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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

JUN 12 1996

OFFICE OF  
PREVENTION, PESTICIDES, AND  
TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Paraquat Dichloride: Honey Bee Acute  
Contact and Oral Studies (D224961)

FROM: *f* Anthony F. Maciorowski, Chief *6-12-96*  
Ecological Effects Branch  
Environmental Fate and Effects Division (7507C)

TO: Robert Forrest, PMT-14  
Fungicide/Herbicide Branch  
Registration Division (7505C)

EEB has reviewed the honey bee acute contact and oral studies submitted to support the reregistration of paraquat dichloride. The studies (MRID 43942603) were determined to be Core for technical paraquat and for its formulated product, Gramoxone, and showed that paraquat tested relatively nontoxic to honey bees. These studies will support the reregistration of formulated products of paraquat dichloride.

Any questions or comments on this memo should be referred to Allen Vaughan at 305-6464.

Attachments

DP Barcode: D224961

MRID No.: 439426-03

**DATA EVALUATION RECORD**  
**ACUTE CONTACT TOXICITY TEST WITH THE HONEY BEE**  
**§ 141-1**

1. **CHEMICAL:** Paraquat dichloride      PC Code No.: 061601

2. **TEST MATERIAL:** 99% Tech.; 1.67 lb/gal EC (Gramoxone)

3. **CITATION**

Authors: Bull, J.M., and W. Wilkinson

Title: PARAQUAT: 5-Day Contact and Oral Toxicity  
to Honey Bees (*Apis mellifera*)

Study Completion Date: October, 1977

Laboratory: Jealott's Hill Research Station

Sponsor: ICI Plant Protection Division

Laboratory Report ID: RJ0578B

MRID No.: 439426-03

DP Barcode: D224961

4. **REVIEWED BY:** Allen W. Vaughan, Entomologist, EEB, EFED

Signature: *Allen W. Vaughan*

Date: 6-11-96

5. **APPROVED BY:** Norman J. Cook, Head, Section 2, EEB, EFED

Signature: *Norman J. Cook*

Date: 6-12-96

6. **STUDY PARAMETERS**

Test Species: *Apis mellifera*

Age of Test Organisms at Test Initiation: Unknown

Exposure Duration: 48 hours

7. **CONCLUSIONS:** Contact LD50 > 144 ug ai/bee (tech.);  
= 72 ug ai/bee (Gramoxone)  
Oral LD50 = 51 ug ai/bee (tech.);  
= 31 ug ai/bee (Gramoxone).

**Toxicity category** Practically nontoxic

8. **ADEQUACY OF THE STUDY**

A. **Classification:** Core

B. **Rationale:** N/A

C. **Repairability:** N/A

9. **GUIDELINE DEVIATIONS** Water was used as a solvent. Although this is not recommended, EEB does not believe this represents a significant deviation in this case.

10. **SUBMISSION PURPOSE:** Reregistration

**11. MATERIALS AND METHODS****A. Test Organisms**

Guideline Criteria	Reported Information
Species	Honey Bee ( <i>Apis mellifera</i> L.)
Age at beginning of test Worker bees of uniform age.	Worker bees
Source	Research colony
Were bees from disease-free colonies?	Not reported
Were bees kept in conditions conforming to proper cultural practices?	Yes

**B. Test System**

Guideline Criteria	Reported Information
Test Chambers	Cylindrical wire mesh cages, 140 mm long and 40 mm diam., closed at both ends by corks.
Temperature during exposure	Approx. 25°C
Relative humidity during exposure	Not reported.
Lighting	Not reported.
Feeding	20% sucrose/water ad libitum

**C. Test Design**

Guideline Criteria	Reported Information
Nominal dosage levels tested	Contact test, technical: 0.72, 1.4, 3.6, 7.2, 14, 36, 72, and 144 ug ai/bee. Contact test, Gramoxone: 1, 2, 5, 10, 20, 50, 100, and 200 ug ai/bee. Oral test, technical: same as for contact test with tech. Oral test, Gramoxone: same as for oral test with tech.

