

Technical Bulletin

Paraquat dichloride

Group of Pesticide: bipyridylium

IUPAC name: 1, 1'-dimethyl-4, 4'-bipyridinediium dichloride; 1,1'-dimethyl-4,4'-bipyridinium dichloride; 1,1'-dimethyl-4,4'-bipyridylium dichloride

: [4685-14-7]CAS RN

Chemical and Physical properties

- *Paraquat 20 %*
- *Paraquat dichloride 27.7%*

Physical state: liquid Odor

pH: (alkalinity or acidity as % H₂SO₄) pH (1 % w/v) 5.07

Flammability: Non-Flammable

Explosivity: Non Explosive

Viscosity: 30 CPS at 25 oC

Corrosivity: Non-Corrosive

Density: 1.046 g/ml at 20 oC

% Persistent foam: max. 25 ml after 1 min

Identification of Paraquat

- *Paraquat 20 SL a Herbicide contains 200 gm Paraquat (Equal Paraquat Dichloride 277 gm) per l liter; Used against most Broad leaved weeds & grasses.*
- *Paraquat 20 SL Non-selective contact herbicide, absorbed by the foliage, with some translocation in the xylem.*
- *Paraquat 20 SL Broad-spectrum control of broad-leaved weeds and grasses in fruit*

orchards (including citrus), plantation crops (bananas, coffee, cocoa palms, coconut palms, oil palms, rubber, etc.), vines, olives, tea, alfalfa, onions, leeks, sugar beet, asparagus, ornamental trees and shrubs, in forestry, etc. Also used for general weed control on non-crop land; as a defoliant for cotton and hops; for destruction of potato haulms; as a desiccant for pineapples, sugar cane, soya beans, and sunflowers; for strawberry runner control; in pasture renovation; and for control of aquatic weeds.

Mode of Action

Non-selective contact herbicide, absorbed by the foliage, with some translocation in the xylem. During photosynthesis, superoxide is generated, which damages cell membranes and cytoplasm.

Application Rate

<i>Crop</i>	<i>Pests</i>	<i>ml/20liter</i>
<i>Crop Residue</i>	<i>Broad leaves & Grasses</i>	<i>25 - 140 ml/20 liter water</i>
<i>Vegetables</i>	<i>Broad leaves & Grasses</i>	<i>100 - 200 ml/20 liter water</i>
<i>Pasture renovation</i>	<i>Broad leaves & Grasses</i>	<i>150 - 250 ml/20 liter water</i>
<i>Weeds in Nurseries</i>	<i>Broad leaves & Grasses</i>	<i>50 - 100 ml/20 liter water</i>

Toxicology of the active ingredient & end use product

1.Fate in animal:

Paraquat was not metabolized by rats. After oral administration (gastric intubation) of single doses of paraquat dichloride or dimethylsulfate to Wister strain male and female rats, most of the

administered radioactivity (69-96%) was excreted in feces as unchanged paraquat. After subcutaneous injection of these compounds, unchanged paraquat appeared mostly in urine (73-96% of the administered radioactivity). Paraquat used in this study (radiochemical purity: 99-100%) was labeled with 14-C in the methyl groups. The doses used for gastric intubation ranged from 0.5 to 50 mg/kg and for subcutaneous injection, from 12.5 to 24 mg/kg. Most of the radioactivity was detected in feces within 2-3 days after dosing and in urine, within 1 day after dosing. Following oral administration of paraquat, up to 30% of the dose appeared in feces in a degraded form. This was due to the microbial degradation of paraquat in the gut. That microbial degradation of paraquat occurred in feces was shown in an *in vitro* experiment in which fecal homogenates were incubated with added paraquat for 24 hours. In that experiment, 40-50% of paraquat was destroyed. However, a similar experiment with sterilized fecal homogenates produced only minor loss (trace amounts) of added paraquat. (MRID 00055107) Paraquat was poorly absorbed after oral administration to rats, dogs and mice. Once absorbed, paraquat was rapidly distributed to most tissues but especially to lungs and kidneys. Tissues other than lungs did not retain paraquat.

