(3-21-91) File Copy: 121011
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MRID No. 416851-05

DATA EVALUATION RECORD

1. **CHEMICAL:** Clethodim.
Shaughnessey No. 059639.

2. **TEST MATERIAL:** Select (Clethodim); CAS No. 99129-21-2; 82.4% purity; a brown-amber liquid.

123-1b

3. **STUDY TYPE:** Non-Target Plants: Vegetative Vigor Nontarget Phytotoxicity Study - Tier 2. Species Tested: Ryegrass, Corn, Oat, Onion.

4. **CITATION:** Chetram, R.S. 1990. Tier 2 Vegetative Vigor Nontarget Phytotoxicity Study Using SELECT (Clethodim). Laboratory Project No. LR 89-55A. Conducted by Pan-Agricultural Laboratories, Inc., Fresno, CA. Submitted by Valent USA Corporation, Walnut Creek, CA. EPA MRID No. 416851-05.

5. **REVIEWED By:**

Richard C. Petrie
Agronomist
EEB/EFED

Signature: Richard C. Petrie
Date: 3/21/91

6. **APPROVED BY:**

Charles Lewis, Acting Head
Section 3,
EEB/EFED

Signature: Charles Lewis
Date: 3/22/91

7. **CONCLUSIONS:**

Vegetative Vigor: This study is scientifically sound and meets the requirements for a Tier 2 vegetative vigor test using non-target plants. The NOEC for onion for all

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parameters tested was 0.25 lb ai/A. Corn was the most sensitive species with respect to phytotoxicity. The NOEC values for phytotoxicity (in lb ai/A) for corn, ryegrass, and oat were 0.003, 0.006, and 0.013, respectively.

Ryegrass was the most sensitive species with respect to plant height. The NOEC values for plant height (in lb ai/A) for ryegrass, corn, and oat were 0.003, 0.006, and 0.013, respectively.

Ryegrass was again the most sensitive species with respect to plant dry weight. The NOEC values for plant dry weight (in lb ai/A) for ryegrass, corn, and oat were 0.003, 0.006, and 0.013, respectively.

8. **RECOMMENDATIONS:** No further Tier II non-target terrestrial plant vegetative vigor studies are required.

9. **BACKGROUND:** Because clethodim is active on grasses only, the registrant was given the opportunity to demonstrate this by performing Tier I tests on dicot species only; as long as Tier II tests were conducted on the required monocot species.

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., ryegrass, oat, corn, and onion). Cultivars, lot number, and germination ratings were provided in the report.

B. **Test System:**

Seedling Establishment: Seeds of each crop were planted in plastic pots (7.5 x 7.5 x 6.0 cm) and filled with a sterilized soil mix. A plexiglass template was used to create planting holes in the soil, thus allowing for uniform planting depth and seed distribution. Oat and corn were planted at a depth of 2.5 cm, while ryegrass and onion were planted at a depth of 1.3 cm. An analysis of the soil was provided in the report. After emergence, each pot was thinned to five plants/pot. The four plant species were

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allowed to grow for 7-12 days before treatment to allow each species to attain the 1-3 true leaf stage. Each treatment replicate was placed on an aluminum tray (6.125 x 31.125 cm). The spray plot was 3.21 x 1.67 ft (i.e., 5.36 ft^2).

All applications were performed with a belt sprayer equipped with a single nozzle. A nozzle height of 12 inches and a nozzle pressure of 50 psi were used. The test spray solutions were prepared by dissolving clethodim technical in deionized water and acetone. The plants were sprayed at the equivalent of 468 l/ha (50 gpa) of water.

The pots were watered three times a day and a total of 25 ml of water was used to irrigate each pot per day.

C. **Dosage:** Clethodim was applied at a rate of 0.25, 0.125, 0.0625, 0.0313, 0.0156, and 0 lb ai/A to all plant species. Continuation tests were conducted on oat, corn, and ryegrass. These application rates were 0.025, 0.013, 0.006, 0.003, 0.002, and 0 lb ai/A. Treatment application rates were adjusted for the percent purity of the test material (82.4%).

D. **Design:** Each crop/treatment combination was replicated five times (i.e., 5 plants/pot, 5 pots/treatment level). After treatment, the pots were randomized within crops and among treatments and placed in an on-site greenhouse.

