OPERATION OF THE PRIOR INFORMED
CONSENT PROCEDURE FOR BANNED
OR SEVERELY RESTRICTED CHEMICALS
IN INTERNATIONAL TRADE

DECISION GUIDANCE DOCUMENTS

Chlordane

JOINT FAO/UNEP PROGRAMME
FOR THE OPERATION OF
PRIOR INFORMED CONSENT

United Nations Environment Programme

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Food and Agriculture Organization of the United Nations
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DISCLAIMER

The inclusion of these chemicals in the Prior Informed Consent Procedure is based on reports of control action submitted to the United Nations Environment Programme (UNEP) by participating countries, and which are presently listed in the UNEP-International Register of Potentially Toxic Chemicals (IRPTC) database on Prior Informed Consent. While recognizing that these reports from countries are subject to confirmation, the FAO/UNEP Joint Working Group of Experts on Prior Informed Consent has recommended that these chemicals be included in the Procedure. The status of these chemicals will be reconsidered on the basis of such new notifications as may be made by participating countries from time to time.

The use of trade names in this document is primarily intended to facilitate the correct identification of the chemical. It is not intended to imply approval or disapproval of any particular company. As it is not possible to include all trade names presently in use, only a number of commonly used and published trade names have been included here.

This document is intended to serve as a guide and to assist authorities in making a sound decision on whether to continue to import, or to prohibit import, of these chemicals because of health or environmental reasons. While the information provided is believed to be accurate according to data available at the time of preparation of this Decision Guidance Document, FAO and UNEP disclaim any responsibility for omissions or any consequences that may flow therefrom. Neither FAO or UNEP, nor any member of the FAO/UNEP Joint Group of Experts shall be liable for any injury, loss, damage or prejudice of any kind that may be suffered as a result of importing or prohibiting the import of these chemicals.

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ABBREVIATIONS WHICH MAY BE USED IN THIS DOCUMENT

(N.B. : chemical elements and pesticides are not included in this list)

ADI	acceptable daily intake
ai	active ingredient
b.p.	boiling point
bw	body weight
°C	degree Celsius (centigrade)
CCPR	Codex Committee on Pesticide Residues
DNA	Designated National Authority
EC	emulsion concentrate
EEC	European Economic Community
EPA	U.S. Environmental Protection Agency
ERL	extraneous residue limit
FAO	Food and Agriculture Organization of the United Nations
g	gram
µg	microgram
GAP	good agricultural practice
GL	guideline level
ha	hectare
IARC	International Agency for Research on Cancer
i.m.	intramuscular
i.p.	intraperitoneal
IPCS	International Programme on Chemical Safety
IRPTC	International Register of Potentially Toxic Chemicals
JMPR	Joint FAO/WHO Meeting on Pesticide Residues (Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and a WHO Expert Group on Pesticide Residues)
k	kilo- (x 103)
kg	kilogram
l	litre
LC_{50}	lethal concentration, 50%
LD_{50}	lethal dose, median

m	metre
mg	milligram
ml	millilitre
m.p.	melting point
MRL	Maximum Residue Limit.
MTD	maximum tolerated dose
ng	nanogram
NOEL	no-observed-effect level
NOAEL	no-observed-adverse-effect level
NS	Not Stated
OP	organophosphorus pesticide
PHI	pre-harvest interval
ppb	parts per billion
ppm	parts per million (Used only in reference to the concentration of a pesticide in an experimental diet. In all other contexts the terms mg/kg or mg/l are used).
ppt	parts per trillion
sp gr	specific gravity
STEL	Short Term Exposure Limit
TADI	Temporary Acceptable Daily Intake
TLV	Threshold Limit Value
TMDI	theoretical maximum daily intake
TMRL	Temporary Maximum Residue Limit
TWA	Time Weighted Average
UNEP	United Nations Environment Programme
WHO	World Health Organization
WP	wettable powder
wt	weight
<	less than
<<	much less than
$\leq$	less than or equal to
>	greater than
$\geq$	greater than or equal to

