

Fipronil

Trade names

Adonis, Ascend, Kalas, Klap, Prince, Pyldor, Recoil, Regent, Schuss, Standak, Talstar, Termidor.

Uses

Insecticide. Broad-spectrum systemic phenylpyrazole, with slow contact and stomach action, and residual effects.

Seed treatment for rice, cotton, corn, beans, sunflowers, soybeans, wheat; foliar spray for vegetables, fruit, coffee, tea, rice, cotton, soybean and other crops; applied directly in the soil for some crops; aerially sprayed for locusts in Australia, Africa. Used for cockroach, termites and ants; fleas on pets and ticks on livestock; houseflies; pests of golf courses, commercial turf.

Widely used in India, China, Pakistan, Indonesia, Malaysia, Philippines, Japan, Iran, Iraq, US, EU, Australia, NZ and others. In 2005 BASF claimed use in over 70 countries on more than 100 crops.

Classifications and risk statements

WHO: Class II moderately hazardous.

US EPA: moderately toxic by ingestion and inhalation (Category II); low toxicity by dermal contact (Category IV); relatively non-irritating to skin (Category IV) and eye (Category III). Ecological risk: acute and chronic risks to freshwater, estuarine and marine invertebrates; direct chronic risks to fresh and saltwater fish species; acute lethal and reproductive risks to birds; reproductive risks to insectivorous mammals; acute and chronic terrestrial invertebrate risk. Metabolite fipronil-sulfone is 10 times more toxic than fipronil.

Regulatory status

International

No international regulatory action.

National

US: all outdoor applications restricted; in-furrow use for corn

and corn seed treatments banned except for export; some granular turf and residential landscape uses banned.

China: main use on rice paddy fields banned in 2009 because high toxicity to fish a problem for aquaculture; also effects on shellfish and bees.

France: suspended in 2003 because of bee deaths.

Italy: suspended use for oilseed rape, sunflower and sweetcorn in 2008, because of concern for bees.

Uruguay: banned some uses (soybean) in 2009 because of bee deaths.

International standards

On PAN International's list of Highly Hazardous Pesticides (2010) for global phase-out, because of carcinogenicity and toxicity to bees.

Manufacture

Bayer, BASF, Makhteshim Agan. Manufactured in France, China, Brazil, Colombia.

Generic versions manufactured in a number of countries, e.g. India, China, Taiwan.

Residues in food

Maize, soy, wheat, honey, tea, etc.

Health effects

Mechanism of toxicity

Disrupts nervous system through interference with the gamma-aminobutyric acid (GABA)-regulated chloride channel.

Poisonings

From 2002 to 2010 there were 4,243 reports of fipronil incidents in the US including 1 death. Most cases were residential exposure; 26% were work-related. Symptoms were neurological (50%) such as headache, dizziness, and paresthesia; eye (44%); gastrointestinal (28%); respiratory (27%); and dermal (21%). Exposures usually from inadvertent spray/splash/spill of products or inadequate ventilation before re-entry.

A survey of 100 people in one area in Madagascar following aerial spraying for locust control found



Commonly used in pest control in agriculture and on pets, fipronil is carcinogenic to both humans and animals.



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60% of them had poisoning symptoms. Self-poisoning cases have been reported from Sri Lanka.

Acute toxicity

Signs and symptoms include headache, dizziness, shaking, paresthesia, seizure, confusion, agitation, slurred speech, tingling and stiffness of hands, muscle weakness, nausea, vomiting, diarrhoea, abdominal pain, tachycardia, palpitations, fatigue, sore throat, difficulty in breathing, upper respiratory pain, cough, wheezing, skin rash, irritated and painful eyes, blurred vision.

Chronic toxicity

General: potent toxin for human liver; caused kidney damage in laboratory animals.

Neurotoxicity: can induce developmental neurotoxicity; can cause neurotoxicity even through dermal contact.

Cancer: US EPA Group C possible human carcinogen (thyroid tumours in rats).

Endocrine disruption: anti-androgenic; decreased thyroid hormone and increased thyroid stimulating hormone.

Reproductive and developmental toxicity: decreased mating, reduced litter size, reduced fertility, reduced post-implantation and offspring survival, delays in physical development, and delayed sexual development in males.

Immunotoxicity: implicated in immunological and neurological dysfunction contributing to neurodevelopmental disorders such as autism and ADHD; toxic to lymphocytic Jurkat cells.

Environmental and agroecological effects

Toxicity

Aquatic: very highly toxic to fish, with metabolite fiprone sulphate 3–6 times more toxic; impairs swimming; developmental neurotoxicity including behavioural changes. Extremely toxic to aquatic invertebrates; very highly toxic to shrimps; highly toxic to oysters. Aerial spraying to control locusts in Madagascar caused massive shrimp kills. Use in rice seed treatment caused massive crawfish kills in USA when the rice field tailwater was released into canals and used to irrigate fish ponds.

Birds: highly toxic to grain-eating birds, low toxicity to some other

birds such as ducks. Birds are exposed by eating treated seeds and contaminated insects (fipronil-contaminated locusts can remain alive for 7–10 days). Sublethal effects include loss of appetite and thirst, loss of weight, withdrawn, reduced responses. Transferred to eggs from fipronil-exposed females, severely reducing hatching and causing under-development in surviving chicks. Causes behavioural and developmental abnormalities.

Terrestrial invertebrates: aerial spraying in Madagascar resulted in 80–95% destruction of termite colonies, a key part of nutrient recycling and the food web; their destruction resulted in significant decline in two insectivorous reptiles.

Mammals: adverse reactions in pets treated for flea control, including severe dermal reactions.

Agroecological disruption

Bees: highly toxic; residues found in bees, hives, honey; impairs olfactory learning, gustatory perception, motor function, and causes disorientation; detected in depopulated hives in Uruguay.

Beneficials: toxic to predatory mites, predatory bugs and parasitoids; reduces prey consumption and reproductive success; recolonisation of nontarget insects very slow after use of fipronil. Toxic to the beneficial fungi *Beauveria bassiana* and *Metarhizium anisopliae* used in biological control.

Resistance: In 10 species, including brown planthopper and white-backed planthopper in rice, and sweet potato whitefly and western flower thrips in cotton.

Environmental fate and contamination

Soil: binds to soil; persistent under field conditions with half life of over 210 days when applied to soil furrows in US, and still detected after 16 months; metabolites are more persistent.

Aquatic: run-off from field uses to water sources is highly likely; increasingly found in aquatic ecosystems, including in urban areas; persists in aquatic sediments; potential groundwater contaminant.

Bioaccumulation: accumulates in fish with a bioconcentration factor up to 575; bioaccumulates in aquatic arthropods but varies greatly with species.

Other: half-life on treated surfaces is 3–7 months; residues on vegetation

last longer than 3 weeks; residues found in houses (floor wipes).

Alternatives

Numerous cultural, mechanical and biological solutions to pest control, as well as natural sprays can be used instead of fipronil, depending on pest and situation.

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