MRID No. 426396-01

DATA EVALUATION RECORD

1. **CHEMICAL:** Paraquat Dichloride.
Shaughnessey No. 061601.

2. **TEST MATERIAL:** Paraquat (Gramoxone Extra); 1,1-dimethyl-4,4-bipyridylium dichloride; Sample ID No. 13183-40-2; 294 g active ingredient per liter.

3. **STUDY TYPE:** 123-1. Non-Target Plants: Seedling Emergence Nontarget Phytotoxicity Study - Tier 2. Species Tested: Soybean, Sugar beet, Oilseed rape, Morningglory, Velvetleaf, Cocklebur, Corn, Wheat, Wild oat, Purple nutsedge.

4. **CITATION:** Canning, L. and J.S. White. 1992. Paraquat: A Glasshouse Study to Evaluate the Effects on Seedling Emergence of a 300 g ai litre^{-1} (2.5 lb ai US gal^{-1}) Soluble Concentrate Formulation on Terrestrial Non-target Plants. Laboratory Project ID No. 92JH089. Conducted by ICI Agrochemicals, Jealotts Hill Research Station, Bracknell, Berkshire, UK. Submitted by ICI Americas Inc., Wilmington, DE. EPA MRID No. 426396-01.

5. **REVIEWED BY:**

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7. **CONCLUSIONS:** This study is scientifically sound (except for wild oat and winter wheat) and meets the requirements for a Tier 2 seedling emergence test for non-target plants using a formulated product. Results from wild oat and winter wheat are invalid due to poor control emergence.

Seedling Emergence: Cocklebur was the most sensitive test species. The NOEL, LOEL, EC_{25}, and EC_{50} for this species were 527, 1054, 1041, and >1054 g ai ha^{-1}, (0.59, 1.18, 1.17, and >1.18 lb ai/A), respectively.

Seedling Damage: By 21 DAA, none of the test species were damaged by soil applications of paraquat. The NOEL, LOEL, EC_{25} and EC_{50} for all species were 1054, >1054, >1054, and >1054 g ai ha^{-1} (1.18, >1.18, >1.18, >1.18 lb ai/A), respectively.

Growth Stage: By 21 DAA, the growth of all test species was not reduced by soil applications of paraquat. The NOEL, LOEL, EC_{25} and EC_{50} for all species were 1054, >1054, >1054, and >1054 g ai ha^{-1} (1.18, >1.18, >1.18, >1.18 lb ai/A), respectively.

Dry Weight: The NOEL, LOEL, EC_{25} and EC_{50} for all the test species were 1054, >1054, >1054, and >1054 g ai ha^{-1} (1.18, >1.18, >1.18, >1.18 lb ai/A), respectively.

8. **RECOMMENDATIONS:** N/A.

9. **BACKGROUND:**

10. **DISCUSSION OF INDIVIDUAL TESTS:** N/A.

11. **MATERIALS AND METHODS:**

A. **Test Plants:** Monocotyledon plants were represented by four species from two families (i.e., corn, wild oat, winter wheat, and purple nutsedge). Dicotyledon plants were represented by six species from six families (i.e., soybean, sugar beet, oilseed rape, morningglory, velvetleaf, and cocklebur). Cultivars, when applicable, were provided in the report, as well as germination percentages (except for nutsedge).

B. **Test System:** Ten seeds of each species were planted in new plastic pots (12.5-cm diameter). The pots were filled to a depth of 9-10 cm with composted soil (1.1% organic matter, pH 6.7). Seeds of crops (corn, winter wheat, soybean, oilseed rape, and sugar beet) were sown and covered with 2 cm of soil. The seeds of weeds (velvetleaf, morningglory, cocklebur, purple nutsedge, and wild oat) were planted and covered with 1 cm of soil. The plants were broken into two groups; the first group contained five "cool-weather" plants (sugar beet, oilseed rape, cocklebur, winter wheat, and wild

oat), and the second group contained five "warm-weather" plants (i.e., soybean, morningglory, velvetleaf, corn, and purple nutsedge). The seeds were planted the day before application of paraquat and not watered to insure that the seeds were exposed to paraquat during imbibition. Each pot was placed on a tray to retain the chemical (and water) and to prevent contamination across treatments.