CHLORDANE

PRIOR INFORMED CONSENT
DECISION GUIDANCE DOCUMENT

1. IDENTIFICATION

1.1 Common Name: Chlordane

1.2 Chemical Type: Chlorinated cyclodiene

1.3 Use: Pesticide (insecticide)

1.4 Chemical Name: 1,2,4,5,6,7,8,8-octachloro-2,3,3a, 4,7,7a-hexahydro-4,7-methanoindene

1.5 CAS No.: 57-47-9

1.6 Trade Names/Synonyms: M-410, Chlor-Kil, Chlorotox, Corodane, Gold Crest C-100, Kilex, Kypchlor, Octachlor, Octa-Klor, Synklor, Topiclor 20, Chlordan, Prentox, Penticklor (Discontinued names: Aspon-chlordane, Ortho-Klor, Niran, Termi-Ded, Velsicol 1068, Gold Crest C-50, Belt)

1.7 Mode of Action: Persistent, non-systemic contact and stomach insecticide with some fungicidal activity

1.8 Formulation Types: Dusts (50-100 g/kg), emulsifiable concentrates (480-960 g/l), granular (50-330 g/kg), oil solutions (300 g/l), wettable powders (250-400 g/kg)

1.9 Basic Producer: Velsicol Chemical Corp. (USA), Northwest Industries, Inc. (USA), Sandoz Crop Protection Corp. (USA)

2. SUMMARY OF CONTROL ACTIONS

2.1 General: Control actions to ban or severely restrict chlordane have been taken by at least 35 countries beginning as early as 1968. In at least 23, chlordane has been completely banned, and in 12 others it is severely restricted. Specific actions reported by governments are summarized in Annex 1.

2.2 Reasons for the Control Action: Control actions have been taken for various reasons including: chlordane's persistence and bioaccumulation in the environment, with potential adverse effects on man and the environment because of continuing long-term exposure through water, food and other sources. Of particular concern is its demonstrated carcinogenic response in laboratory rodents and its potential impact on human health from widespread environmental contamination in the food chain.

2.3 Uses Banned: In most countries uses have been banned, particularly outdoor uses and general use in agriculture. In those countries that have restrictions, uses are limited to structural subterranean termite and soil pest control by public health or professional applicators only (see Annex 1) .

2.4 Uses Reported to be Continued in Effect: Most, if not all temperate climate countries do not use chlordane in any agricultural or widespread outdoor applications. In those countries, where uses are continued, the product is restricted to structural termite control and wood treatment. In tropical and subtropical countries that have retained seed treatment or pre-planting agricultural uses, chlordane is restricted to crops that form the edible portions above the ground and, in particular, to crops with longer growing seasons and that are not direct-to-table foods. Several countries have reported that uses have been restricted to structural pest control only (Belize, Canada and Cyprus). Chlordane's use as a seed dressing is reportedly permitted in one country only (China). Although wood treatment use has been retained by many countries, according to the manufacturer, no country reported this as an active use. See Annex 1.

2.5 Alternatives: Although many alternatives are known to be used, no specific alternative pesticide-use combinations have been suggested by countries taking control actions. For example, in the USA chlorpyrifos is one pesticide used to replace the termiticide use of chlordane. Many alternatives are more acutely toxic to humans than chlordane.

2.6 Contacts for Further Information: FAO/UNEP Joint Data Base, IRPTC Geneva; Designated National Authorities in countries taking control actions.

3. SUMMARY OF FURTHER INFORMATION ON CHLORDANE

3.1 Chemical and Physical Properties: Technical chlordane is a mixture of chlorinated hydrocarbons consisting of isomers of chlordane and closely related compounds and by-products. The approximate composition of technical chlordane is as follows: trans-chlordane (24%), cis-chlordane (19%), chlordene isomers (22%), heptachlor (10%), nonachlor (7%), miscellaneous constituents (19%). It is a viscous amber-coloured liquid, stable toward acid, insoluble in water, but miscible with aliphatic and aromatic hydrocarbon solvents, including deodorized kerosene. Chlordane loses its chlorine in the presence of alkali. Technical chlordane has a cedar-like odour.

