Paraquat

Paraquat splashes can cause eye irritation, eye inflammation, blurred vision and blindness

Pesticide Action Network Asia and the Pacific

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Trade names

Gramoxone and many others.

Uses

Herbicide. Fast-acting, non-selective, contact herbicide absorbed by foliage. Used for broad-leaved weeds and grasses in more than 100 crops, especially oil palm, banana and tea plantations. Also used as a pre-harvest defoliant. Used as alternative to Roundup in GM crops with glyphosate-resistant weeds. Most use is in developing countries where conditions of use (hot, humid, lack of protective clothing, leaking knapsack sprayers, lack of washing and medical facilities, lack of control over workplace, repeated use) make it particularly hazardous.

Classifications and risk statements

WHO: Class II moderately hazardous.

Regulatory status

International

Formulations containing 20% paraquat or more have been recommended by the Chemical Review Committee of the Rotterdam Convention on Prior Informed Consent (PIC) for inclusion in the Convention; to be decided by the Conference of the Parties in 2013. 16 countries (and the EU as a whole) have notified the Secretariat of bans and restrictions.

National

Banned in 36 countries: Bosnia & Herzegovina, Cambodia, Ivory Coast, Kuwait, Norway, Sri Lanka, Switzerland, Syria, United Arab Emirates; and all countries of the European Union (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom). Malaysia banned it in 2002 and then reversed the ban in 2006 due to industry pressure.

Restricted in Belize, Chile, Columbia, Costa Rica, Fiji, Indonesia, Philippines, Saudi Arabia, South Korea, Uruguay, USA.

Ban or restrictions being considered in China.

International Standards

On PAN International's Dirty Dozen (1985) and list of Highly Hazardous Pesticides (2010) for global phase-out because of acute toxicity.

Use prohibited by a number of non-regulatory organisations including UTZ coffee certification, Rainforest Alliance (banana, coffee, cacao, citrus), Fairtrade labelling Organisation, Common Code for Coffee Community, Forest Stewardship Council, ProTerra, World Bank, Dole, Chiquita.

Manufacture

Syngenta, and others. China is biggest producer.

Health effects

Poisonings

Highly acutely toxic by swallowing, absorption through damaged skin, or by inhalation. Thousands have died from ingestion (mainly suicide) or dermal exposure (mainly occupational). A teaspoon of paraquat concentrate can cause death. Paraquat is corrosive to the skin and is easily absorbed once the skin is damaged. A farmer died after 3.5 hours spraying diluted paraquat with a leaking knapsack.

Others have died from spilling the concentrate on their skin.

Thousands have suffered severe acute and chronic effects from occupational use. In Burkina Faso, Gramoxone Super was responsible for 20% of 296 poisoning incidences from field applications.

Death is by respiratory failure and may occur within a few days after poisoning or up to a month later.

There is no antidote. Paraquat damages the lungs, heart, kidneys, adrenal glands, central nervous system, liver, muscles and spleen, causing multi-organ failure.

When paraquat has been banned or severely restricted deaths from suicides dropped dramatically.

Acute toxicity

WHO classifies paraquat as Class II, moderately hazardous; but PAN believes it should be Class I because of its acute toxicity, delayed effects and lack of antidote.

Symptoms include acute respiratory distress, shortness of breath and rapid heartbeat; loss of appetite, abdominal pain, thirst, nausea, vomiting, and diarrhoea; giddiness, headache, fever, muscle pain, and lethargy; burns to the mouth, nosebleeds, skin fissures, peeling, burns and blistering; eye injuries; and nail damage including discolouration and temporary nail loss.

Crosses, and accumulates in, the placenta, and can cause acute poisoning including death of the foetus or chronic effects that can persist for the lifetime.

Chronic toxicity

General: damages the mitochondria of cells through the production of free radicals and oxidative stress, causing interruption of important biochemical processes and causing cell death.

Neurotoxicity: a neurotoxicant. Exposure, even to relatively low doses, during critical periods in childhood may adversely affect the development of brain functions. Likely to cause the onset, and/or accelerate the development, of Parkinson's disease; the longer the exposure the greater the risk; there may be a lag time between exposure and development of symptoms; and early exposures are the most damaging. The unborn foetus and children are most at risk.

Cancer: regulators state paraquat is not carcinogenic, despite it causing nasal and squamous cell carcinomas in rats; but there are a considerable number of independent studies showing it to be genotoxic, and some epidemiological evidence linking it to cancer, especially skin cancer.

Endocrine disruption: it decreases testosterone, follicle-stimulating hormone, luteinizing hormone and prolactin in male rats. One epidemiological study linked paraquat exposure to hypothyroidism.

Reproductive and developmental toxicity: regulators conclude paraquat does not cause reproductive effects or birth defects. Independent studies show it can cause reproductive problems in rodents and hens; and birth defects in rodents and frogs, prompting some scientists to state that it should be classified as a teratogen. An epidemiological study has linked congenital malformations in children with paternal exposure to paraquat.

Immunotoxicity: evidence of effects on the immune system.

Metabolic effects: may be implicated in type II diabetes.

Sensitive populations

People with impaired pulmonary function or selenium-deficient diets; and children.

Environmental and agroecological effects

Toxicity

Extremely biologically active and toxic to plants and animals.

Aquatic: very ecotoxic to the aquatic environment. Causes teratogenic malformations in fish and amphibia, disrupted hormones in frogs, and is genotoxic in tadpoles. Amphibia are at risk through residues in plants, reduction in food sources and habitat, spray drift from up to 300m away, and downstream transport of paraquat in sediment. Aquatic plants can concentrate high levels of paraquat. Planktonic algae are very sensitive to paraquat and it can cause significant ecological disturbances in freshwater ecosystems through alterations in species composition, potentially resulting in loss of biodiversity, harmful algal blooms, disease, and decline in fisheries.

Birds: moderately toxic to birds; can affect reproduction or hatchability of eggs when adult birds are exposed; causes endocrine disruption in birds.

Mammals: freshly sprayed foliage kills rabbits and hares. Poisoning incidents include fish, dogs, hares, cattle, sheep; deliberate poisonings of dogs.

Agroecological disruption

Soil organisms: toxic to some soil fungi and bacteria, and increases populations of some soil pathogens.

Resistance: 22 different species of weeds in 13 countries have become resistant to paraquat.

Environmental fate and contamination

Soil: binds strongly to soil particles and tends to remain strongly bound for a long time in an inactive state, although it can also desorb again and become biologically active; half-life in soil can be up to 20 years.

Aquatic: in water it is adsorbed on to particles and sediment, with a half-life under mid-European conditions estimated to be between 2 and 820 years depending on sunlight and depth of water. It has been found in surface waters, drinking water, and in groundwater although it is generally believed to be immobile in the soil and not to leach to groundwater.

Alternatives

Numerous design, management, mechanical and cultivational practices, as well as some plant extracts, can be used instead of paraquat, depending on the weed species and the situation.

Further Information

- Paraquat Monograph, PANAP: http://www.panap.net/system/files/monograph_paraquat.pdf
- Berne Declaration: http://www.stop-paraquat.net