All applications were performed with a hydraulic track-sprayer equipped with a single nozzle. A nozzle height of 50 cm and a nozzle pressure of 207 kPa were used. This system delivered 100 ±10 l hectare^{-1} (ha^{-1}). The test spray solutions were prepared by mixing the formulated paraquat with deionized water to achieve a stock solution of the highest dose. This was used to prepare the five lower rate solutions by serial dilution.

The pots were moved to a greenhouse and top watered two or three times a day on an as needed basis after the test material had been allowed to dry for two hours. Greenhouse conditions for warm season species were as follows: a temperature range of 19-55°C and a relative humidity range of 31-63%. Greenhouse conditions for cool season species were as follows: a temperature range of 12-50°C and a relative humidity range of 12-88%.

Biological pest control agents were applied uniformly over the treated and control plants at 14 days after application (DAA) of the test compound (Table 2, attached).

C. Dosage: Paraquat in the form of Gramoxone Extra was applied at rates of 32.9, 65.9, 132, 264, 527, and 1054 g active ingredient (ai) ha^{-1} to all plant species. The maximum application rate for paraquat was reported to be 1054 g ai ha^{-1} (0.94 lb ai/acre).

D. Design: Each species/treatment combination was replicated three times (i.e., 10 seeds of each species/pot, 3 pots per replicate). Controls were replicated six times. After treatment, the pots were randomized within each replicate in on-site greenhouses of the proper temperature regime.

Treatments and controls were assessed daily for seedling emergence by recording the number of seedlings

emerged for each species per replicate until full emergence. Following emergence, plant development was observed in comparison with the controls and percent damage of seedlings was assessed at 7, 14, and 21 DAA. For each species, each replicate was observed separately, but all ten (or less) seedlings within that replicate were combined to yield an overall damage rating per replicate (0 to 100%). Observations of symptomology were also recorded. At 21 days after treatment, growth stage for each species was recorded. The seedlings were then harvested by cutting the stems at the soil surface. All emerged seedlings for each species within a replicate were combined for drying and the number of seedlings harvested was recorded. Dry weight was assessed as grams per plant by drying to a constant weight in an oven at 75°C.

E. Statistics: For seedling emergence and final dry weights, NOEL values were calculated by analyses of variance and t-tests. Prior to analysis, data were arcsine square-root transformed. The NOEL was taken to be the highest dose at and below which there was no significant difference from the control. Species which appeared to show a dose-response relationship were analyzed further using regression analysis.

Dose-response relationships were analyzed using iteratively reweighted maximum likelihood regression of the arcsine transformation of percent damage on $\log_{10}$ (rate). The EC_{10}, EC_{25}, and EC_{50} estimates were obtained from the line. Non-treatment related plant variation was taken as 10% within the damage scoring system, thus it was proposed that the EC_{10} represented the no-observed-effect level (NOEL) at which no effect, greater than natural variation, occurred. The EC_{25} and EC_{50} values for emergence and dry weight were determined using iteratively reweighted maximum likelihood regression. However, in these cases, emergence and weight data were logit transformed.

12. REPORTED RESULTS:

Seedling Emergence: Seedling emergence was not significantly reduced for any of the test species; however, cocklebur demonstrated a general decrease in emergence with increasing treatment rate, and a predictive model was developed for this species. The EC_{25} was reported to be 1041 g ai ha^{-1} (95% confidence interval = 480->1054 g ai ha^{-1}) and the EC_{50} was 5414 g ai ha^{-1}. The number of days to full emergence was not affected for all ten test species.

Seedling Damage: Following emergence (7 DAA), morningglory was affected by paraquat application. However, the EC_{10} for morningglory was still reported as >1054 g ai ha^{-1}. By 14 DAA, morningglory had recovered, and the EC_{10}, EC_{25}, and EC_{50} were all reported to be >1054 g ai ha^{-1} for all species for this rating as well as the 21 DAA rating. The predominant symptom of damage for morningglory was leaf malformation.