3.2 Toxicological Characteristics:

3.2.1 Acute Toxicity: Oral LD_{50} (rat), 335-430 mg/kg; dermal LD_{50} (rat), 690 mg/kg (females), 840 mg/kg (males); inhalation LC_{50} (rat), greater than 200 mg/kg. WHO Classification: ai: Class II - moderately hazardous.

Formulations: 4EC (dermal, rabbit) LD_{50} > 2 g/kg; 45% in Petroleum Distillate (50%) (dermal, rabbit) LD_{50}, > 2 g/kg - moderately hazardous (Class II).

3.2.2 Short-term Toxicity: Subchronic feeding studies in rats and mice, administered chlordane or oxychlordane, demonstrated degenerative effects on the liver such as endoplasmic

reticulum hypertrophy, enlarged central hepatic lobule cells, and increased liver weight. These degenerative changes in liver are known as "chlorinated hydrocarbon insecticide rodent liver" (CHIRL). These effects were evident after nine months in rats administered 2.5 ppm chlordane in the diet.

In 90-day inhalation studies, chlordane elicited liver alterations in rats at 1 μg/l, but in monkeys similarly exposed there were no adverse effects at doses up to and including 10 μg/l. Reportedly, these liver alterations returned to normal after cessation of treatment.

3.2.3 Chronic Toxicity: Based on available rodent (rat, mouse) and dog feeding studies, the principal chronic effects were observed in the liver, including increased liver weight, hepatocellular swelling and necrosis, and fatty degeneration. NOEL: rat, 1 ppm (0.05 mg/kg bw); mouse, 1 ppm (0.12 mg/kg bw); dog, 3 ppm (0.075 mg/kg bw).

JMPR ADI: 0-0.0005 mg/kg bw. Baboons were administered 0.1 to 1.0 mg/kg bw chlordane in the diet for 24 months. Animals were maintained on a high cholesterol, high saturated fat diet. These dose levels did not significantly alter serum lipoprotein levels or the rate of atherogenesis. Chlordane is carcinogenic in mice (hepatocellular adenomas/carcinomas); IARC concluded there is "sufficient evidence" that chlordane is carcinogenic in mice, and "limited evidence" that chlordane is carcinogenic in experimental animals. Overall IARC placed chlordane in Group 3, "cannot be classified according to carcinogenicity in humans". The US Environmental Protection Agency has classified chlordane a Group B2 "probable" human carcinogen, because of benign and malignant liver tumours in four strains of mice of both sexes and in F344 male rats.

3.2.4 Epidemiological Studies:

Non-fatal: A 15-month-old, 9 kg child drank no more than a mouthful of an aqueous suspension of a 50% wettable powder. The dose was about 10 mg/kg. After three hours a generalized tremor developed followed by convulsions.

An 18-year-old girl (50 kg) accidentally swallowed a teaspoonful of insecticide containing 40% agricultural grade chlordane. Realizing her mistake she ate bread and drank milk. She vomited twice in the next four hours. She was treated in a hospital for severe convulsions. Five days after admission she was released. Two months later a normal EEG and visual exam showed no permanent neurological disorder.

Fatal Cases: A child's room had been sprayed by an exterminator with insecticides containing organophosphate and chlordane. The child was eight-and-a-half months old and weighed 10 kg. Symptoms developed shortly and death followed four days after exposure.

A woman half-filled an 8 oz glass with toxichlor dust (58% chlordane with talc), added water and swallowed it. She died nine days later. She had ingested 6 g of chlordane (104 mg/kg).

A young woman spilled 100 ml of 25% chlordane solution on her dress. She died within 40 minutes. The dose of chlordane was 30 g.

Two patients died from low oral doses of chlordane (2-4 g); both showed fatty degeneration of the liver by microscopic examination. Both patients had characteristics of alcoholism.

An alcoholic was deloused with a skin application of 500 cc of a 2% chlordane/oil solution. He had a generalized eczema which aided absorption. Impaired liver function associated with alcoholism probably increased the chlordane toxicity. Death followed shortly after application. The estimated dose was 10 g of chlordane.