2. Acute toxicity

Route of application	Animal	Active ingredient	Formulated product
Oral LD50	Rat	150 mg/kg	2250 mg/kg
Dermal (LD50)	Rat	> 900 mg/kg	>25000 mg/kg
Inhalation (LC50)	Rat	NON TOXIC	NON TOXIC
Skin irritation	Rabbit	Irritating	Irritating
Eye irritation	Rabbit	Irritating	Irritating
Skin sensitization	Guinea pig	Non sensitizing	Non sensitizing

WHO Classification: active ingredient and formulated product

WHO Class

Active ingredient: II

formulated: II

3. Sub Chronic feeding studies:

Study	Dose	Effects	NOAEL
3-month feeding, rat	-----	-----	-----
3-month feeding dog	0, 7, 20, 60 or 120 ppm	Weight loss, decreased food intake, increased absolute and relative lung weight, marked dyspnea, harsh rales, slow and/or irregular heart beat, large lesions in the lungs.	20 ppm

4. Chronic Toxicity & carcinogenicity

Studies

Study	Dose	Effect	NOAEL
2-year feeding, rats	0, 25, 75 or 150 ppm	Opacities/cataracts in the males and the females; ptosis/swollen eyelids in the females, non-neoplastic lung lesions in the male no survivors.	25 ppm
18-month feeding mice			
1-year feeding, dogs	0, 200, 500 and 1250/2500 ppm	Increase in the severity and extent of chronic pneumonitis in the mid-dose and high dose male and female dogs.	15 ppm

5. Delayed neurotoxicity:

Statement on conclusion:

Considering the chemical nature of paraquat and the fact that it has not been shown to inhibit cholinesterase activities, does not produce cholinergic-like toxic signs and does not affect morphology of the central and peripheral nervous systems, the following studies are not required: acute delayed neurotoxicity study in the hen (81-7); acute (81-8 SS) and sub chronic (82-5b or 82-7) neurotoxicity screening battery studies in the rat; and developmental neurotoxicity study in the rat (83-6). There is currently no evidence to suggest the need for these studies.

6. Teratogenicity & Reproduction

study	Effect	Dose	Noael
Teratogenicity, rat	Treatment-related developmental effects (delayed ossification in the forelimb and hindlimb digits) were observed only in the mid-dose and high-dose groups. It was reported that 41.9% of the control group fetuses had good forelimb digit ossification compared with 28.8% and 23.0% of the mid-dose and high-dose fetuses, respectively. Similar results were noted for the hindlimb digit ossification.	0, 1, 5 or 10 mg/kg/day,	3 mg/kg/day
Teratogenicity, rabbit			
Two-generation, rat	Paraquat, at all levels tested, had no effect on body weight gain, food consumption and utilization, fertility and length of gestation of the F0, F1 and F2 parents. However, there was a high incidence of mortality in the high-dose F0 F1 and F2 females, due mostly to severe lung damage caused by paraquat. The incidence of lung injury (red or purple discoloration, congestion, edema, fibrosis, hyaline membrane formation, inflammatory cell infiltration and/or hyperplasia) ranged from 27% to 35%. There was also an increased incidence of alveolar histiocytosis in the lungs of the mid-dose and high-dose male and female parents. In the case of the F0 F1 and F2 females, the incidence was 28-40% (control groups), 28-54% (low-dose groups), 62-80% (mid-dose groups) and 80-100% (high-dose groups). The corresponding incidences for the males were 11-30%, 0-13%, 10-71% and 50-86%, respectively.	0, 25, 75 or 150	150 ppm

Statement on conclusion

No adverse affect appeared

7. Mutagenicity

Test	Doses/conc.	Result
Ames test: S.typhi 98, 100, 1537	<i>0.16, 0.8, 4, 20, 100, 500, 2500 and 5000 µg/plate.</i>	<i>Negative</i>
Chromosome aberration, Ch. Hamster ovary cells, with & without metabolic activation	<i>0.75 to 3500 µg/mL.</i>	<i>Negative</i>
DNA repair in rat hepatocytes	<i>1.2 to 2470 µg/mL,</i>	<i>Negative</i>

Statement on conclusion: not mutagenesis and have no adverse affect

8. Acceptable daily intake:

ADI is calculated on the basis of the NOAEL in the most susceptible species, the dog in this case, in the long-term studies and an appropriate safety factor (usually 100).

ADI = NOAEL/100 = mg/kg body weight per day

0.004 mg/kg b.w.

9. Fate in plants and residues in target crops:

Summary on metabolism and disposition in plants:

In plant metabolism studies reflecting pre-emergence treatment, the total radioactive residues (TRR) were 0.0048 ppm in carrot root and 0.0034 ppm in lettuce leaf samples following a single pre-emergence application at 13x the maximum rate of 1 lb cation/A. These data suggest that radioactive residues of paraquat are not readily taken up from the soil in significant quantities by these crop commodities following this mode of treatment. No further residue characterization and identification was conducted on these samples because of the low magnitude of radioactivity obtained. In plant metabolism studies reflecting desiccant treatment, the total radioactive residues were 0.075 and 0.087 ppm in potatoes, 0.652 and 0.841 ppm in soybeans, and 506.3 and 768.5 ppm in soybean foliage following a single foliar desiccant application at 6x the maximum seasonal rate of 1.25 lb cation/A for potatoes and 29x the maximum single application rate of 0.25 lb cation/A for soybeans). Paraquat cation was the major C-residue identified, and accounted for 91% of the total radioactivity in potatoes, 84% of the total radioactivity in soybeans, and virtually all of the total radioactivity in soybean foliage. Other minor metabolites found in soybean foliage were QINA (quaternary iso-nicotinic acid), a photodegradant and monoquat (1-

methyl-4, 4'-bipyridinium ion), each at 0.3% of TRR.

