

US EPA ARCHIVE DOCUMENT

DATA EVALUATION RECORD

STUDY 9

CHEM 061601

Paraquat dichloride

§164-5

FORMULATION--15--SOLUBLE CONCENTRATE (SC/L)

DP Barcode D191550

STUDY ID 42802102

Anderson, L, R.E. Hoag, C.W. Anders, and M. Earl. 1992. Paraquat: field soil dissipation under in-use conditions in the USA during 1987-89 (Goldsboro, North Carolina). Laboratory Report No. PP148BD05/Report No. RJ1146B. Unpublished study performed by ICI Agrochemicals, Berkshire, UK, and submitted by ICI Americas, Inc., Wilmington, DE.

REVIEW TIME = 1.5 days

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CONCLUSIONS:

Dissipation -- Long Term Field

1. This study can be used towards the fulfillment of data requirements.
2. Paraquat is inactivated (dissipates) by binding to soil but is resistant to degradation; although bound paraquat does not appear to be available under environmental conditions, it can be extracted by reflux with strong acid (see Comment 1).

Paraquat residues decreased slightly during the year after the first application and then showed a tendency to build up when applied in four single annual applications of 1.41 lb ai/A to loamy sand to sandy loam soil plots of bare ground or cotton. In the cropped plot, paraquat residues in the 0- to 3.5-inch layer were 1.24-1.38 ppm immediately after the first application and 0.48-0.94 ppm during the first year. Paraquat residues were 1.1-1.2 after the second application, 1.4-1.5 ppm after the third application and 1.9 ppm after the fourth application. In the 4.5- to 10-inch layer, residues were 0.06-0.07 ppm at sampling intervals from after 356 days following the third application. In the bare soil plot, paraquat residues were 0.92-1.14 ppm immediately after the first application and were 0.13-0.38 ppm at one year. Residues were 0.78-0.97 ppm after the second application and 1.5 ppm after the third application.

Paraquat residues from the 4.5- to 10-inch depth were recovered at 0.16 ppm Immediately after the first application.

METHODOLOGY:

Gramoxone Super (SC/L 1.5 or 2.5 lbs ai/gallon) was applied in a four single annual applications of 1.22-1.39 lb ai/A/year to plots of loamy sand and sandy loam soil (73-77% sand, 17-21% silt, 4-6% clay, pH 4.8-6.6, organic matter 1.0-1.6%, CEC 2.0-2.6 meq/100 g) located near Pikeville, North Carolina. One plot was planted to cotton (40 x 53 ft) and the second plot was unvegetated (40 x 15 ft); a control plot (40 x 68 ft) was located near the treated plots. Each treated plot was divided into three subplots. A total of five applications were made: 6/2/1987, 5/9/1988, 5/25/1989, 5/16/1990, and 5/7/1991.

Samples were taken with zero contamination corers to 15.5 inches or to 33.5 inches. The top 0- to 3.5-inch samples were taken with a 2 inch diameter corer and the deeper samples were taken with a 1 inch diameter corer. Samples from the subplots were composited to make three replicate samples for the first year's sampling and were composited in a single sample after the second application. Samples were removed prior to and immediately after the first application, at 27, 184, 267, and 342 days after the first application, at 170 and 380 days after the second, at 139 and 356 days after the third, and at 149 and 356 days after the fourth application. No samples were taken after the fifth application.

Soil samples (25 g) were extracted by refluxing with 6 M sulfuric acid for 5 hours; the refluxate was filtered and poured onto a cation exchange resin column. The sample on the column was sequentially washed with water, HCl, 2.5% ammonium chloride solution, and water. The paraquat was removed with saturated ammonium chloride solution. An aliquot of the ammonium chloride solution was treated with sodium dithionite "in alkali" to reduce paraquat to a free radical which was measured by UV spectroscopy. The detection limit was 0.05 ug/g soil; mean analytical recoveries ranged from 76 to 104%.

RESULTS:

When four single annual applications of paraquat (Gramoxone Super 1.5 lb ai/gallon) at 1.22-1.39 lb ai/A were made to loamy sand and sandy loam soil plots of bare ground and cotton, paraquat residues decreased during the year after the first application and then showed a tendency to build up.

The cropped plot: In the top 0- to 3.5 inches of soil, paraquat was recovered from the cropped plot at 1.24-1.38 ppm immediately after the first application, and ranged from 0.48-0.94 ppm from 27-342 days posttreatment (Table III). Paraquat was 1.2 ppm at 380 days after the second application, 1.4 ppm at 356 days following the third

application and 1.9 ppm at 356 days following the fourth application. Data showing paraquat residues in the 0- to 3.5-inch depth throughout the study were presented in Figure 4. In the 4.5- to 10-inch soil segment, paraquat was recovered at 0.11 ppm immediately after the first application, and was 0.06-0.07 after the third and fourth applications. No residues were recovered from deeper than 10 inches.

The bare soil plot: In the 0- to 3.5 inch segment from the bare soil plot, paraquat was recovered at 0.92-1.14 ppm immediately after the first application, and decreased to 0.63-0.80 ppm at 27 days and to 0.13-0.38 ppm at 342 days posttreatment (Table IV). Paraquat was 0.78 ppm at 380 days after the second application, and 1.5 ppm at 139 days following the third application; data from sampling intervals following the 139 day third application interval were not reported. Data showing paraquat residues in the 0- to 3.5-inch depth throughout the study were presented in Figure 5. In the 4.5- to 10-inch soil segment, paraquat was recovered at 0.16 ppm immediately after the first application, and was not recovered from later intervals. No residues were recovered from deeper than 10 inches.

Total rainfall was 182.3 inches or 91% of the 30 year average. Air and soil temperatures varied seasonally and generally followed the 30-year average; the air temperature ranged from 28 to 91 F and the soil temperature at 2-inches was 36-102 F. The water table at this site was >5 feet; the slope was 3-6% (from the soil survey report).

COMMENTS AND DISCUSSION:

1. As shown in laboratory and field studies, paraquat is resistant to hydrolytic and microbial degradation. Paraquat is inactivated by adsorption to clay particles and even soils with low clay contents can adsorb very high rates of the compound. In the batch equilibrium adsorption/desorption studies included in this submission, paraquat showed no desorption (ie: once bound to the soil, paraquat will not exchange with Ca^{2+} in the soil solution). Paraquat can be extracted from the soil clays by refluxing with 6 M HCL or H_2SO_4 . While the compound persists on soil clays for several years, this persistence does not appear to reflect the environmental activity of paraquat.
2. This study would have been stronger if samples had been taken immediately after the second, third, and fourth applications (1) to confirm the application rate and (2) to verify the slow decrease in paraquat observed in the first year. As the study stands, so few samples were taken that it was not possible to determine the pattern of degradation for paraquat in subsequent years.
3. A fifth application was made to the cropped plot on May 7, 1991, after samples were removed 371 days after the fourth application. No data were included from this fifth application so it was not included in this review.

4. The registrant stated that the single application of 1.44 lb ai/A represented a pre-emergence application of 0.94 lb ai/A and a harvest desiccant application of 0.47 lb ai/A. The single large application represented the worst case scenario.
5. The registrant did not attempt to provide a degradation half-life for these data but cited studies which reported an environmental half-life of approximately 10 years for paraquat.

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