3.3 Environmental Characteristics:

Fate: The half-life of chlordane in soil when used at agricultural rates is approximately one year. Chlordane is relatively immobile in the environment and not expected to leach since it is insoluble in water. Degradation of chlordane is variable, depending upon the type of application (i.e. surface vs. subterranean) and climate (i.e. temperate vs. tropical/subtropical). Chlordane has been found in a wide variety of agricultural soils where it had not been used for at least five years. Soil drench treatments in three different types of soil in Hawaii demonstrated that 2.3%, 2.9% and 2.4% of the applied dosage of chlordane were present in coral, sandy loam, and clay soils, respectively, seven years later. Studies in the U.S. demonstrate that in sandy loam soil, 15-40% of the applied chlordane was present for up to 14 years. In Florida, soil surface applications demonstrated a half-life of 2772 days, with all the residues within the upper 2.5 cm of soil. Chlordane applied to the surface of a lake resulted in levels declining from 5.5 ppb after seven days to 0.11 ppb after 421 days. Sediment from the lake showed concentrations of 30 ppb at 279 days, declining to 10 ppb 421 days after application.

Human half-life data have shown a whole body half-life of the absorbed dose of 21 days in a young boy, and a serum half-life of 88 days in a four-year-old girl. Both exposures resulted from accidental ingestion. Half-life in rats is 23 days following repeated exposure for 56 days.

Effects: Highly toxic to freshwater fish, aquatic invertebrates, and birds; 96 hr LC_{50} from 42 to 90 μg/L in rainbow trout, 57 to 74.8 μg/l in bluegill: LC_{50} in mallard duck, 858 ppm, in bobwhite quail, 331 ppm, and in pheasant, 430 pm. The biomagnification of chlordane in the environment in such organisms as algae, as well as its low water solubility and persistence in water sediment, can result in bioaccumulation in exposed organisms and possible biomagnification in the food chain.

3.4 Exposure:

3.4.1 Food: Since virtually all agricultural food uses have been banned or severely restricted, exposure via food is continually declining. Extraneous Residue Limits (ERLs) have replaced previous MRLs to reflect this change in use pattern.

3.4.2 Occupational/Use: Dermal and inhalation routes are likely routes of exposure from occupational uses. 0.15 mg/m^3 is the recommended threshold limit value-time weighted-average (TLV-TWA) for chlordane in workroom air. A 15-minute exposure of 2 mg/m^3 has been recommended. Airborne chlordane in houses treated for termites should not exceed 5 μg/m .

3.4.3 Environment: Low levels have been reported in air samples (< 1 ng/m^3) and in precipitation (i.e. rain, snow), ppt (ng/L). Higher levels have been reported in river and stream bed sediment (μg/kg).

3.4.4 Accidental Poisoning:

Acute symptoms: central nervous system effects (headache, blurred vision, dizziness, slight involuntary muscular movements, tremor, sweating, insomnia, nausea, and general malaise).

Severe poisoning: as in acute, plus epileptiform convulsions, loss of consciousness, urinary and faecal incontinence, disorientation, personality changes, psychic disturbances, and loss of memory. Encephalographic patterns are abnormal.

Antidote/First Aid: Treatment is symptomatic; use of gastric lavage and parenteral phenobarbital has resulted in reversal of the neurological signs. Drugs useful to control convulsions include: diazepam, lorazepam, barbiturates, and muscle-paralysing agents such as succinylcholine. Benzodiazepine drugs are currently the preferred anticonvulsants. Cholestyramine resin accelerates biliary-faecal excretion.

3.5 Measures to Reduce Exposure:

Handling: In handling chlordane or its formulations care should be exercised to avoid skin contact, inhalation of dusts or mists and ingestion. Protective gloves, overalls and boots should be water-resistant; an approved respirator should be worn for application in enclosed areas such as crawl spaces. Mixers/loaders should wear goggles or a face shield as well when mixing, loading or handling the concentrate.

Exposure of the general public through food, water and air has been significantly reduced or eliminated following the banned and restricted use control measures. Avoid applying chlordane in or around poultry houses, barns, silos, milk houses, or other structures or enclosures where livestock or poultry are held, or where food/feed is stored, prepared or processed. Chlordane should not be applied to any crop when edible portions are present or to soil which will be planted with crops whose edible portion in or on the ground.

