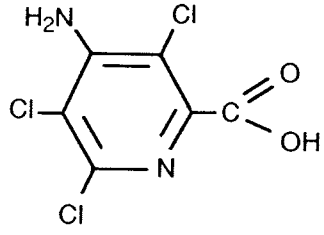
PICLORAM

1. Exposure Data

1.1 Chemical and physical data

1.1.1 *Synonyms, structural and molecular data*

Chem. Abstr. Serv. Reg. No.: 1918-02-1
Chem. Abstr. Name: 2-Pyridinecarboxylic acid, 4-amino-3,5,6-trichloro-
IUPAC Systematic Name: 4-Amino-3,5,6-trichloropyridine-2-carboxylic acid
Synonyms: 4-Aminotrichloropicolinic acid; 4-amino-3,5,6-trichloropicolinic acid; ATCP; picolinic acid, 4-amino-3,5,6-trichloro; 3,5,6-trichloro-4-aminopicolinic acid



$C_6H_3Cl_3N_2O_2$ Mol. wt: 241.46

1.1.2 *Chemical and physical properties*

(*a*) *Description*: Colourless crystals with a chlorine-like odour (Royal Society of Chemistry, 1989)

(*b*) *Melting-point*: Decomposes at 215°C (Royal Society of Chemistry, 1989; Meister, 1990)

(*c*) *Solubility*: Slightly soluble (at 25°C) in water (0.43 g/l), dichloromethane (0.6 g/l), acetonitrile (1.6 g/l), diethyl ether (1.2 g/l) and benzene (0.2 g/l); moderately soluble (at 25°C) in acetone (19.8 g/l), isopropanol (5.5 g/l), ethanol (10.5 g/l) and methanol (18.5 g/l); very slightly soluble (at 25°C) in carbon disulfide (< 0.05 g/l) and kerosene (0.01 g/l) (US Environmental Protection Agency, 1988a; Royal Society of Chemistry, 1989)

(*d*) *Vapour pressure*: 6.16×10^{-7} mm Hg [0.82×10^{-7} kPa] at 35°C (Budavari, 1989)

(*e*) *Stability*: In aqueous solutions, decomposed by ultraviolet irradiation (Royal Society of Chemistry, 1989) but stable to hydrolysis (US Environmental Protection Agency, 1988b); very stable to acidic and basic media, but decomposed by hot concentrated alkalis; readily forms water-soluble alkali-metal and amine salts (Royal Society of Chemistry, 1989).

(f) Conversion factor for airborne concentrations[1]: $mg/m^3 = 9.88 \times ppm$

1.1.3 *Trade names, technical products and impurities*

The trade name is Tordon.

Picloram is available as granules and as soluble concentrates (Worthing & Walker, 1987; Royal Society of Chemistry, 1989). In the USA, it is formulated as the potassium, triisopropanolamine and triethylamine salts and as the isooctyl ester, either as pellets or as soluble concentrates in water (US Environmental Protection Agency, 1988b).

Picloram is compatible with many other herbicides and with fertilizers (Royal Society of Chemistry, 1989). It is formulated in combination with 2,4-D (see IARC, 1987a), 2,4,5-T (see IARC, 1987a), triclopyr(2-butoxyethyl), amitrole (see IARC, 1987b), atrazine (see monograph, p. 441), simazine (see monograph, p. 495), bromacil, dalapon, diuron, tebuthiuron, MCPA (see IARC, 1987a) and mecoprop (see IARC, 1986) (Royal Society of Chemistry, 1986; Worthing & Walker, 1987; Anon., 1989a).

The US Environmental Protection Agency (1988b) has limited the level of hexachlorobenzene (see IARC, 1987c) contamination in technical-grade picloram to a maximum of 200 ppm (mg/kg) and the level of nitrosamines, a potential contaminant of the triethylamine and triisopropanolamine forms of picloram, to a maximum of 1 ppm (mg/kg).

1.1.4 *Analysis*

Selected methods for the analysis of picloram in various matrices are given in Table 1.

