DATA EVALUATION RECORD

STUDY 6

CHEM 061601 Paraquat dichloride §164-5

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

DP Barcode DD191550
STUDY ID 42802101
Anderson, L, R.E. Hoag, J. Safford, C.W. Anders, and M. Earl. 1992. Paraquat: field soil dissipation under in-use conditions in the USA during 1987-91 (Champaign, Illinois). Laboratory Report No. PP148BD05/Report No. RJ1187B. Unpublished study performed by ICI Agrochemicals, Berkshire, UK, and submitted by ICI Americas, Inc., Wilmington, DE.

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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 did not degrade when applied in four single annual applications of 2.63 lb ai/A to silty clay loam soil plots of bare ground and no-till corn; plots were located near Champaign, Illinois. Paraquat was recovered in the 0- to 3.5- and the 4.5- to 10-inch soil layers from the control, cropped and bare soil plots. In the cropped plot, paraquat residues in the 0- to 3.5-inch layer increased from 1.2-2.4 ppm after the first application to a maximum of 5.9 ppm at 170 days after the fourth application. In the bare soil plot, paraquat residues were 0.90-2.4 ppm after the first application and were 2.2 ppm at the final sampling of one year after the third application. In the 4.5- to 10-inch soil layer, paraquat residues were maximums of 0.36 and 0.39 ppm at the final sampling intervals for the cropped and bare soil, respectively.

METHODOLOGY:

Gramoxone Super (SC/L 1.5 or 2.5 lbs ai/gallon) was applied in a single application at 2.63 lb ai/A/year to plots of silty clay loam and clay loam soil (18-24% sand, 43-47% silt, 33-37% clay, pH 6.9-7.3, organic matter 0.6-4.3%, CEC 17-21.8 meq/100 g) located near Champaign, Illinois. One plot was planted to no-till corn (7 x 55 ft) and the second plot was unvegetated (7 x 20 ft); a control plot (10 x 100 ft) was located near the treated plots. Each treated plot was divided into three subplots. A total of four applications were made, one each May from 1987-1990.

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 29, 121, 213, and 363 days after the first application, at 169 and 376 days after the second application, at 154 and 344 days after the third application, and at 170 and 371 days after the fourth and final 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 54 to 79%.

RESULTS:

When four single annual applications of paraquat (Gramoxone Super 1.5 lb ai/gallon) at 2.63 lb ai/A were made to silty clay loam soil plots of bare ground and no-till corn, paraquat residues did not appreciably degrade during the first year and showed a tendency to accumulate in soil after additional applications. Paraquat was recovered in the 0- to 3.5- and the 4.5- to 10-inch soil layers from the control, cropped and bare soil plots.

In the top 10 inches of soil, the control plot contained 0.06-0.25 ppm paraquat and the pretreatment samples from the treated soil plots contained 0.08-0.09 ppm paraquat. This level of contamination did not interfere with the overall conclusions of the study.

The cropped plot: In the top 0- to 3.5 inches of soil, paraquat ranged from 1.2-2.4 ppm from 0-363 days after the first application

(Table III). Paraquat was 2.8-3.1 ppm at 169 and 373 days after the second application, 3.3-4.7 ppm at 154 and 344 days following the third application and was 5.4-5.9 ppm at 170 and 371 days following the fourth application. Data showing paraquat residues in the 0- to 3.5-inch depth throughout the study are shown in Figure 4. In the 4.5- to 10-inch soil segment, paraquat ranged from 0.10-0.39 ppm at all sampling intervals including pretreatment. No residues were recovered from below the 10-inch depth.

The bare soil plot: In the top 0- to 3.5 inches of soil, paraquat was recovered from the bare soil plot at 0.90-2.4 ppm at 0-363 days after the first application (Table IV). Paraquat was 1.6-1.8 ppm at 169 and 373 days after the second application, and was 1.9-2.2 ppm at 154 and 344 days following the third application. Due to lack of uncompromised sampling sites in the bare soil plot, paraquat was only applied to this plot three times. Data showing paraquat residues in the 0- to 3.5-inch depth throughout the study are shown in Figure 5. In the 4.5- to 10-inch soil segment, paraquat ranged from 0.06-0.15 ppm after the first and second applications (including pretreatment) and was 0.25-0.36 ppm after the third application. Paraquat residues were recovered from the 10- to 15-inch soil segment at 0.07 ppm at 376 days after the second application; no residues were recovered from this depth at any other sampling interval.

Total rainfall was 95% of the 30 year average; the yearly totals were 26.76, 24.68, 32.12, and 49.36 inches for 1987, 1988, 1989, 1990, respectively, and 11.82 inches for January to May 1991. Temperatures varied seasonally and generally followed the 30-year average. The water table at this site fluctuates between 0 and 8 feet; the slope is 0-3%.

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 to confirm the application rate. However, this information would not change the overall pattern of persistence of paraquat at this site.

3. In 1987 and 1988, aliquots of the application solutions were removed from the spray tank pre- and post-application; these samples were 44-57% of calculated values in 1987 and 107% in 1988. Spray tank mix samples were not taken in 1989 or 1990.

4. A fifth application was made to the cropped plot on May 8, 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.

5. The registrant stated that the single application of 2.63 lb ai/A represented a pre-emergence application of 0.94 lb ai/A, one post-emergence application of 0.28 lb ai/A and three post-emergence applications of 0.47 lb ai/A. The single large application "prevented the greater degree of crop intervention and subsequent photolysis on the leaf surface which would have resulted from normal use".

6. The registrant cited studies which reported an environmental half-life of approximately 10 years for paraquat.

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