Guideline Criteria	Reported Information
Number of bees exposed per dosage level	30 bees in 3 reps.
Other experimental design information	10 bees per chamber.
Bees randomly or impartially assigned to test groups	Yes
Control	Water
Solvent control	None
Total observation period and frequency of interim observations	Hourly for first 3-5 hrs, and then 24, 48, 72, 96, and 120 hrs after treatment.

**12. REPORTED RESULTS**

Guideline Criteria	Reported Information
Quality assurance and GLP compliance statements were included in the report?	Yes
Observed adverse effects on bees at respective dosages	None reported
Control and Solvent Control Mortality	<20%
Were raw data included?	Yes

**Agency Statistical Analysis**

Method Used: For contact test with technical, visual inspection was used. For other three tests, binomial test was used.

Results: Results support authors' analyses.

**13. REVIEWER'S COMMENTS: None.**

Vaughan Paraquat Honey Bee Acute Contact

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CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB. (PERCENT)
144	85.5	19.5	22.807	0
72	85.5	12.5	14.6199	0
36	90	1	1.111111	0
14	90	3	3.333334	0
7.2	90	3	3.333334	0
3.6	85.5	.5	.5848	0
1.4	90	3	3.333334	0
.7	85.5	2.5	2.924	0

BECAUSE THE NUMBER OF ORGANISMS USED WAS SO LARGE, THE 95 PERCENT CONFIDENCE INTERVALS CALCULATED FROM THE BINOMIAL PROBABILITY ARE UNRELIABLE. USE THE INTERVALS CALCULATED BY THE OTHER TESTS.

AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 0

THE MOVING AVERAGE METHOD CANNOT BE USED WITH THIS DATA SET BECAUSE NO SPAN WHICH PRODUCES MOVING AVERAGE ANGLES THAT BRACKET 45 DEGREES ALSO USES TWO PERCENT DEAD BETWEEN 0 AND 100 PERCENT.

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H
5	.7339542	3.085007
GOODNESS OF FIT PROBABILITY		
5.076349E-03		

SINCE THE PROBABILITY IS LESS THAN 0.05, RESULTS CALCULATED USING THE PROBIT METHOD PROBABLY SHOULD NOT BE USED.

SLOPE = .592892  
 95 PERCENT CONFIDENCE LIMITS = .0849548 AND 1.100829

LC50 = 6755.043  
 95 PERCENT CONFIDENCE LIMITS = 437.2727 AND 2.061143E+18

LC10 = 48.70635  
 95 PERCENT CONFIDENCE LIMITS = 10.75934 AND 6610.957

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NOTE: BECAUSE THERE WAS CONTROL MORTALITY, AND NONE OF THE LOWER CONCENTRATIONS PRODUCED ZERO MORTALITY, THE DATA HAS BEEN SUBJECTED TO ABBOTT'S CORRECTION.

Vaughan Paraquat Honey Bee Acute Oral

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CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB. (PERCENT)
144	86	70	81.3953	0
72	86	55	63.9535	0
36	86	35	40.6977	0
14	86	2	2.3256	0
7.2	86	0	0	0

3.6	90	3	3.333334	0
1.4	90	1	1.111111	0
.7	90	1	1.111111	0

THE BINOMIAL TEST SHOWS THAT 36 AND 72 CAN BE USED AS STATISTICALLY SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS, BECAUSE THE ACTUAL CONFIDENCE LEVEL ASSOCIATED WITH THESE LIMITS IS GREATER THAN 95 PERCENT.

AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 47.44427

RESULTS CALCULATED USING THE MOVING AVERAGE METHOD

SPAN	G	LC50	95 PERCENT CONFIDENCE LIMITS
3	2.759932E-02		52.39772 45.43643

60.49207

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H
5	.671097	18.72286

GOODNESS OF FIT PROBABILITY

0 A PROBABILITY OF 0 MEANS THAT IT IS LESS THAN 0.001.

SINCE THE PROBABILITY IS LESS THAN 0.05, RESULTS CALCULATED USING THE PROBIT METHOD PROBABLY SHOULD NOT BE USED.

