Growing in Unison

Growing crops with environmental responsibility & economic success
Our strong safety profile allows us to control severe sucking pests while staying mindful of the environment. SIVANTO® prime’s protective measures include strong and quick efficacy providing effective virus vector control, flexibility in method and timing of application, and resistance management of selected pests. SIVANTO® prime is highly selective and affects neither the quality of the crop nor that of the harvest, thus ensuring greater safety in agriculture and sustainable farm management.
SIVANTO® AT A GLANCE
Its unique pharmacophore system makes SIVANTO® prime chemically distinct from established sucking pest chemistry.

SIVANTO® prime at a glance

- **Active ingredient:** Flupyradifurone
- **Chemical class:** Butenolide
- **Brand name:** SIVANTO® prime
- **Formulation:** SL 200 | Soluble liquid
- **Mode of action:** Agonist of the insect nicotinic acetylcholine receptor (nAChR)
- **IRAC* classification:** Group 4D
- **Crops:** Vegetables, fruits incl. grapes, citrus and plantation crops (coffee, cocoa), as well as ornamental, ornamental plants, beans, cotton, tea trees and essential oils.
- **Key pests:** Aphids, whiteflies and psyllids, selected hoppers, planthoppers, psyllids, beetles, mirids, leaf miners and sawflies.

SIVANTO® prime - an innovation for sucking pest control

SIVANTO® prime is a modern broad-spectrum with an outstanding safety profile for the control of major sucking pests like aphids, whiteflies, and other key insect pests including larval and adult stages. The active ingredient of SIVANTO® prime, Flupyradifurone, belongs to Bayer’s own chemical class of butenolides. It is a systemic insecticide which is most effective when used as foliar application, but also has excellent drench application properties.

SIVANTO® prime also has excellent safety characteristics. It is highly compatible with honey and bumblebees allowing wide application windows and treatments during flowering. Its selectivity to most beneficials in fruit and field-grown vegetable crops provides a perfect fit for Integrated Pest Management (IPM) programs. In particular, for resistant species, essential oils like garlic, cloves and oregano provide a valuable tool for resistance management.

Additionally, SIVANTO® prime provides a wide range of significant benefits to growers, such as excellent speed of action, quick feeding cessation, effective virus vector control and flexible applicability at any crop stage.

Growing in unison with the farmer

SIVANTO® prime delivers something new with its state-of-the-art family of insecticides. It answers the needs of value-driven fruit, plantation and vegetable growers: quick and effective care of difficult-to-control sucking pests, high safety standards and an excellent IPM fit, new resistance management tools with maximum application flexibility, and easy crop management for superior profitability of produce.

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*IRAC – Insecticide Resistance Action Committee*
Inspired by nature

Innovative pest control derived from nature for gentle usage

The creation of flupyradifurone was inspired by the natural compound stemofoline – an isolate from Stemona japonica, a medicinal plant that grows mainly in South-East Asia. Stemofoline is an alkaloid with exciting insecticidal properties. For decades, scientists around the world have tried using this knowledge to develop a commercial crop protection but have failed in their attempts.

Bayer’s research scientists have now succeeded in identifying which part of this complex natural product is responsible for its insecticidal action: the butenolide pharmacophore system addressing the nicotinic acetylcholine receptor (nAChR) in targeted pests. By combining it with two other chemical fragments, the scientists discovered that the efficacy and selectivity of the active ingredient could be significantly improved.
We are bringing pest control back to its natural beginnings. SIVANTO® prime offers an uncomplicated pest control solution that is inspired by nature’s own formula. The result is a more sustainable, responsible and convenient way to grow and harvest your crops; a new concept that has never before been offered in the world of agrochemistry. **SIVANTO® prime**: a sustainable way to farm for more rewarding results.

Growing in unison with environmental responsibility.
Non-hazardous for humans and mammals

SIVANTO® prime’s active ingredient (flupyradifurone) has low acute toxicity when exposed through ingestion, inhalation, and dermal absorption. It is only slightly irritating to the eyes and is not a skin irritant.

According to all scientific data currently available, the agricultural use of flupyradifurone does not pose a cancer risk to humans.