Table 1. Methods for the analysis of picloram

Sample matrix	Sample preparation	Assay procedure[a]	Limit of detection	Reference
Water	Adjust to pH 12; wash with dichloromethane; acidify; extract with ethyl ether; derivatize with diazomethane	GC/ECD	0.14 µg/l	US Environmental Protection Agency (1989)
Soil	Extract with potassium chloride/potassium hydroxide solution; acidify; saturate with sodium chloride and equilibrate with ethyl ether; clean-up on an alumina column	GC/ECD	5 ppb (µg/kg)	US Food and Drug Administration (1989a)
Milk	Extract with ethyl ether; clean-up on basic alumina column; partition residues from aqueous bicarbonate into ethyl ether; methylate residue; analyse	GC/ECD	0.05 ppm (mg/l)	US Food and Drug Administration (1989b)
Formulations	Acidify in acetone; exchange solvent to dimethylformamide	IR	Not reported	Ramsey (1967)

[1]Calculated from: mg/m^3 = (molecular weight/24.45) × ppm, assuming standard temperature (25°C) and pressure (760 mm Hg [101.3 kPa])

Table 1 (contd)

Sample matrix	Sample preparation	Assay procedure[a]	Limit of detection	Reference
Crop samples	Extract with sodium hydroxide; acidify; treat with potassium permanganate; extract with ethyl ether; clean-up on a buffered celite column; methylate with diazomethane	GC/ECD	0.05 ppm (mg/kg)	US Food and Drug Administration (1989c)
Animal tissues	Extract with methanol/sodium carbonate; acidify; extract with ethyl ether; clean-up on an alumina column; treat further with potassium permanganate (liver); methylate with diazomethane	GC/ECD	0.005 ppm (mg/kg)	US Food and Drug Administration (1989d)

[a]Abbreviations: GC/ECD, gas chromatograph/electron capture detector; IR, infra-red spectrometry

1.2 Production and use

1.2.1 *Production*

Picloram was first introduced into commercial production in 1963. It is synthesized from α-picoline by successive chlorination, amination and hydrolysis (Ramsey, 1967).

The annual worldwide production of picloram from 1969 to the present has been 400-1600 tonnes per year. In 1981, it was estimated that 1000-1300 tonnes were produced in the USA, of which 630-850 tonnes were exported (Schutte, 1982). It is currently produced in the USA (Meister, 1990).

1.2.2 *Use*

Picloram is a systemic herbicide that is absorbed rapidly by roots and leaves and accumulates in new growth. It is used for the control of most annual and perennial broad-leaved weeds (except crucifers), including woody weeds, bracken, ferns and docks on grassland and non-crop areas. Most grasses are resistant to picloram, but seedling grasses may be susceptible (Worthing & Walker, 1987; Royal Society of Chemistry, 1989). Picloram is used alone or in combination with 2,4-D against deep-rooted perennials on non-crop land and in combination with 2,4-D or 2,4,5-T for brush control (Worthing & Walker, 1987).

Picloram may also be used for annual broadleaf weed control in spring and winter wheat, oats and barley; for perennial broadleaf weed control in fallow grainland; and for broadleaf annual and perennial weed control in rangeland and permanent grass pasture (Anon., 1989b).

In the USA, the potassium and triisopropanolamine salts of picloram are approved for food crop use on small grains, pastures and rangeland grasses; for use on noncrop areas and rights-of-way; and for forestry use. The triethylamine salt is approved for crop use on pastures and rangelands, and the isooctyl ester is approved for noncrop use on industrial sites and rights-of-way and for forestry use (US Environmental Protection Agency, 1988b).

A product available in the USA containing picloram and 2,4-D is applied to cut tree surfaces to kill unwanted growth (Anon., 1989b).

In the USA in 1981, it was estimated that yearly usage of picloram (active ingredient) was as follows (tonnes): utility rights-of-way, 130-160; rangeland, 100-120; forest site preparation, 70-90; pastures, 65-80; wheat, 4-5 (Schutte, 1982). By 1987, the amount used on pasture and rangeland had approximately doubled (270-410 tonnes) (Eckerman, 1987).

1.3 Occurrence

1.3.1 *Water*

Picloram was found in 420 of 744 surface water samples collected from 135 locations and in three of 64 groundwater samples collected from 30 locations. It was found in seven states of the USA. Levels (85th percentile) of 0.13 μg/l in surface water and 0.02 μg/l in groundwater were found in all positive samples; the maximal concentration found in surface water was 4.6 μg/l and that in groundwater, 0.02 μg/l (US Environmental Protection Agency, 1988c).