SLOPE = 1.94253  
 95 PERCENT CONFIDENCE LIMITS = .3511996 AND 3.53386

LC50 = 53.57368  
 95 PERCENT CONFIDENCE LIMITS = 18.7332 AND 587.1535

LC10 = 11.88954  
 95 PERCENT CONFIDENCE LIMITS = 3.986552E-02 AND 29.18828

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NOTE: BECAUSE THERE WAS CONTROL MORTALITY, AND NONE OF THE LOWER CONCENTRATIONS PRODUCED ZERO MORTALITY, THE DATA HAS BEEN SUBJECTED TO ABBOTT'S CORRECTION.

Vaughan Gramoxone Honey Bee Acute Contact

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CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB. (PERCENT)
200	85	74	87.0588	0
100	85	57	67.0588	0
50	85	21	24.7059	0
20	85	7.000001	8.2353	0
10	85	6	7.0588	0
5	85	2	2.3529	0
2	85	0	0	0
1	90	3	3.333334	0

THE BINOMIAL TEST SHOWS THAT 50 AND 100 CAN BE USED AS STATISTICALLY SOUND CONSERVATIVE 95 PERCENT

CONFIDENCE LIMITS, BECAUSE THE ACTUAL CONFIDENCE LEVEL ASSOCIATED WITH THESE LIMITS IS GREATER THAN 95 PERCENT.

AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 75.97213

RESULTS CALCULATED USING THE MOVING AVERAGE METHOD

SPAN	G	LC50	95 PERCENT CONFIDENCE LIMITS	
3	3.013768E-02		75.90065	65.53318
88.25458				

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H
5	.9533559	26.89445

0

A PROBABILITY OF 0 MEANS THAT IT IS LESS THAN 0.001.

SINCE THE PROBABILITY IS LESS THAN 0.05, RESULTS CALCULATED USING THE PROBIT METHOD PROBABLY SHOULD NOT BE USED.

SLOPE = 1.726821  
 95 PERCENT CONFIDENCE LIMITS = 4.075384E-02 AND 3.412888

LC50 = 71.90783  
 95 PERCENT CONFIDENCE LIMITS = 14.0573 AND 1.154456E+10

LC10 = 13.22272  
 95 PERCENT CONFIDENCE LIMITS = 1.152314E-22 AND 41.10471

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NOTE: BECAUSE THERE WAS CONTROL MORTALITY, AND NONE OF THE LOWER CONCENTRATIONS PRODUCED ZERO MORTALITY, THE DATA HAS BEEN SUBJECTED TO ABBOTT'S CORRECTION.

Vaughan Gramoxone Honey Bee Acute Oral

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CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB. (PERCENT)
200	86	86	100	0
100	86	78	90.6977	0
50	86	68	79.0698	0
20	86	22	25.5814	0
10	86	4	4.6512	0
5	90	1	1.111111	0
2	86	1	1.1628	0
1	80	3	3.75	0

THE BINOMIAL TEST SHOWS THAT 20 AND 50 CAN BE USED AS STATISTICALLY SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS, BECAUSE THE ACTUAL CONFIDENCE LEVEL ASSOCIATED WITH THESE LIMITS IS GREATER THAN 95 PERCENT.

AN APPROXIMATE LC50 FOR THIS SET OF DATA IS 30.24569

RESULTS CALCULATED USING THE MOVING AVERAGE METHOD

SPAN	G	LC50	95 PERCENT CONFIDENCE LIMITS	
6	1.251017E-02		29.93223	26.22323
1.31085				

RESULTS CALCULATED USING THE PROBIT METHOD

ITERATIONS	G	H
6	2.239262	86.36446

0

A PROBABILITY OF 0 MEANS THAT IT IS LESS THAN 0.001.

SINCE THE PROBABILITY IS LESS THAN 0.05, RESULTS CALCULATED USING THE PROBIT METHOD PROBABLY SHOULD NOT BE USED.

SLOPE = 2.395743  
95 PERCENT CONFIDENCE LIMITS = -1.189286 AND 5.980773

LC50 = 29.25144  
95 PERCENT CONFIDENCE LIMITS = 0 AND +INFINITY

LC10 = 8.630589  
95 PERCENT CONFIDENCE LIMITS = 0 AND 56.8174

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