Growth Stage: Growth stage was measured at 21 DAA and none of the test species were affected at the maximum test rate. Wild oat demonstrated a slight reduction in tillers at the higher two rates of paraquat.

Dry Weight: Twenty-one day mean dry weight yields and NOELs are reported in Table 23 (attached). Morningglory demonstrated a significant reduction in dry weight at all rates of paraquat, which resulted in an NOEL of <32.9 g ai ha^{-1}. The NOEL for the remaining nine species was >1054 g ai ha^{-1}. This significant reduction was thought to be due to one uncharacteristically high dry weight measurement in the control. Since no visual damage was apparent after 14 DAA for this species, this reduction is not believed to be biologically significant.

13. **STUDY AUTHOR'S CONCLUSIONS/QUALITY ASSURANCE MEASURES:** The authors made no conclusions other than those stated above.

Statements of Quality Assurance and compliance to Good Laboratory Practice (GLP) regulations were enclosed in the report indicating adherence to GLPs as specified by Title 40, Part 160 of the Code of Federal Regulations.

14. **REVIEWER'S DISCUSSION AND INTERPRETATION OF STUDY RESULTS:**

A. Test Procedure: The test procedures followed the SEP and Subdivision J guidelines, except for the following:

Wild oat and winter wheat control emergence was less than 70%.

The test was conducted with a formulated product rather than the technical material. If a test material is of less than 80% purity, then an inert ingredients control should be incorporated into the test design.

B. Statistical Analysis: The reviewer used analysis of variance (ANOVA) coupled with Dunnett's test to verify the NOEL and lowest-observed-effect level (LOEL) for

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morningglory dry weight

Summary Statistics and ANOVA

Transformation = None

Group (rate (g ai ha^{-1}))	n	Mean	s.d.	cv%
1 = control	6	.5317	.0765	14.4
2 33	3	.4333	.0462	10.7
3* 66	3	.4133	.0321	7.8
4 132	3	.4467	.0751	16.8
5* 264	3	.4000	.0200	5.0
6 527	3	.4433	.0252	5.7
7 1054	3	.4600	.0436	9.5

NOEL: 1054 g ai ha^{-1}

LOEL: >1054 g ai ha^{-1}

*) the mean for this group is significantly less than the control mean at alpha = 0.05 (1-sided) by a t - test with Bonferroni adjustment of alpha level

Minumum detectable difference for
t-tests with Bonferroni adjustment = -.085405
This difference corresponds to -16.06 percent of control

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**************************************************
*                                                *
* Note - the above value for the minimum         *
* detectable difference is approximate as        *
* the sample sizes are not the same for all of   *
* the groups.                                    *
*                                                *
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Between groups sum of squares = .051500 with 6 degrees of freedom.

Error mean square = .003103 with 17 degrees of freedom.

Bartlett's test p-value for equality of variances = .437

morningglory dry weight

Summary Statistics and ANOVA

Transformation = None

Group rate (g ai ha^{-1})	n	Mean	s.d.	cv%
1 = control	5	.5080	.0559	11.0
2 33	3	.4333	.0462	10.7
3* 66	3	.4133	.0321	7.8
4 132	3	.4467	.0751	16.8
5* 264	3	.4000	.0200	5.0
6 527	3	.4433	.0252	5.7
7 1054	3	.4600	.0436	9.5

NOEL = 1054 g ai ha^{-1}

LOEL = >1054 g ai ha^{-1}

*) the mean for this group is significantly less than the control mean at alpha = 0.05 (1-sided) by a t - test with Bonferroni adjustment of alpha level

Minumum detectable difference for
t-tests with Bonferroni adjustment = -.080149
This difference corresponds to -15.78 percent of control

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*                                              *
* Note - the above value for the minimum       *
* detectable difference is approximate as      *
* the sample sizes are not the same for all of *
* the groups.                                  *
*                                              *
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Between groups sum of squares = .029636 with 6 degrees of freedom.

Error mean square = .002247 with 16 degrees of freedom.

Bartlett's test p-value for equality of variances = .657