10. Consumer Risk

Assessment:

Acceptable Daily Intake ADI is calculated on the basis of the NOAEL in the most susceptible species, the dog in this case, in the long-term studies and an appropriate safety factor (usually 100)

ADI = NOAEL/100 = mg/kg body weight per day

Permissible daily intake (MPI) =

60 x ADI = mg/person/day

0.24mg/kg b.w.

11. Environmental Fate (see ref. summary of environmental behavior):

Hydrolysis:

The hydrolysis data requirement is fulfilled. Paraquat dichloride at 91 ppm did not hydrolyze at pH 5, 7, and 9 when incubated at 25 or 40° C. (Upton, Hedley, and Skidmore, 1985. No MRID).

Photolysis:

Photo degradation in Water

The photolysis in buffered solution data requirement is fulfilled. Paraquat dichloride at 28 ppm in sterile pH 7 aqueous buffer solution did not photo degrade when continuously irradiated with a xenon arc lamp for 32 days at 25°C. Paraquat dichloride accounted for 90.2- 98.0% of the applied radioactivity throughout the study in the irradiated and dark control samples; no degradates were reported from TLC or HPLC analyses. Volatiles were trapped during this experiment and 0.15% of the applied radioactivity was recovered as CO

Photo degradation on Soil

The photo degradation on soil surfaces data requirement is fulfilled. Paraquat dichloride did not photo degrade when mixed with a sterile soil and exposed to natural sunlight for 85 weeks. (Pack, 1982,

11.1 Fate in soil:

Aerobic soil metabolism The aerobic soil metabolism data requirement is fulfilled. Paraquat dichloride at 4.32 ppm did not degrade in sandy loam soil incubated under aerobic conditions at 20 ± 2°C for 180 days. Paraquat dichloride comprised 93% of the applied radioactivity at 180 days post treatment. Most of the radioactivity was extracted with technical grade paraquat by isotopic exchange. There was no volatile radioactivity. No degradates were reported from TLC or HPLC analyses.

Anaerobic soil metabolism The anaerobic soil metabolism data requirement is fulfilled. Paraquat dichloride at 4.32 ppm did not degrade in sandy loam soil incubated under anaerobic conditions for 60 days following a 30-day aerobic incubation. Paraquat dichloride comprised 88.8% of the applied radioactivity at 90 days post treatment [60 days of anaerobic incubation]. Most of the radioactivity was extracted with technical grade paraquat by isotopic exchange. A trace amount of radioactivity (0.29% of applied) was recovered in the water phase at 61 days post treatment [30 days post flooding]. There was no volatile radioactivity. No degradates were reported from TLC or HPLC analyses.

11.2 Leaching (Mobility) in Soil

Leaching, adsorption/desorption The un aged mobility data requirement is fulfilled. Paraquat dichloride was immobile in silty clay loam, loam, loamy sand, and sand soils. It was not possible to determine Freundlich K values because no paraquat was detected in the adsorption solution at the lower application rates. At high application rates (50-1000 times the field application rate), K values ranged from at 68-50,000 ml/g. There was no desorption of paraquat from these soils.

12. Ecotoxicology

12.1 Effect on non-target organisms

Bee toxicity:

<i>Test</i>	<i>48-h-LD50 (mg/bee)</i>
<i>Oral</i>	
<i>Contact</i>	<i>150 mg/bee</i>

Statement on bee toxicity

Non toxic.

12. 2Aquatic toxicity:

96-hour exposure resulted in the following LC50 values

<i>Species</i>	<i>LC50 mg/</i>
<i>Mirror carp LC50, 96 hr</i>	<i>135 mg/l</i>
<i>Rainbow trout LC50, 48 hr</i>	<i>26 mg/l</i>

Statement on fish toxicity:

Highly Toxic

12.3 Accumulation in aquatic organisms:

The fish bioaccumulation data requirement was waived. The KOW logKP=-4.5 paraquat dichloride at 20 C indicating that bioaccumulation is unlikely.

12.4 Effect on earthworm:

Statement on earth worm toxicity:

LC50 >1380 mg/kg soil.