<table>
<thead>
<tr>
<th>Test type (SIVANTO® prime)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute oral toxicity, rat LD₅₀</td>
<td>≥ 5000 mg/kg</td>
</tr>
<tr>
<td>Acute dermal toxicity, rat LD₅₀</td>
<td>&gt; 2000 mg/kg</td>
</tr>
<tr>
<td>Acute inhalation toxicity, rat LD₅₀</td>
<td>3.5 mg/L</td>
</tr>
<tr>
<td>Acute skin irritation</td>
<td>not irritating</td>
</tr>
<tr>
<td>Acute eye irritation</td>
<td>not irritating</td>
</tr>
<tr>
<td>Skin sensitization</td>
<td>sensitizing</td>
</tr>
</tbody>
</table>

Ecotoxicological profile

The intrinsic toxicity of SIVANTO® prime’s active ingredient was evaluated on a broad range of indicator species under worst-case exposure scenarios.

The results found that there are no adverse effects on non-target arthropod populations when it is used under practical conditions in the field.

<table>
<thead>
<tr>
<th>Ecotoxicological properties on non-target organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds (bobwhite quail):</td>
</tr>
<tr>
<td>Fish (rainbow trout):</td>
</tr>
<tr>
<td>Aquatic invertebrates (Daphnia):</td>
</tr>
<tr>
<td>Aquatic plants (algae):</td>
</tr>
<tr>
<td>Earthworms (Eisenia) 14 day:</td>
</tr>
</tbody>
</table>
No adverse effects on honey bees and bumblebees

*SIVANTO® prime* has been tested in laboratory and extensive semi-field and field studies using crops that are highly attractive to bees.

Acute and chronic laboratory studies show that it has a low intrinsic toxicity to adult and immature honey bees. When applied at the proposed label rates, *SIVANTO® prime* presents no adverse effects on honey bees – even when applied to flowering crops.

Field studies (Bee-attractive crop)

Higher tier studies demonstrate that exposure under worst-case conditions cause no adverse effects on honey bees and honey bee colonies when applied during full bloom and when bees were actively foraging – including in the long term.

Tunnel studies (Bee-attractive crop, confined & forced exposure)

No adverse effects in honey bees and honey bee colonies when applied during full bloom and when bees were actively foraging.

Studies indicate that *SIVANTO® prime* has no adverse effects on foraging honey bees, foraging activity, brood and colony development, hive vitality and honey bee health or on over-wintering colonies when used in accordance with the proposed label instructions.

Selectivity to beneficials

Based on the recommended field rates and positioning of *SIVANTO® prime*, the results show that the compound is selective to most beneficials in fruit and outdoor grown vegetable crops.

<table>
<thead>
<tr>
<th>Beneficial group</th>
<th>Species</th>
<th>Stage</th>
<th>Crop</th>
<th>Foliar</th>
<th>Drench</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predatory mites:</td>
<td><em>Amblyseius swirskii</em></td>
<td>Motile</td>
<td>Bell pepper</td>
<td>4</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td><em>Typhlodromus pyri</em></td>
<td></td>
<td>Apple</td>
<td>4</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td><em>Kampimodromus abersiae</em></td>
<td></td>
<td>Apple/grape</td>
<td>4</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Predatory bugs:</td>
<td><em>Orius laevigatus</em></td>
<td>Mixed</td>
<td>Bell pepper</td>
<td>4</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td><em>Anthocoris nemoralis</em></td>
<td>Mixed</td>
<td>Pear/com</td>
<td>4</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Coccinellidae:</td>
<td><em>Coccinella septempuncta</em></td>
<td>Larvae</td>
<td>Apple</td>
<td>3</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Hover flies:</td>
<td><em>Episyrphus balteatus</em></td>
<td>Larvae</td>
<td>Cabbage</td>
<td>3</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Lacewing:</td>
<td><em>Chrysoameria spp.</em></td>
<td>Adult</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Parasitoid wasps:</td>
<td><em>Encarsia formosa</em></td>
<td>Mixed</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Enicoecus</em></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td><em>Aphidos colemani</em></td>
<td>Mixed</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Aphelinus mali</em></td>
<td>Mixed</td>
<td>Apple</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

*IOBC rating* = International Organization for Biological and Integrated Control

Harmful: Slightly harmful: Moderately harmful: Non-hazardous

Positioning in IPM systems (example: in pome fruits)

Two *IPM*-compatible foliar applications of *SIVANTO® prime* to control rosy apple aphids have no adverse effects on predatory mites and coccinellidae in pome fruits.

SIVANTO® prime has been tested in laboratory and extensive semi-field and field studies using crops that are highly attractive to bees.

No adverse effects in honey bees and honey bee colonies when applied during full bloom and when bees were actively foraging.