1.3.2 *Soil*

The main degradation pathways of picloram in the environment are photolysis and microbial degradation in aerobic soil. Field tests in Texas (USA) using a liquid formulation of picloram indicated that approximately 74% of the picloram in the test ecosystem, which contained soil, water and vegetation, was dissipated 28 days after application (Scifres *et al.*, 1977). In New Zealand, within 12 months after aerial application of 1.1 kg/ha picloram, residues in soil had fallen to 'safe levels' in 65% of locations sampled; the figure rose to 75% after 14 months (MacDiarmid, 1975).

Laboratory studies indicate that, under aerobic soil conditions, the half-time of picloram is dependent on the concentration applied and the temperature and the moisture of the soil. The major metabolite is carbon dioxide, other metabolites being present in insignificant amounts (Meikle *et al.*, 1974). Under anaerobic conditions in soil and aquatic media, picloram degrades extremely slowly in the absence of light (US Environmental Protection Agency, 1988c).

Picloram does not usually persist in soil after normal agricultural, forestry and industrial applications. In the field, picloram dissipates at a faster rate in hot, wet areas than in cool, dry locations. The half-time of picloram under most field conditions is a few months (US Environmental Protection Agency, 1988c). There is little potential for picloram to move from treated areas into runoff water (Fryer *et al.*, 1979). Although this chemical is considered to be moderately mobile, leaching is generally limited to the upper parts of most soil profiles (Grover, 1977). Instances in which picloram has entered groundwater are largely limited to misapplication or unusual soil conditions (Frank *et al.*, 1979).

1.4 Regulations and guidelines

The US Environmental Protection Agency has proposed to establish a 'maximum contaminant level' (feasible and enforceable limits to public health) in drinking-water and a 'maximum contaminant level goal' (desirable but non-enforceable) for picloram at 0.5 mg/l (Anon., 1990).

National pesticide residue limits for picloram in foods are presented in Table 2.

Table 2. National pesticide residue limits for picloram in foods[a]

Country	Residue limit (mg/kg)	Commodities
Argentina	0.5	Sorghum, maize, wheat, barley, canary grass
Australia	5	Edible offal
	0.2	Cereal grains
	0.05[b]	Meat, milk, milk products
Brazil	50[c]	Grasses
	1.0[c]	Forage
	0.2	Meat and meat products
	0.1[c]	Rice, wheat, barley, grains
	0.05	Milk, sugar-cane[c]
Canada	Negligible	Barley
Italy	0.5	Forage
USA[d]	80	Grasses, forage
	5	Kidney (cattle, goats, hogs, horses and sheep)
	3	Milled fractions (except flour) of wheat, barley and oats when used in feed
	1.0	Green forage and straw (barley, oats and wheat)
	0.5	Barley grain, flax seed and straw, liver (cattle, goats, hogs, horses and sheep), oats grain, wheat grain
	0.2	Fat, meat by-products, meat (cattle, goats, hogs, horses and sheep, excluding kidney and liver)
	0.05	Eggs, milk, poultry (fat, meat by-products, meat)

[a]From Health and Welfare Canada (1990)
[b]Set at or about the limit of detection
[c]Provisional
[d]From its application in the acid form or in the form of its potassium, triethylamine or triisopropanolamine salts, expressed as picloram

The time-weighted average occupational exposure limit for picloram in air is 10 mg/m^3 in Belgium, Finland, the Netherlands, Switzerland, the United Kingdom, the USA and Venezuela. The short-term exposure limit is 20 mg/m^3 in Finland and the United Kingdom, and the ceiling is 20 mg/m^3 in Venezuela (Cook, 1987; American Conference of Governmental Industrial Hygienists, 1989; US Occupational Safety and Health Administration, 1989).

2. Studies of Cancer in Humans

No data were available to the Working Group.

3. Studies of Cancer in Experimental Animals

Oral administration

Mouse: Groups of 50 male and 50 female B6C3F$_1$ mice, five weeks old, were fed diets containing picloram (technical-grade; at least 90% pure with 130 ppm [mg/kg]

hexachlorobenzene [US Environmental Protection Agency, 1988]. The time at which chemical analysis of the technical product was carried out is not reported.) Since the maximum tolerated dose was not established beforehand, the concentration of picloram in the feed was changed during the course of the study. Low-dose groups were fed 5000 mg/kg of diet for one week and 2500 mg/kg diet for the subsequent 79 weeks; high-dose groups were fed dietary concentrations of 10 000 mg/kg of diet for one week and 5000 mg/kg of diet for the following 79 weeks. During the remaining 10 weeks of the study, the animals were fed basal diet. Groups of 40 control animals of each sex (10 matched and 30 concurrent) received the basal diet during the entire study period of 90 weeks. There was no significant difference in survival between test and control groups. The body weights of the mice were unaffected by the administration of picloram. No significant difference in tumour incidence was found between treated and control animals (US National Cancer Institute, 1978). [The Working Group noted the short duration of treatment.]