12.5 Effect on Birds:

The following values were determined in acute oral studies:

Species	LD50 Acute oral LD50 mg/l	
Mallard Duck LD50	199 gm/ kg	
Bobwhite quail LD50	175 gm/ kg	

Statement on bird toxicity:

Toxic to birds

Storage

Precautions to be taken in handling and storage:

Hazards to Humans and Domestic Animals:

Caution

1. Harmful if absorbed through skin.
2. Causes moderate eye irritation.
3. Avoid contact with eyes, skin or clothing.
4. Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.

5. *Do not apply to humans, their clothing or bedding.*
6. *Do not allow children or pets to contact treated surfaces until spray has dried.*
7. *Do not contaminate food or use on household pets. Cover fish tanks prior to application.*
8. *Do not apply this product in patient rooms while occupied or in any rooms while occupied by the elderly or infirm.*
9. *Do not apply to classrooms when in use. Avoid contamination of food, feedstuffs, or water supply.*
10. *Do not contaminate food preparation surfaces, kitchen utensils, and dishes or feed storage containers.*
11. *Any food/feed contact surfaces and cooking utensils in the treatment area should be covered during treatment or thoroughly cleaned before using. Do not spray where electrical short circuits might result, such as wall outlets, conduits, etc.*

Environmental Hazards:

1. *This product is extremely toxic to fish and aquatic invertebrates.*
2. *Remove from premises or tightly cover fish tanks and disconnect aerators when applying indoors where such containers are present.*
3. *Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark.*
4. *Do not apply when weather conditions favor drift from treated areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas.*
5. *Do not contaminate water when disposing of equipment wash waters. Apply this product only as specified on this label.*

Storage:

1. Do not contaminate water, food or feed by storage.
2. Store in original container in secured dry storage area.
3. Prevent cross-contamination with other pesticides or fertilizers.
4. Do not store above 56 oC for extended periods of time.
5. Preferred storage is above 0 o C. Storing below 0 o C may result in solidification. If warmed to above 0 o C, product will return to original form.
6. Freezing does not adversely affect this product. If container is damaged or spill occurs, use product immediately or dispose of product and damaged container as indicated.

The name of Local Companies Produces Paraquat / Jordanian Companies

Name of local companies	Trade name	Reg.NO
VAPCO	HERBIKILL 20 SL	984
MEDMAC	PARACHUTE SL	2496
ALYMAMA	YAMAQUAT 20 SL	1137
MOBEEDCO	PARAQUAT 20 SL	986

The name of Imported Companies (applicant) of Paraquat

Name of Applicant companies	Trade name	Reg.NO	Country Origin
المجموعة التخصصية	AGRISONE 24% SL	2046	China
شركة جهاد ياسين	ALANXONE 20% SL	2223	China.
شركة مقدادي	GRAMAXONE 20 SC	5	Belgium
شركة عبد الحميد عبد الحافظ	GRASSMASTER SL	2354	China
شركة الاوفياء الزراعية	HERBQUAT SL	2280	China
مؤسسة الكروم	MONSOON SL	2038	China
شركة عبد الحافظ	WEEDLESS 20 SC	1663	China.
شركة نبات	PILARXONE 24 SL	1415	Taiwan
المجموعة العربية للانتاج والتوزيع	GRAMOKON SL	2373	China
الاشراق	PARAGRASS AS	2402	China.

Technical material imported for local manufacturing 2010

<i>Active Ingredient</i>	<i>Manufacturing Company</i>	<i>Quantity/Kg</i>
<i>Paraquat-cl2 (TK) min 52% W/V</i>	<i>The Arab Pesticides &Veterinary DrugsMFG.CO</i>	<i>19600</i>
<i>Paraquat-cl2 (TK) min 42% W/W</i>	<i>Vapco</i>	<i>68800</i>
	<i>Total Quantity</i>	<i>88400</i>

Quantity of F imported Paraquat during 2010

<i>Name of Applicant companies</i>	<i>Trade name</i>	<i>Quantity/ Lt</i>
المجموعة التخصصية	AGRISONE 24% SL	-

شركة جهاد ياسين	ALANXONE 20% SL	4500
شركة مقداي	GRAMAXONE 20 SC	6000
شركة عبد الحميد عبد الحافظ	GRASSMASTER SL	5250
شركة الاوفياء الزراعية	HERBQUAT SL	-
مؤسسة الكروم	MONSOON SL	-
شركة عبد الحافظ	WEEDLESS 20 SC	9000
شركة نبات	PILARXONE 24 SL	-
المجموعة العربية للانتاج والتوزيع	GRAMOKON SL	5000
الاشراق	PARAGRASS AS	9000
	Total Quantity	38750

Notes

Reference to toxicological research center, until now they didn't have any documented information about poisoning in paraquat