Studies indicate that *SIVANTO® prime* has no adverse effects on foraging honey bees, foraging activity, brood and colony development, hive vitality and honey bee health or on over-wintering colonies when used in accordance with the proposed label instructions.
SIVANTO® prime is a systemic insecticide that is flexible in application and highly target-selective against a broad range of sucking pests, such as aphids, hoppers and whiteflies. It is also effective against mealybugs, leaf miners, soft scales, citrus psyllids as well as some weevils, thrips and beetles.

SIVANTO® prime offers protection to a wide variety of fruit, vegetable, plantation and defined broadacre crops. It is highly effective against sucking pests such as whiteflies (Bemisia tabaci, B. argentifolii, and Trialeurodes vaporariorum), aphids (Myzus persicae, Nasonovia ribisnigri), psyllids (Bactericera cockerelli), scales (Quadraspidiotus perniciosus), leafhoppers (Empoasca vitis; Scaphoideus titanus, Erythroneura spp.), grapevine mealybugs (Planococcus ficus), cotton aphids (Aphis gossypii), lygus bugs (Lygus spp.), Asian citrus psyllids (Diaphorina citri), citrus tristeza (Coccus pseudomagnoli- arum), thrips (Scirtothrips citri), citrus thrips (Scirtothrips citri), pear suckers (Aonidiella aurantii), cocoa mirids (Distantiella theobroma, Sahlbergella singularis), grapevine leafhoppers (Vidius fiorii), and many others.

SIVANTO® prime fits into spray programs in sustainable crop solutions. It complements Bayer’s sucking insect solution portfolio in perennial and annual crops. It fits ideally into integrated spray programs – together with e.g. ketoenols, biologics – in our sustainable crop solutions. It answers the needs of even the most challenging spray programs.

In addition, SIVANTO® prime conveniently supports different types of application (foliar, soil, drip irrigation) and provides adaptable application timing (including during blooming).

### Crop positioning

**Fits into spray programs in sustainable crop solutions**

SIVANTO® prime complements Bayer’s sucking insect solution portfolio in perennial and annual crops. It fits ideally into integrated spray programs – together with e.g. ketoenols, biologics – in our sustainable crop solutions. It answers the needs of even the most challenging spray programs.

In addition, SIVANTO® prime conveniently supports different types of application (foliar, soil, drip irrigation) and provides adaptable application timing (including during blooming).
Pome fruits

Solving apple and pear problems for growers in Belgium

Rosy apple aphids and pear suckers remain a major concern for pome fruit growers in Belgium. **SIVANTO® prime** is highly effective in protecting pome fruits against these pests, which are responsible for significant damage and quality issues each year.

**Efficacy on *Psylla pyri***

[Number of larvae, Ransberg/Belgium, 2010]

Solving apple and pear problems for growers in Belgium

Rosy apple aphids and pear suckers remain a major concern for pome fruit growers in Belgium. **SIVANTO® prime** is highly effective in protecting pome fruits against these pests, which are responsible for significant damage and quality issues each year.

**Efficacy on *Dysaphis plantaginea***

[Number of aphids, Sint-Truiden/Belgium, 2011]

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**SIVANTO® prime** controls pear suckers at flowering perfectly. It’s really a major step for maximum fruit quality at harvest! During the development of **SIVANTO® prime** we appreciated its consistency and excellent performance in all the trials on rosy apple aphids. The long-lasting efficacy of this pre-flowering application was absolutely striking! **Rhopalosiphum insertum** aphids were additionally controlled. A post-flower application also controls **Aphis pomi** and **Aphis spiraecola**, and showed useful side effects on **Eriosoma**.**
Citrus

Presenting a new tool for sustainable, effective citrus production

With the invasion of citrus greening disease into Brazil, the United States and other major citrus production areas, the survival of the citrus industry in the Americas is at risk. So far, there is no cure for citrus greening, a disease caused by a bacterium named Candidatus liberibacter which is transmitted by the Asian citrus psyllid (ACP) Diaphorina citri as its vector.

Fighting psyllids is still an enormous task; citrus greening continues to spread further and losses due to the disease are increasing. Available ACP control options, especially during blooming, are limited and only marginally effective. SIVANTO® prime successfully fills this gap with fast feeding cessation that minimizes the probing of target pests and thus reduces the risk of virus and bacteria transmission.

Efficacy on Diaphorina citri

[Winter Garden/FL, USA, number of adults/sweep, 2013]

Efficacy on Coccus pseudomagnoliarum

[Tulare/CA, USA, number of nymphs/10 leaves, 2012]

Frequency of Asian citrus psyllid adult feeding phases

(measured by EPG*** technique)

SIVANTO® prime minimizes the probing of target pests (fast feeding cessation), and thus reduces the risk of virus and bacteria transmission.