Plant height was measured by extending the seedling to its maximum height and recording the height to the nearest millimeter. The mean plant height was calculated at 0 and 21 days after application.

Plant phytotoxicity was monitored at 7, 14, and 21 days after treatment. The phytotoxicity ratings evaluated five observable toxic effects: 0-indicates no effect; 1-indicates slight plant effect; 2-indicates a moderate effect (e.g., mild stunting or chlorosis); 3-indicates a severe effect; and 4-indicates a total effect or plant death.

Twenty-one days after treatment, the plants within treatment replicates (pots) were cut at the soil level and dried in a pre-weighed paper bag at 70°C for a minimum of 48 hours. After drying, the dry weight of the plant material was recorded.

Temperature, relative humidity, photoperiod, and illuminance during the period of growth were provided in the report.

E. **Statistics:** All data were entered into a Lotus 1-2-3 spreadsheet. The spreadsheet calculated replicate means, treatment means, standard deviations, and analysis of variance tables. Treatment means were used to calculate the percent effect resulting from the treatment. The percent effect was calculated using the following equation:

$$\% \text{ effect} = \frac{(\text{treatment mean} - \text{control mean})}{\text{control mean}} \times 100$$

Plant heights taken prior to treatment were used as a baseline to calculate the percent effect on growth at the 21 day observation period. The percent increase in height from the 0 day reading was calculated using the following equation:

$$\% \text{ increase} = \frac{(\text{21 day mean} - \text{0 day mean})}{\text{0 day mean}} \times 100$$

The percent effect on growth was calculated for each treatment using the following equation:

$$\% \text{ effect} = \frac{(\text{treat. \% increase} - \text{cont. \% increase})}{\text{control \% increase}} \times 100$$

An analysis of variance table was constructed using the Lotus 1-2-3 raw data spreadsheet. A one-way analysis of variance (ANOVA) model for data with equal sub-samples was used to analyze the data. The F-value from the analysis of variance table and an F table were used to determine if the treatment means were significantly different ($p < 0.05$). Treatment mean separation was achieved using either SAS or the LOTUS 1-2-3 spread-sheet.

The percent effect values were input into a SAS probit analysis program. The program ignores positive values and transforms the dose by natural logarithms. For plant height and dry weight, the probit is calculated using replicate means.

12. **REPORTED RESULTS:**

Phytotoxicity rating: Statistical analysis of the 21 day

phytotoxicity ratings showed no significant difference between control and any treatment level for onion plants. However, treatment of corn, oat, and ryegrass with clethodim did result in a significant increase on mean phytotoxicity. The NOEC values (in lb ai/A) for the four species, in increasing sensitivity to clethodim, are as follows:

onion (0.25) < oat (0.013) < ryegrass (0.006) < corn (0.003).

Plant height: Statistical analysis of the 21 day plant height data showed no significant difference between control and any treatment level for onion plants. Treatment of corn, oat, and ryegrass with clethodim did result in a significant decrease on plant height. The NOEC values (in lb ai/A) for the four species, in increasing sensitivity to clethodim, are as follows:

onion (0.25) < oat (0.013) < corn (0.006) < ryegrass (0.003).

Oat, corn, and ryegrass exhibited a dose response in the continuation studies, therefore, probit analysis was conducted to estimate EC values. These values are listed in Table 4 (attached).

Plant dry weight: Statistical analysis of the plant dry weight data showed no significant difference between control and any treatment level for onion plants. Treatment of corn, oat, and ryegrass with clethodim did result in a significant decrease on plant height. The NOEC values (in lb ai/A) for the four species, in increasing sensitivity, are as follows:

onion (0.25) < oat (0.013) < corn (0.006) < ryegrass (0.003).

Oat, corn, and ryegrass exhibited a dose response in the continuation studies, therefore, probit analysis was conducted to estimate EC values. These values are listed in Table 4.

13. **STUDY AUTHOR'S CONCLUSIONS/QUALITY ASSURANCE MEASURES**:
"A no-effect concentration was reached on all measurement parameters for oat, ryegrass, corn, and onion."

The Quality Assurance Unit of Pan-Agricultural Laboratories, Inc., was responsible for the assurance of compliance with

Good Laboratory Practice (GLP) Standards. Statements of compliance to GLP and QA were enclosed in the report.

