citri*) and citrus red scale (*Aonidiella aurantii*) control. On the two predatory groups Isoclast™ active was classified as harmless, whereas on both parasitoids a toxic effect was shown, so higher tier work was needed under semi-field and field conditions.
GREENHOUSE/GLASSHOUSE STUDIES

Initial glasshouse work focused on the parasitoids *Encarsia formosa*, *Eretmocerus eremicus* and *Aphidius colemani* and the Predatory diptera *Feltiella acarisuga*.

At 24 and 48 g a.i./ha exposure on these at 0, and to aged residues showed Isoclast™ active to be harmless to these parasitoids.

The effects of Isoclast™ on beneficial insects and mites was also used to study integrated pest management systems (IPM) in greenhouses mainly in vegetables, for several group of beneficial insects and results are summarized in table 2 based on the IOBC classification.

**Table 2: IOBC classification of Isoclast™ active on predatory mites/bugs and parasitic wasps in glasshouse conditions**

<table>
<thead>
<tr>
<th>Arthropod group</th>
<th>Species</th>
<th>Expected effect of Isoclast™ when the beneficial species is present *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predatory mites</td>
<td><em>Phytoseiulus persimilis</em></td>
<td>Harmless</td>
</tr>
<tr>
<td></td>
<td><em>Amblyseius swirskii</em></td>
<td>Harmless</td>
</tr>
<tr>
<td>Predatory bugs</td>
<td><em>Orius laevigatus</em></td>
<td>Slightly harmful</td>
</tr>
<tr>
<td></td>
<td><em>Macrolophus caliginosus</em></td>
<td>Slightly harmful</td>
</tr>
<tr>
<td>Parasitic wasps</td>
<td><em>Aphidius spp.</em></td>
<td>Moderately harmful</td>
</tr>
</tbody>
</table>

* One application of Isoclast™ at 4.8 gai/L or 48 gai/ha under glasshouse conditions in vegetable crops.

Results have shown that Isoclast™ active has low toxicity to most predatory mites and these predators can be introduced after application when spray deposits have dried. Direct application to populations may cause minor temporary reductions. On predatory insects Isoclast™ has moderate toxicity and can be introduced 3 days after the application. Direct application to populations may cause beneficial population reductions, but the persistence of this effect is up to 3 days. Isoclast™ based on these studies is classified as moderately harmful to parasitic wasps and these parasitoids can be introduced 7 days after application.
These are field studies to assess effects and recovery on non target arthropod communities. A field study on arthropod communities either under real conditions of good agricultural practice (GAP) or alternatively in an off crop situation is needed, if laboratory studies as well higher tier studies cannot sufficiently prove harmlessness on non target arthropods. The full fauna study allows determining short and long term effects on arthropod communities and the potential for recovery.

Isoclast™ active has been tested on a range of arthropods and figure 5 shows the effect of the Isoclast™ brand Transform (containing Isoclast™ at 240 g a.i./l) on the arthropod fauna in cotton. The total beneficial arthropods are very similar to the untreated plots. This clearly illustrates Isoclast™ has a favourable ecotoxicology profile.

The information in Figure 6 shows that the numbers of natural enemies in plots treated with Isoclast™ active and flonicamid were not significantly different from numbers in untreated.

Figure 5: total beneficial arthropods

![Bar chart showing beneficial insects per m crop row](image)

Figure 6. Impact of Isoclast™ Active on Natural Enemies Cotton, Shafter, California, 2010

<table>
<thead>
<tr>
<th>Productoz/A (g a.i./ha)</th>
<th>0</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoclast™ 1.5 (50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isoclast™ 2 (75)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fonicamid 2.3 (81)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Acephate 16 (1010)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clothianidin 4 (61)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambda cyhalothrin 2 (34)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxamyl 32 (1050)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Untreated</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No. unspecified natural enemies per sweep 23 DAA. Isoclast™ brand was Transform™ 500 WG
FULL FAUNA FIELD STUDIES

In other large scale full fauna field studies on various crops, Isoclast™ active induced statistically significant effects on 10-20% of taxa. These were mainly transient effects on parasitic Hymenoptera and most recovered within one month. It must be also noted that some population impact of the parasite was likely due to reduction in hosts in the field.

FIELD STUDIES

Small plot field trials have also been used to evaluate the impact of Isoclast™ on beneficial arthropods. Such trials are very close to the practical effect of pesticides in the environment, that cannot be demonstrated by laboratory, greenhouse and semi-field testing.

