1-9-86

DYNAMAC CORPORATION

DIQUAT DIBROMIDE

Final Report

Task 2: Environmental Fate and Exposure Assessment

Contract No. 68-01-6679

JANUARY 9,1986

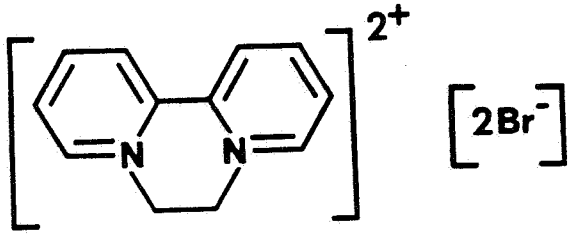
Submitted to:
Environmental Protection Agency
Arlington, VA 22202

Submitted by:
Dynamac Corporation
Enviro Control Division
The Dynamac Building
11140 Rockville Pike
Rockville, MD 20852

Environmental Fate and Exposure Assessment

Diquat Dibromide

AQUACIDE, DEXTRONE, REGLONE, REGLOX, WEEDTRINE-D



6,7-Dihydrodipyrido(1,2-a:2',1'-c)pyrazinediium dibromide

Diquat dibromide is a nonselective contact herbicide, desiccant, and plant growth regulator (sugarcane tassel control only) registered for use on a variety of terrestrial food crop (field and vegetable), terrestrial nonfood crop (ornamentals and golf courses), terrestrial noncrop (rights-of-way and industrial sites), greenhouse, aquatic noncrop, and domestic outdoor sites. Of the total amount of diquat dibromide applied in the United States, ~27% was used on rights-of-way, ~23% was used in agriculture and related uses (of which ~64% was used on potatoes and alfalfa, and 8% was used on sugarcane), ~22% was used for industrial purposes, and ~18% was used for aquatic weed control. Application rates range from 0.25 to 60.0 lb cation/A. Currently, there are no multiple active ingredient products registered which contain diquat dibromide. Single active ingredient formulations consist of 0.021-2.0 lb cation/gal and 0.19-2.36% SC/L, and 0.094 and 0.23% RTU-L. Diquat dibromide is generally foliarly applied by broadcast or directed spray by ground or aircraft, or injected below the water surface. Applicators need not be certified or under the direct supervision of applicators certified to apply diquat dibromide.

Available data are insufficient to fully assess the environmental fate of diquat dibromide and the exposure of humans and nontarget organisms to diquat dibromide. Data summarized here are scientifically valid but do not fulfill registration requirements unless noted.

[^{14}C]Diquat (100% pure, specific activity 0.122 GBq/mM) at ~55 mg cation/l was stable to hydrolysis in sterile, aqueous solutions buffered at pH 5 and 7 when incubated in the dark at 25 C for 30 days (Upton et al., No MRID). At pH 9 [^{14}C]diquat degraded by ~10% over the 30 day incubation period.

Diquat dibromide (test substance uncharacterized) at 0.23 ppm dissipated in reservoir water to nondetectable levels (<0.01 ppm) in 10-15 days (Schreck et al., 00100609). Diquat (test substance uncharacterized) at 500, 1000, and 4000 ppbw dissipated in the water of plastic pools (4 ft^2 x 2 ft deep) containing soil with ~20, 30, and 600-900 ppbw detected 12 days post-treatment (Yeo, 00068232). Different levels of total water hardness did not affect the dissipation rate of diquat from water.

Dermal, ocular, and inhalation exposures to workers may occur during application. The primary potential for exposure from SC/L formulations is during mixing and loading where dermal, ocular, and ingestion exposures can occur via splashing. Exposure resulting from use of the RTU-L formulations is expected to be similar to those asssociated with the SC/L formulations. Application from aircraft increases the potential for exposure of humans and nontarget organisms to diquat dibromide due to spray drift and volatilization. Human exposure to diquat dibromide during handling, mixing, and application operations could be minimized by the use of approved respirators and protective clothing. However, no data are available to assess such exposures. No federal reentry intervals have been established for diquat dibromide. No PIMS data were available.

In summary, diquat is stable to hydrolysis in aqueous solutions buffered at pH 5 and 7 but is slowly (10% in 30 days) hydrolyzed at pH 9. Diquat dibromide at 0.23 ppm dissipates in natural reservoir water to <0.01 ppm in 10-15 days. In artificial pools containing soil, diquat dibromide at 500, 1000, and 4000 ppbw dissipates to ~20, 30, and 600-900 ppbw in 12 days.

The following data are required (EPA Data Requirements for Registering Pesticides) to fully assess the environmental fate and transport of, and the potential exposure to diquat dibromide: photodegradation studies in water and air, and on soil; aerobic and anaerobic soil metabolism studies;

aerobic and anaerobic aquatic metabolism studies; leaching and adsorption/desorption studies; laboratory and field volatility studies; terrestrial and aquatic, and possibly long-term field dissipation studies; accumulation studies in fish, aquatic nontarget organisms, irrigated crops, and rotational crops; and reentry studies.

Hydrolysis studies: One study (Upton et al., No MRID) was submitted and fulfills data requirements by providing information on the hydrolysis of diquat at pH 5, 7, and 9.

Photodegradation studies in water: No data were submitted; however, all data are required.

Photodegradation studies on soil: No data were submitted; however, all data are required.

Photodegradation studies in air: No data were submitted. None are required due to the low volatility of diquat dibromide.

Aerobic soil metabolism studies: No data were submitted; however, all data are required.

Anaerobic soil metabolism studies: No data were submitted, however, all data are required.