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:

All plants in each replicate were weighed together, then the total weight was divided by the total number of plants to obtain each replicate mean value. The plants should have been individually weighed so the variation among plants within each replicate could be accounted for in the statistical analysis of the data.

B. **Statistical Analysis:** Statistical analyses were conducted on ryegrass (the most sensitive species) data for dry weight (attached). No-effect concentration data was analyzed using Dunnett's comparison test and EC values were computed using a probit analysis program. The results are in near agreement with the author's.

C. **Discussion/Results:**

These studies are scientifically sound and meet the requirements for Tier 2 vegetative vigor test using non-target plants.

Phytotoxicity rating: Based on phytotoxicity ratings, only onion demonstrated no effect from clethodim application at 21 days after treatment. Oat, corn, and ryegrass did show significant ($p < 0.05$) signs of phytotoxicity at 21 days with corn being the most sensitive.

Plant height: Only onion was not significantly ($p < 0.05$) affected by clethodim application after 21 days. Plant height was significantly decreased for the remainder of the species, with ryegrass being the most sensitive.

Plant dry weight: Onion dry weight was not significantly ($p < 0.05$) affected by clethodim application after 21 days. Plant dry weight was significantly decreased for the remainder of the species, with ryegrass being the most sensitive.

D. **Adequacy of the Study:**

(1) **Classification:** Core.

(2) **Rationale:** N/A.

(3) **Repairability:** N/A.

15. **COMPLETION OF ONE LINER:** N/A.

DATA EVALUATION RECORD

1. **CHEMICAL:** Clethodim.
Shaughnessey No. 059639.

2. **TEST MATERIAL:** Select (Clethodim); CAS No. 99129-21-2; 82.4% purity; a brown-amber liquid.

3. **STUDY TYPE:** Non-Target Plants: Vegetative Vigor Nontarget Phytotoxicity Study - Tier 2. Species Tested: Ryegrass, Corn, Oat, Onion.

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5. **REVIEWED By:**

Mark A. Mossler, M.S.
Agronomist
KBN Engineering and
Applied Sciences, Inc.

Signature: Mark A. Mossler
Date: 3/8/91

6. **APPROVED BY:**

Pim Kosalwat, Ph.D.
Senior Scientist
KBN Engineering and
Applied Sciences, Inc.

Signature: P. Kosalwat
Date: 3/8/91

Henry T. Craven, M.S.
Supervisor, EEB/HED
USEPA

Signature:
Date:

10 hrs

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7. **CONCLUSIONS:**

Vegetative Vigor: This study is scientifically sound and meets the requirements for a Tier 2 vegetative vigor test using non-target plants. The NOEC for onion for all parameters tested was 0.25 lb ai/A. Corn was the most sensitive species with respect to phytotoxicity. The NOEC values for phytotoxicity (in lb ai/A) for corn, ryegrass, and oat were 0.003, 0.006, and 0.013, respectively.

Ryegrass was the most sensitive species with respect to plant height. The NOEC values for plant height (in lb ai/A) for ryegrass, corn, and oat were 0.003, 0.006, and 0.013, respectively.

Ryegrass was again the most sensitive species with respect to plant dry weight. The NOEC values for plant dry weight (in lb ai/A) for ryegrass, corn, and oat were 0.003, 0.006, and 0.013, respectively.

8. **RECOMMENDATIONS:** A Tier 3 study is required.

9. **BACKGROUND:** N/A

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., ryegrass, oat, corn, and onion). Cultivars, lot number, and germination ratings were provided in the report.

B. **Test System:**

Seedling Establishment: Seeds of each crop were planted in plastic pots (7.5 x 7.5 x 6.0 cm) and filled with a sterilized soil mix. A plexiglass template was used to create planting holes in the soil, thus allowing for uniform planting depth and seed distribution. Oat and corn were planted at a depth of 2.5 cm, while ryegrass and onion were planted at a depth of 1.3 cm. An analysis of the soil was provided in the report. After emergence, each pot was thinned to five plants/pot. The four plant species were allowed to grow for 7-12 days before treatment to allow

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each species to attain the 1-3 true leaf stage. Each treatment replicate was placed on an aluminum tray (6.125 x 31.125 cm). The spray plot was 3.21 x 1.67 ft (i.e., 5.36 ft^2).