Rat: Groups of 50 male and 50 female Osborne-Mendel rats, five weeks old, were fed diets containing picloram (technical grade; at least 90% pure with 130 ppm [mg/kg] hexachlorobenzene [US Environmental Protection Agency, 1988]. The time at which chemical analysis of the technical product was carried out is not reported.) The concentrations of picloram in the feed were changed during the study: low-dose groups were fed 10 000 mg/kg of diet for 39 weeks and 5000 mg/kg diet for the subsequent 41 weeks; high-dose groups were fed dietary concentrations of 20 000 mg/kg of diet for 39 weeks and 10 000 for the following 41 weeks. During the remaining 33 weeks of the study, the animals were fed basal diet. Groups of 50 control animals of each sex (10 matched and 40 concurrent) received the basal diet during the entire study period of 113 weeks. There was no significant difference in survival between control and test groups. Mean body weights of treated rats were higher than those of the matched controls during the second year of the study. In female rats, C-cell adenomas of the thyroid occurred in 1/38 pooled controls, 3/46 low-dose and 7/46 high-dose rats ($p = 0.029$ test for trend). An increased incidence of neoplastic nodules of the liver was observed in treated females: in 0/39 pooled controls, 5/50 low-dose and 7/49 high-dose animals ($p = 0.014$; $p = 0.016$, test for trend); in males, this lesion appeared only in three animals of the low-dose group. Hepatocellular carcinomas occurred in one low-dose male rat and one high-dose female rat. A dose-related increase in the incidence of foci of cellular alteration was observed in the liver in animals of each sex (US National Cancer Institute, 1978). [The Working Group noted the short duration of treatment and the changes in dietary concentration during the study.]

Groups of 50 male and 50 female Fischer 344 rats, five weeks of age, were fed diets providing 0, 20, 60 and 200 mg/kg bw technical-grade picloram (93-94% pure; 6-7% tri- and tetrachlorinated pyridine compounds) for 24 months. Survival was similar in treated and control groups ($> 68\%$). A dose-related increase in the combined incidence of benign and malignant liver-cell tumours was observed in males: two adenomas occurred in controls, two adenomas and two carcinomas in animals given 20 mg/kg bw, eight adenomas and two carcinomas at 60 mg/kg bw and four adenomas and two carcinomas at 200 mg/kg bw [$p = 0.04$, test for trend] (Stott *et al.*, 1990).

4. Other Relevant Data

4.1 Absorption, distribution, metabolism and excretion

4.1.1 *Humans*

Six male volunteers aged 40-51 years received single oral doses of 0.5 and 5 mg/kg bw picloram (99.6% pure, sodium salt) or a dermal application of 2 mg/kg bw picloram acid in an ethanolic vehicle on the back. Picloram was well absorbed when administered orally (> 90% of the dose) but was poorly absorbed through the skin (0.2% of the dose). High renal clearance (670 ml/min) of unchanged picloram (> 90% of the dose) suggests that active renal tubular secretion is most important for picloram excretion. Plasma disappearance was biphasic, with a rapid phase (half-time, approximately 1 h) and a highly variable terminal phase (half-time, 4-57 h) (Nolan *et al.*, 1984).

4.1.2 *Experimental systems*

Comparatively few data have been published on the disposition and metabolic fate of picloram in animals. Studies in rats and dogs, published as abstracts (Redemann, 1965a,b), suggest that picloram is excreted rapidly in the urine as unchanged material. Disposition studies (Kutschinski & Van Riley, 1969) in young cattle confirm that tissue retention is minimal with dietary intakes of 2.6-23 mg/kg per day. At the highest dietary intake level studied (1600 ppm [mg/kg]), tissue concentrations were recorded as (ppm [mg/kg]): kidney, 15-18; blood, 1.4-2; liver, 1.1-1.6; and muscle and fat, 0.3-0.5. Clearance was rapid after cessation of intake.

Treatment of rats with picloram (1-200 mg/kg bw intraperitoneally) induced a dose-dependent increase in ethoxyresorufin and ethoxycoumarin *O*-deethylation in rat liver. Picloram also binds to rat-liver microsomes from animals pretreated with phenobarbital and 3-methylcholanthrene, causing a typical type-I binding spectrum (Reidy *et al.*, 1987).