Anaerobic aquatic metabolism studies: No data were submitted; however, all data are required.

Aerobic aquatic metabolism studies: No data were submitted; however, all data are required.

Leaching and adsorption/desorption studies: One study (Riley et al., 00121315) was reviewed and is considered scientifically invalid because there was no standard curve to relate the growth inhibition of wheat to the concentrations of the test substance. In addition, this study would not fulfill data requirements because the test substance was uncharacterized, complete soil characteristics were not provided, and K_d values were

not reported. All data are required.

Laboratory volatility studies: No data were submitted; however, all data are required.

Field volatility studies: No data were submitted; however, all data are required.

Terrestrial field dissipation studies: No data were submitted; however, all data are required.

Aquatic field dissipation studies: Two studies were reviewed. In one study (Yeo, 00068232), the portion pertaining to the plastic pools is scientifically valid. However, the portion of this study pertaining to the natural reservoirs is scientifically invalid because the water flow into and out of the sites was not characterized. In addition, this study does not fulfill data requirements because the test substance was uncharacterized, the soil and water were not completely characterized, field test data were incomplete, there was no pretreatment sampling, soil samples were not taken, the pattern of formation and decline of degradates was not addressed, the sampling procedures were not described, and a nonspecific analytical method was used. The second study (Schreck et al., 00100609) is scientifically valid but does not fulfill data requirements because more than one pesticides was applied; the test substance was uncharacterized; the water, soil, and sediment were uncharacterized; the soil or sediment was not sampled; complete field test data were not reported; the pattern of formation and decline of degradates was not addressed; and a nonspecific analytical method was used. All data are required.

Forestry dissipation studies: No data were submitted; however, no data are required because currently diquat dibromide has no registered forestry uses.

Dissipation studies for combination products and tank mix uses: No data were submitted; however, no data are required because data requirements for combination products and tank mix uses are currently not being imposed for this Standard.

Long-term field dissipation studies: One study (Wilkinson, 00052389, and Gowman et al., 00052390) was reviewed and could not be validated because the data are too variable and the analytical methods were not described in sufficient detail to accurately assess the dissipation of the test substance from soil. In addition, this study would not fulfill data requirements because the test substance was not a typical end-use product, the soil was not from the U.S., more than one pesticide was applied to the soil, no pre- or immediate posttreatment samples were taken, degradates were not identified, complete field test data were not provided, and a nonspecific analytical method was used. Data requirements are contingent upon the rate of dissipation determined in the terrestrial field dissipation studies.

Confined accumulation studies on rotational crops: No data were submitted; however, all data are required.

Field accumulation studies on rotational crops: No data were submitted. Data are required if residues of concern are found in the confined rotational crop studies.

Accumulation studies on irrigated crops: No data were submitted; however, all data are required.

Laboratory studies of pesticide accumulation in fish: No data were submitted; however, all data are required.

Field accumulation studies on aquatic nontarget organisms: No data were submitted; however, all data are required.

Reentry studies: No data were submitted; however, all data are required.

Label Restrictions

Pending submission of acceptable crop rotation data, crops other than those with registered diquat dibromide uses should not be rotated into diquat dibromide-treated fields.

Pending the submission of irrigated crop data, do not use water containing diquat dibromide residues, from application to ditches, to irrigate crops.

For terrestrial uses do not enter treated areas without wearing protective clothing until the spray has dried.

Pending submission of reentry data a 24-hour reentry interval is imposed.

References

Gowman, M.A., D. Riley, and S.E. Newby. 1980. Paraquat and diquat: long-term high-rate trial, Frensham, U.K. 2. Persistence and movement in soil, and glasshouse bioassays: Report Series RJ 0014 B. Unpublished study received June 4, 1980 under 239-2186; prepared by ICI, submitted by Chevron Chemical Co., Richmond, CA; CDL:242577-B. (00052390)

Riley, D., R. Gratton, and W. Wilkinson. 1972. Diquat: Physiochemical behaviour and herbicidal activity of residues in soil: AR 2372 A. Unpublished study received Dec. 21, 1982 under 239-2247; prepared by ICI Plant Protection, Ltd., Eng., submitted by Chevron Chemical Co., Richmond, CA; CDL:249102-Q. (00121315)

Schreck, C., R. Corning, and C. Berry, et al. 1974. Aquatic plant control using herbicides in a large potable water supply reservoir. Annual rept., July 1, 1973--June 30, 1974: Contract No. DACW65-74-C-0013. Virginia Polytechnic Institute and State Univ., Dept. of Fisheries and Wildlife Sciences for U.S. Dept. of the Army, Corps of Engineers; unpublished study; CDL: 247354-B. (00100609)

Upton, B.P., P. Hendley, and M.W. Skidmore. 1985. Diquat: Hydrolytic stability in water at pH 5, 7, and 9. ICI Plant Protection Division, Jealotts' Hill Research Station, Bracknell, Berkshire, UK. Accession Nos. 259950, 259951. (No MRID)

Wilkinson, W. 1980. Paraquat and diquat: long-term high-rate trial, Frensham, U.K. 1. Management of site, effects on crops and weeds and residues

in crops: Report Series RJ 0013 B. Unpublished study received June 4, 1980 under 239-2186; prepared by ICI, submitted by Chevron Chemical Co., Richmond, CA; CDL:242577-A. (00052389)

Yeo, R.R. 1967. Dissipation of diquat and paraquat and effects on aquatic weeds and fish. Weeds 15:42-46. Also In unpublished submission received Aug. 22, 1977 under 239-1663; submitted by Chevron Chemical Co., Richmond, CA; CDL:231431-R. (00068232)