All applications were performed with a belt sprayer equipped with a single nozzle. A nozzle height of 12 inches and a nozzle pressure of 50 psi were used. The test spray solutions were prepared by dissolving clethodim technical in deionized water and acetone. The plants were sprayed at the equivalent of 468 l/ha (50 gpa) of water.

The pots were watered three times a day and a total of 25 ml of water was used to irrigate each pot per day.

C. **Dosage:** Clethodim was applied at a rate of 0.25, 0.125, 0.0625, 0.0313, 0.0156, and 0 lb ai/A to all plant species. Continuation tests were conducted on oat, corn, and ryegrass. These application rates were 0.025, 0.013, 0.006, 0.003, 0.002, and 0 lb ai/A. Treatment application rates were adjusted for the percent purity of the test material (82.4%).

D. **Design:** Each crop/treatment combination was replicated five times (i.e., 5 plants/pot, 5 pots/treatment level). After treatment, the pots were randomized within crops and among treatments and placed in an on-site greenhouse.

Plant height was measured by extending the seedling to its maximum height and recording the height to the nearest millimeter. The mean plant height was calculated at 0 and 21 days after application.

Plant phytotoxicity was monitored at 7, 14, and 21 days after treatment. The phytotoxicity ratings evaluated five observable toxic effects: 0-indicates no effect; 1-indicates slight plant effect; 2-indicates a moderate effect (e.g., mild stunting or chlorosis); 3-indicates a severe effect; and 4-indicates a total effect or plant death.

Twenty-one days after treatment, the plants within treatment replicates (pots) were cut at the soil level and dried in a pre-weighed paper bag at 70°C for a minimum of 48 hours. After drying, the dry weight of the plant material was recorded.

Temperature, relative humidity, photoperiod, and

illuminance during the period of growth were provided in the report.

E. **Statistics:** All data were entered into a Lotus 1-2-3 spreadsheet. The spreadsheet calculated replicate means, treatment means, standard deviations, and analysis of variance tables. Treatment means were used to calculate the percent effect resulting from the treatment. The percent effect was calculated using the following equation:

$$\% \text{ effect} = \frac{(\text{treatment mean} - \text{control mean})}{\text{control mean}} \times 100$$

Plant heights taken prior to treatment were used as a baseline to calculate the percent effect on growth at the 21 day observation period. The percent increase in height from the 0 day reading was calculated using the following equation:

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An analysis of variance table was constructed using the Lotus 1-2-3 raw data spreadsheet. A one-way analysis of variance (ANOVA) model for data with equal sub-samples was used to analyze the data. The F-value from the analysis of variance table and an F table were used to determine if the treatment means were significantly different ($p < 0.05$). Treatment mean separation was achieved using either SAS or the LOTUS 1-2-3 spread-sheet.

The percent effect values were input into a SAS probit analysis program. The program ignores positive values and transforms the dose by natural logarithms. For plant height and dry weight, the probit is calculated using replicate means.

12. **REPORTED RESULTS:**

Phytotoxicity rating: Statistical analysis of the 21 day phytotoxicity ratings showed no significant difference

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between control and any treatment level for onion plants. However, treatment of corn, oat, and ryegrass with clethodim did result in a significant increase on mean phytotoxicity. The NOEC values (in lb ai/A) for the four species, in increasing sensitivity to clethodim, are as follows:

onion (0.25) < oat (0.013) < ryegrass (0.006) < corn (0.003).

Plant height: Statistical analysis of the 21 day plant height data showed no significant difference between control and any treatment level for onion plants. Treatment of corn, oat, and ryegrass with clethodim did result in a significant decrease on plant height. The NOEC values (in lb ai/A) for the four species, in increasing sensitivity to clethodim, are as follows:

onion (0.25) < oat (0.013) < corn (0.006) < ryegrass (0.003).

Oat, corn, and ryegrass exhibited a dose response in the continuation studies, therefore, probit analysis was conducted to estimate EC values. These values are listed in Table 4 (attached).