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* DAA = Days after first application
** DAB = Days after second application
*** EPG = Electrical Penetration Graph
**** Potential for pathogen transmission to occur
Among the newer active ingredients recently developed for whitefly and CYSDV management (e.g. Cyazypyr, sulfoxaflor), SIVANTO® prime is clearly the most effective and has the best fit in desert melon IPM programs. In experimental trials conducted over the past five years, soil at-planting applications of SIVANTO® prime have provided excellent residual control of immatures and adults. When used in conjunction with a foliar spray program, these applications have provided as good as or significantly better reductions in the incidence of CYSDV on fall melons than the industry standard.

Dr. José Antonio Garzon, Universidad Autónoma de Sinaloa, Mexico

I've had a higher yield and better fruit quality at harvest since using SIVANTO® prime in my trials. Many colleagues have asked me many times what I have applied to my tomatoes.

Dr. John Palumbo, University of Arizona, USA

Higher share of marketable tomatoes due to SIVANTO® prime’s rapid control of virus vector transmission in Mexico

Whiteflies and aphids are major pests on tomatoes that transmit several viruses and permanent yellowing diseases. SIVANTO® prime applied to foliage provides rapid knockdown of whiteflies and potato psyllid adults. Furthermore, it has been demonstrated in various trials that when SIVANTO® prime (400g a.i./ha) is applied as a drench after transplanting, a lower number of plants with diseases transmitted by sucking pests is observed. In addition, more tomatoes with greater overall fruit quality are harvested.

SIVANTO® prime

Vegetables: melons | tomatoes

Visual comparison 76 days after application

Trial set-up: Tomato Yellow Leaf Curl Virus (TYLCV, transmitted by whiteflies), comparison of SIVANTO® prime with neonicotinoid insecticides; data generated 2012 by Dr. José Antonio Garzon, Universidad Autónoma de Sinaloa, Mexico

Higher share of marketable tomatoes due to SIVANTO® prime's rapid control of virus vector transmission in Mexico
Coffee

Excellent control of coffee leaf miners through versatile application methods

The coffee leaf miner (Leucoptera coffeella) makes its home in coffee trees. Digging into the leaves, this pest creates large brown spots. Rubbing and bending an infested leaf will break it apart and often expose the presence of tiny larval miners.

Leaves damaged by this pest typically die and drop off the tree early, impacting the tree’s ability to produce coffee beans. SIVANTO® prime is used not only as a foliar treatment but also as a soil application in order to maximize its long-lasting efficacy against coffee leaf miners.

Coffee leaf miner (Leucoptera coffeella)

Coffee in Ituverava area

Ribeirao Preto/Brazil

“SIVANTO® prime is a flexible compound which does not create any effects on predatory mites and is selective to beneficials in coffee. It is an excellent tool for integrated programs in alternation with other compounds. Besides its efficacy, we have observed an outstanding vigor-enhancing effect, especially in young plantings, giving significant growth promotion, and with that, an earlier harvest of the crop. Other products used in coffee often cause mites to flare up. We have not seen this effect with SIVANTO® prime.”

Rodolfo San Juan and Francisco Lozano, Agronomic Development, Bayer Brazil; Elias Tapia, Marketing Insecticides, Bayer Region Latin America

Growth stages

Coffee leaf miner (Leucoptera coffeella)

Foliar efficacy on Leucoptera coffeella

[Mined leaf %, Ituverava/Brazil, 2013]

Foliar efficacy (%)

20 DAB** 50 DAB** 70 DAB** 80 DAB**

Sivanto® prime 200 g a.i./ha

Chlorantraniliprole 31.5 g a.i./ha

Sivanto® prime 150 g a.i./ha

Application: 06/12/2013

Soil efficacy on Leucoptera coffeella

[Mined leaf %, Araguari/Brazil, 2012]

Soil efficacy (%)

20 DAB** 50 DAB** 70 DAB**

Sivanto® prime 400 g a.i./ha

Standard 250 g a.i./ha

Application: 30/11/2011 03/02/2012

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Growing in unison with your harvest

We are making day-to-day farm management more successful and convenient. Considering every detail – from distribution on your crops to speed of efficacy – SIVANTO® prime doesn’t leave anything to chance.

The long-lasting efficacy of SIVANTO® prime ensures long-term protection of your crops resulting in higher-quality produce at harvest.

SIVANTO® prime: finding new ways to bring out the best in your crops.
A novel formulation concept for convenient and efficient farm management

Using a unique formulation concept, SIVANTO® prime 200 SL (soluble liquid) is based on a specifically tailored emulgator system that has never been used before within the agrochemical industry.