4.2 Toxic effects

4.2.1 *Humans*

No data were available to the Working Group.

4.2.2 *Experimental systems*

Picloram has low toxicity in experimental animals, according to the available published data. The acute oral LD_{50} in rats is approximately 8200 mg/kg bw, and the dermal LD_{50} in rabbits is > 4000 mg/kg bw (Ben-Dyke *et al.*, 1970). Bioavailability and toxicity appear to depend on the salts or formulation tested. For example, the oral LD_{50} values cited by Hayes *et al.* (1986) for the soluble potassium salt are 954 mg/kg bw in male rats and 686 mg/kg bw in female rats. No LD_{50} has been published for other salts used in commercial formulations.

The liver is the primary target organ for picloram toxicity during chronic administration. In Fischer 344 rats, centrilobular hepatocyte hypertrophy appeared as early as two weeks at the highest dose rates (500-2000 mg/kg per day) and at lower rates over longer intervals (150-500 mg/kg per day over 13 weeks; 60-200 mg/kg per day over 6-12 months). A subsequent two-year feeding study in Fischer 344 rats (Stott *et al.*, 1990) using picloram

(93-94% pure; main impurities, tri- and tetrachlorinated pyridines) at 20, 60, 200 mg/kg per day confirmed that there was dose-related enlargement of eosinophilic centrilobular hepatocytes and mild hepatomegaly, the effect being greater in males than in females.

Administration of the more soluble potassium salt in drinking-water for 90 days at 190-600 mg/kg (bw?) per day to Sprague-Dawley rats also caused liver lesions, described as an increased incidence and/or severity of hepatocyte mononuclear foci, as well as causing mild renal damage, described as multi-focal renal tubular epithelial degeneration (Hayes *et al.*, 1986). The doses used in this study, 600-1070 mg/kg per day, were clearly in the lethal range, producing significant mortality (males, 20-90%; females, 10-70%). Comparable doses given to pregnant rats by gavage over shorter periods of administration also produced mortality: 750 mg/kg per day caused 14% mortality and 1000 mg/kg per day, 26% (Thompson *et al.*, 1972).

4.3 Reproductive and developmental effects

4.3.1 *Humans*

No data were available to the Working Group.

4.3.2 *Experimental systems*

Following application of picloram to fertile mallard eggs by immersing them for 30 sec in an aqueous solution, the LC_{50} for embryonic death was equivalent to application of 100 lb/acre (112 kg/ha), an exposure level calculated to be 12 times that expected after usual application in the field, i.e., 100 gal/acre (935 litres/ha). Exposure at this level caused stunted embryos (Hoffman & Albers, 1984).

When hens' eggs were sprayed with picloram at 10 times the normal field level of application (11.2 kg/ha) before incubation and on days 4 or 18 of incubation, no effect was observed on hatching success, early performance of chicks (Somers *et al.*, 1978a) or their reproductive performance in adulthood (Somers *et al.*, 1978b).

A classical teratology study with Sprague-Dawley rats given 500, 750 or 1000 mg/kg bw picloram per day by gavage on days 6-15 of gestation provided evidence of retarded fetal growth but no teratogenic effect and no effect on postnatal survival or development (Thompson *et al.*, 1972). Similarly, administration of 40, 200 or 400 mg/kg bw per day picloram acid equivalent (given as the potassium salt) on days 6-18 of gestation to New Zealand rabbits had no embryotoxic or teratological effect (John-Greene *et al.*, 1985). In both these studies, the higher doses caused some toxicity to the mothers.

4.4 Genetic and related effects (see also Table 3 and Appendices 1 and 2)

4.4.1 *Humans*

No data were available to the Working Group.