Plant dry weight: Statistical analysis of the plant dry weight data showed no significant difference between control and any treatment level for onion plants. Treatment of corn, oat, and ryegrass with clethodim did result in a significant decrease on plant height. The NOEC values (in lb ai/A) for the four species, in increasing sensitivity, are as follows:

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Oat, corn, and ryegrass exhibited a dose response in the continuation studies, therefore, probit analysis was conducted to estimate EC values. These values are listed in Table 4.

13. **STUDY AUTHOR'S CONCLUSIONS/QUALITY ASSURANCE MEASURES:**
"A no-effect concentration was reached on all measurement parameters for oat, ryegrass, corn, and onion."

The Quality Assurance Unit of Pan-Agricultural Laboratories, Inc., was responsible for the assurance of compliance with

Good Laboratory Practice (GLP) Standards. Statements of compliance to GLP and QA were enclosed in the report.

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:

All plants in each replicate were weighed together, then the total weight was divided by the total number of plants to obtain each replicate mean value. The plants should have been individually weighed so the variation among plants within each replicate could be accounted for in the statistical analysis of the data.

The Herbicide Handbook (WSSA '89) lists the maximum label rate of clethodim as 0.6 lb ai/A. If this is the case, these tests need to be conducted again at this maximum rate.

B. **Statistical Analysis:** Statistical analyses were conducted on ryegrass (the most sensitive species) data for dry weight (attached). No-effect concentration data was analyzed using Dunnett's comparison test and EC values were computed using a probit analysis program. The results are in near agreement with the author's.

C. **Discussion/Results:**

These studies are scientifically sound and meet the requirements for Tier 2 vegetative vigor test using non-target plants.

Phytotoxicity rating: Based on phytotoxicity ratings, only onion demonstrated no effect from clethodim application at 21 days after treatment. Oat, corn, and ryegrass did show significant ($p < 0.05$) signs of phytotoxicity at 21 days with corn being the most sensitive.

Plant height: Only onion was not significantly ($p < 0.05$) affected by clethodim application after 21 days. Plant height was significantly decreased for the remainder of the species, with ryegrass being the most sensitive.

Plant dry weight: Onion dry weight was not significantly ($p < 0.05$) affected by clethodim

application after 21 days. Plant dry weight was significantly decreased for the remainder of the species, with ryegrass being the most sensitive.

D. **Adequacy of the Study:**

(1) Classification: Core.

(2) Rationale: N/A.

(3) Repairability: N/A.

15. **COMPLETION OF ONE LINER:** N/A.

CLETHODIM

Page 15 is not included in this copy.

Pages _____ through _____ are not included in this copy.

The material not included contains the following type of information:

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_____ Identity of product impurities.

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ryegrass avg ht

Summary Statistics and ANOVA

Transformation = None

Group	n	Mean	s.d.	cv%
rate (lb a.i./A)				
1 = control	3	28.3333	4.9329	17.4
2 .0016	3	39.0000	9.6437	24.7
3 .0031	3	24.6667	9.0738	36.8
4* .0063	3	10.3333	7.5056	72.6
5* .0125	3	5.0000	2.6458	52.9
6* .025	3	5.3333	4.5092	84.5

NOEC = 0.0031

*) the mean for this group is significantly less than
the control mean at alpha = 0.05 (1-sided) by Dunnett's test

Minumum detectable difference for Dunnett's test = -14.027090
This difference corresponds to -49.51 percent of control

Between groups sum of squares = 2930.444444 with 5 degrees of freedom.

Error mean square = 47.222222 with 12 degrees of freedom.

Bartlett's test p-value for equality of variances = .645

ryegrass weight

Estimated EC Values and Confidence Limits

Point	Conc.	Lower 95% Confidence Limits	Upper 95% Confidence Limits
EC 1.00	0.0009	0.0000	0.0028
EC 5.00	0.0016	0.0000	0.0040
EC10.00	0.0023	0.0000	0.0051
EC15.00	0.0028	0.0000	0.0061
EC50.00	0.0071	0.0013	0.1157
EC85.00	0.0179	0.0081	52792.2810
EC90.00	0.0223	0.0096	1509260.8800
EC95.00	0.0308	0.0119	222872656.0000
EC99.00	0.0565	0.0173	%2721944700000.0000

$EC_{25} = 0.0046$ lb ai/A.

$y = 10.55 + 2.58x$

$y =$ % probit response

$x =$ log (conc.)