Translaminar and xylem-systemic movement

SIVANTO® prime’s active ingredient is taken up into the leaves and stems with spray application and via the roots when applied to soil or alternative substrates. After absorption into the plant, SIVANTO® prime is translocated acropetally in the xylem, in the direction of the transpiration stream, and is translaminarily distributed into adjacent plant cells.

Due to this translaminar movement, it is successful against insects feeding on the underside, even when applied only to the topside of the leaf.

Contact, feeding and translaminar efficacy

Hard-to-reach spots and pests are no longer a problem: Compared to standard competitors, SIVANTO® prime provides very fast feeding cessation (measured by honeydew excretion) even on aphids feeding on the underside of leaves.

Foliar application: SIVANTO® prime’s systemic translocation properties distribute the active substance rapidly throughout the leaves to reach even hidden pests.

The formulation of SIVANTO® prime is easy to handle and store thanks to its improved cold stability and provides rapid solubility and good miscibility in the spray tank due to the excellent spontaneity of its formulation. After spray application the advanced retention properties result in high bioavailability of the compound and enhanced plant penetration to ensure rapid activity of the active ingredient.
The Science behind SIVANTO® Features & benefits

Systemic translocation after drench application

Days after drench application:
1 2 3 4 5 6 7 8 9 10 ... 14 ... 24

Numbers and letters indicate leaf positions: c = cotyledon | leaf 1 = oldest leaf | 12 = youngest leaf | f = flowers

Uptake and distribution of 14C-labelled (pyridinylmethyl-14C) SIVANTO® prime a.i. formulated as SL200 after soil drench application of 24 mg a.i. per plant at 80-90% water holding capacity 1 to 24 days after treatment (dat); exposition time 6 days.

Due to take-up through the roots and rapid distribution within the entire plant, SIVANTO® prime is ideal for drench applications.

Systemic translocation after foliar application

- Single droplet on center midrib of leaf 7
- Two droplets on either side of the midrib of two center private leaves
- One droplet on main stem above leaf 8

Uptake and distribution of [pyridinylmethyl-14C]-labelled FPF formulated as SL200 after defined droplet applications on different leaf parts of tomato plants grown at 50% water holding capacity 1 and 4 days after treatment (dat). White rings indicate application points; exposition time 3 days.

SIVANTO® prime’s systemic translocation properties distributes the active substance rapidly throughout the leaves to reach even hidden pests.

Mode of action

As an agonist of the insect nicotinic acetylcholine receptor (nAChR), flupyradifurone mimics the natural neurotransmitter acetylcholine.

Nerve connections in the central nervous system of insects.

Neurotransmitter release from pre-synaptic vesicles and their binding to post-synaptic nAChRs.

SIVANTO® prime binds to and opens the post-synaptic nAChR.

In contrast to the natural neurotransmitter the active substance of SIVANTO® prime cannot be inactived by the respective enzyme, causing excitation of the nerve cell. The lasting effect of the product results in a disorder of the insect nervous system and subsequent collapse.
Classification

With its unique pharmacophore system, flupyradifurone is chemically distinct from neonicotinoid insecticides and sulfoxaflor.

Flupyradifurone is an agonist of the nicotinic acetylcholine receptor (IRAC MoA Group 4). It binds to the nAChR but with a different pharmacophore than neonicotinoids (4A) and sulfoximines (4C). Thus, flupyradifurone presents little to no metabolism-based cross-resistance with neonicotinoids in target species.

However, target-site mutation-based cross-resistance affects all compounds within IRAC group 4. This results in loss of sensitivity in target pests. Therefore, a clear resistance management strategy has been developed to keep SIVANTO® prime working against neonicotinoid-resistant populations (e.g. whiteflies).

SIVANTO® prime

An innovation for sucking pest control

A modern insecticide with an excellent safety profile for the control of major sucking pests including selected neonicotinoid-resistant pest populations (e.g. whiteflies, selected aphids)

Non-hazardous to honey bees and bumblebees allowing wide application windows; an innovation for sucking pest control and treatments during flowering

Selectivity to most beneficials in fruit and outdoor grown vegetable crops provides a perfect fit for IPM programs

Fast activity leading to quick feeding cessation provides effective virus vector control

The unique butenolide chemistry even allows applications against selected neonicotinoid-resistant pest populations

Favorable crop compatibility and applications at any crop stage give full flexibility in optimizing successful and easy farm management.
Growing in Unison

SIVANTO®

www.sivanto.bayer.com

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