There are many types of bugs that are important predators of other insect pests, and the trials showed the effect of Isoclast™ even at 100 g a.i./ha on Geocoris spp (big-eyed bugs) in cotton, and alfalfa and Orius spp (pirate bug) in alfalfa to be statistically similar to the untreated plots. The same was reported for spiders and braconid wasps in alfalfa.

In Turkey a field trial was carried out to determine the impact of Isoclast™ active under field conditions on Anagyrus pseudococci which was the most sensitive parasitoid from laboratory and semi-field testing.

The citrus crop was artificially infested with mealybugs and the parasitoid was placed 2 weeks after the establishment of the host. Isoclast™ formulated as Breaker™ 240 SC (containing Isoclast™ at 240 g a.i/L) was applied at 20 cc/ha (4.8 g a.i/ha) and compared to spirotetramat 100ml/100L water (10 g a.i./ha) as a reference standard product and Dimethoate 150ml/100L water (as a toxic standard product). Assessments were made at weekly intervals up to 28 days after application, and results showed that based on the IOBC classification Isoclast™ under field conditions was harmless to A. pseudococci.
FULL FAUNA FIELD STUDIES

In Kenya, Closer™ 240 SC was evaluated in field and greenhouse tests for its compatibility for use in IPM in roses. Results showed that Closer™ 240 SC has minimal toxicity to *Phytoseiulus persimilis* (<25% mortality) and the persistence after application was zero days, so one can re-introduce natural predators the next day after spraying with Closer™.

In numerous field trials in Turkey, observations were made on the presence of larvae and adults in the trial site on various crops where Breaker™ 240 SC was applied and showed the presence of a range of beneficial insects (Table 4).

Table 4: Beneficial insects observed in field crop system in Turkey, 2012-2013

<table>
<thead>
<tr>
<th>Crop</th>
<th>Beneficials observed in plots treated with Breaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables (lettuce/eggplant)</td>
<td><em>Chrysoperla carnea, Aphidoletes spp., Syrphid</em> and various <em>Coccinellid</em></td>
</tr>
<tr>
<td>Pome Fruits (apple)</td>
<td><em>Chrysoperla carnea, Coccinella septempuncta, Scymnus spp. and Syrphid spp</em></td>
</tr>
<tr>
<td>Stone Fruits (peach/cherry)</td>
<td><em>Chrysoperla carnea, Coccinella septempuncta, Scymnus spp., Syrphid spp., Chilocorus bipustulatus</em> and various <em>Coccinellid</em></td>
</tr>
</tbody>
</table>

IMPACT OF ISOCLAST™ ACTIVE ON MITE FLARING

Untreated shows excessive vegetative growth due to loss of fruit resulting from plant bug feeding.

The application of Transform™ 500 WG (containing Isoclast™ at 500 g a.i./kg) at 50-100 g a.i./ha applied 3 consecutive times showed that the untreated and Isoclast™ treated cotton show little two spotted mite damage, while acephate and novaluron treated cotton is heavily damaged by mites.

The brown-colored foliage due to flaring of mite populations.

*Isoclast™ brand was Transform™ 500 WG*
FULL FAUNA FIELD STUDIES

Four applications of Transform™ (containing Isoclast™ active at 240 g a.i./l) at the maximum label rate of 400cc/ha, had a minimal effect on the number of two-spotted mites, and the cotton was as green and healthy as the unsprayed control plot. The same number of applications of Regent (fipronil), even at the lowest label rate, had a marked effect, and the explosion in mite numbers led to the highly visual crop effect which can be clearly seen in the photo below. Both demonstration trials clearly indicate that Isoclast™ does not cause flaring of mites.

Integrated pest management is becoming more important in the control of the insect pest spectrum employing the uses of insecticides, biological and cultural methods. The toxicity of insecticides to beneficial insects and mites is an increasingly important consideration before starting a spray program. Environmentally "softer" insecticides help to preserve naturally occurring parasites and predators, which can support to keep the pest population below the economic threshold.

Isoclast™ active does not persist in the terrestrial environment and degrades rapidly to products that exhibit low toxicity to non-target organisms. In soil Isoclast™ under field conditions has an average DT 50 of only 4 days, and the estimated photochemical oxidation DT 50 in air is less than 1 day.

Laboratory, greenhouse and field testing of Isoclast™ formulated as various brands, demonstrated that Isoclast™ has a minimal effect on predaceous arthropods. At labelled use rates it will have no significant impact on population levels on beneficial insects and mites, making Isoclast™ an ideal tool for use in IPM programs.

Based on the results from the studies carried out, as well as on observations from other field trials, use of Isoclast™ is not expected to cause outbreaks of secondary insect pests such as mites (often referred to as “flaring”).