4.4.2 *Experimental systems*

Picloram did not induce mutation in bacteriophage, *Salmonella typhimurium* or *Drosophila melanogaster*, but there is one report of induction of forward mutation in *Streptomyces coelicolor*. Mitotic recombination was induced in *Saccharomyces cerevisiae* but

Table 3. Genetic and related effects of picloram

Test system	Result[a]		Dose[b] LED/HID	Reference
	Without exogenous metabolic system	With exogenous metabolic system		
BPF, Bacteriophage, forward mutation	–	0	500.0000	Andersen *et al.* (1972)
BPR, Bacteriophage T4, reverse mutation	–	0	6000.0000	Andersen *et al.* (1972)
SA0, *Salmonella typhimurium* TA100, reverse mutation	–	–	1667.0000	Mortelmans *et al.* (1986)
SA5, *Salmonella typhimurium* TA1535, reverse mutation	–	–	200.0000	Carere *et al.* (1978)
SA5, *Salmonella typhimurium* TA1535, reverse mutation	–	–	1667.0000	Mortelmans *et al.* (1986)
SA7, *Salmonella typhimurium* TA1537, reverse mutation	–	–	200.0000	Carere *et al.* (1978)
SA7, *Salmonella typhimurium* TA1537, reverse mutation	–	–	1667.0000	Mortelmans *et al.* (1986)
SA8, *Salmonella typhimurium* TA1538, reverse mutation	–	–	200.0000	Carere *et al.* (1978)
SA9, *Salmonella typhimurium* TA98, reverse mutation	–	–	1667.0000	Mortelmans *et al.* (1986)
SAS, *Salmonella typhimurium*, reverse mutation	–	–	0.0000	Andersen *et al.* (1972)
SAS, *Salmonella typhimurium* TA1536, reverse mutation	–	–	200.0000	Carere *et al.* (1978)
SCF, *Streptomyces coelicolor*, streptomycin resistance	+	0	200.0000	Carere *et al.* (1978)
SCH, *Saccharomyces cerevisiae*, mitotic recombination	+	0	5.0000	L'vova (1984)
SCH, *Saccharomyces cerevisiae*, mitotic recombination	+	–	5.0000	L'vova (1989)
ANG, *Aspergillus nidulans*, mitotic recombination	–	0	800.0000	Bignami *et al.* (1977)
DMX, *Drosophila melanogaster*, sex-linked recessive lethal mutation	–	0	1000.0000 injection	Woodruff *et al.* (1985)
DMX, *Drosophila melanogaster*, sex-linked recessive lethal mutation	–	0	5000.0000 feeding	Woodruff *et al.* (1985)
DMN, *Drosophila melanogaster*, aneuploidy	–	0	650.0000	Woodruff *et al.* (1983)
CHL, Chromosomal aberrations, human lymphocytes *in vitro*	–	0	50.0000	L'vova (1984)
CBA, Chromosomal aberrations, mouse bone marrow *in vivo*	–	0	10.0000	L'vova (1984)

[a] +, positive; –, negative; 0, not tested

[b] In-vitro tests, μg/ml; in-vivo tests, mg/kg bw

not in *Aspergillus nidulans*. In single studies, picloram did not induce aneuploidy in *D. melanogaster* or chromosomal aberrations in either cultured human lymphocytes or mouse bone-marrow cells *in vivo*.

5. Summary of Data Reported and Evaluation

5.1 Exposure data

Picloram is a systemic herbicide used to control broad-leaved weeds on pasture, rangeland, rights-of-way, forestland and some grains. It was first registered for use in 1963.

Picloram has been formulated as granules and soluble concentrates in the form of amine and potassium salts and esters.

Exposure to picloram may occur during its production and application and, at much lower levels, from consumption of foods containing residues.

5.2 Carcinogenicity in humans

No data were available to the Working Group.

5.3 Carcinogenicity in experimental animals

Technical-grade picloram was tested for carcinogenicity in one experiment in mice and in two experiments in rats by administration in the diet. No increase in tumour incidence was observed in mice. In rats, it increased the incidence of liver-cell tumours (mainly benign) in males in one study and in males and females in another, and of C-cell adenomas of the thyroid in female rats in one study.

5.4 Other relevant data

The liver is the primary organ for picloram toxicity following chronic administration to rats.

No data were available on the genetic and related effects of picloram in humans.

Picloram did not induce chromosomal aberrations in mouse bone-marrow cells *in vivo* nor in cultured human cells. With the exception of a single report in which forward mutation was induced in *Streptomyces coelicolor*, picloram gave negative results in all short-term tests for mutation. It induced mitotic recombination in yeast but not in fungi.

5.5 Evaluation[1]

No data were available from studies in humans.

There is *limited evidence* for the carcinogenicity of picloram of technical grades in experimental animals.

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[1]For definition of the italicized terms, see Preamble, pp. 26-28.

Overall evaluation

Picloram *is not classifiable as to its carcinogenicity to humans (Group 3).*

6. References

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