Exposure of fish and aquatic organisms may be reduced by avoiding spraying near or over water bodies or by restricting or banning uses posing hazards of water contamination.

Effluents from manufacturing, formulating, storage and equipment cleaning operation should be controlled to avoid water contamination.

3.6 Packaging and Labelling: Follow FAO Guidelines on Good Labelling Practice for Pesticides and Guidelines for the Packaging and Storage of Pesticides.

3.7 Waste Disposal Methods: Guidelines are under development. This section will be updated when guidelines are available.

3.8 Maximum Residue Limits (mg/kg):

JMPR/Codex Alimentarius: Codex has changed designation of limits for all commodities from MRLS (Maximum Residue Levels) to ERLs (Extraneous Residue Limits), recognizing the widespread banning of uses in agriculture and that most residues would be the result of previously authorized uses. Current ERL levels (in mg/kg) are: almonds, cotton seed oil (edible), eggs, fruits and vegetables, hazelnuts, maize, oats, pecan, rice (polished), rye, sorghum, soya bean oil (refined), walnuts, and wheat, 0.02; in cotton seed oil (crude), linseed oil (crude), meat, poultry meat, and soya bean oil (crude), 0.05; and in milks, 0.002.

EEC: all levels are 0.02 mg/kg.

USA: all tolerances revoked. Action Levels recommended, 0.1 ppm for all previous tolerances.

Some countries are reducing or revoking national limits to cover only environmental residues from previous uses. Food exporting countries using chlordane should consider the MRLs in their market countries in making decisions on continued use of chlordane.

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ANNEX 1
SUMMARY OF CONTROL ACTIONS AND REMAINING USES FOR CHLORDANE
AS REPORTED BY COUNTRIES

BANNED:

Bulgaria	(NS)	Banned as agricultural chemical.
Ecuador	(1985)	Banned as agricultural chemical
EEC-countries *	(1988)	Banned as agricultural chemical.
Japan	(1971)	Banned as ingredient in pesticides.
Kenya	(1987)	Banned as agricultural chemical.
Liechtenstein	(NS)	Banned.
Panama	(1987)	Banned as agricultural chemical.
Republic of Korea	(1986)	Banned.
Singapore	(1984)	Banned.
Sweden	(1971)	Banned.
Switzerland	(1986)	Banned.
Yugoslavia	(1972)	Banned as agricultural chemical.

WITHDRAWN:

None reported.

SEVERELY RESTRICTED:

Dominica (NS) Severely restricted pesticide.

Mexico (1988) Pesticide of restricted agricultural use for maize and sorghum.

Only remaining uses allowed:

Belize (NS) Sub-surface application only, for termite control.

Canada (1985) All uses, except essential restricted use for subterranean termites, were suspended.

Colombia (1988) Temporary use solely for treatment of timber accepted.

Cyprus (1980) Severely restricted to termite control, for underground application in non-agricultural land or premises.

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* **EEC-countries** - Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and United Kingdom.

USA (1978) All uses cancelled except subsurface ground insertion for termite control (to apply to the use of emulsifiable or oil concentrate formulations, for controlling subterranean termites on structural sites such as buildings, houses, barns and sheds) and dipping of roots or tops of non-food plants.

Venezuela (1983) Only permitted when intended for control of vectors for medical reasons by Ministry of Health, control of agricultural pests by Ministry of Agriculture, control of *Atta* sp. and other ants, exclusively with granulated formulations of aldrin and chlordane applied directly to the soil and control of termites in formulations containing aldrin and chlordane.

Specific uses reported as not allowed:

Argentina (1969/72) Prohibited for use on cattle, sheep, goats, swine and horses (1969) and for use as antiweevil agent on seeds and their products intended for human or animal consumption (1972).

Chile (1983) Not allowed on natural or artificial meal directly or in concentrated form as animal feed. Prohibited on seeds, grain, etc.

China (1982) Prohibited for use on fruit trees, tea, vegetables, herbs, tobacco, coffee and pepper. Only permitted for seed dressing and underground insect control.

Use permitted only with special authorization:

Japan (1986) Manufacture and import prohibited without authorization by the Government. Uses other than those specified by Cabinet order are prohibited. Import of specified products containing this substance are prohibited.

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