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Item ID Number: 00053

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Report/Article Title Downwind Travel of Herbicides (U): Procedures to be Used in Trials 15-22, Field Experiment No. 593

Journal/Book Title

Year 1972

Month/Day April

Color —

Number of Images 12

Description Notes Project No. 97-97-01

AD 900219
UNCLASSIFIED

SUFFIELD MEMORANDUM NO. 15/72

AD 900219

DOWNWIND TRAVEL OF HERBICIDES (U)
(Procedures to be Used in Trials 15 - 22,
Field Experiment No. 593)

by

B.G. Cameron and J. Monaghan

PROJECT NO. 97-97-01

April 1972

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SYNOPSIS: DRES SUFFIELD MEMORANDUM NO. 15/72

WORKING NO: 97-97-01

TITLE: Downwind Travel of Herbicides (U)
(Procedures to be Used in Trials 15 - 22,
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AUTHOR: B.G. Cameron and J. Monaghan

DATE: April 1972

SECURITY GRADING: UNCLASSIFIED INITIAL DISTRIBUTION: May 1972

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REFERENCES

1. a) Suffield Memorandum No. 48/71
b) DRES Chemistry Memorandum No. 17/72
c) Field Trials suggested by Canada Department of Agriculture, 29 Feb. 72

BACKGROUND

2. DRES has assisted the Saskatchewan Research Council (SRC) and the Canada Department of Agriculture (CDA) in trials with 2,4-D formulations in 1969, 1970 and 1971. Results from Trials 4-14 of this series, which were done with C¹⁴ tagged materials, show that the downwind drift of 2,4-D dimethylamine salt is largely restricted to fine aerosol which is released with the spray. However, with 2,4-D butyl ester and isooctyl ester the initial drift of aerosol is followed by vapour evolved from the sprayed area.

3. SRC/CDA wish to confirm the aerosol and vapour results for the isooctyl ester and to determine the downwind drift of aerosol of the dimethylamine salt at different volume applications per unit area. DRES has a continuing interest in the trials for the purpose of making fundamental measurements of the sprayed material and application of the results to diffusion models.

OBJECTIVES

3. a) SRC/CDA

(1) To determine the effect of volume application on downwind drift of aerosol of 2,4-D dimethylamine salt at two application levels:

- (a) 10 oz/acre in water solution sprayed at the rate of 5 gal/acre
- (b) 10 oz/acre in water solution sprayed at the rate of 10 gal/acre

(2) To measure the downwind drift and vapour evolution from 2,4-D isooctyl ester sprayed at 10 oz/acre in water emulsion at the rate of 10 gal/acre at two ground temperatures.

b) DRES

(1) To determine the wind and size range of droplets from selected spray nozzles.

(2) To determine the density and drop size of ground deposits from the sprays with each 2,4-D compound.

(3) To determine the drop size of the airborne droplet clouds and the change in droplet size with downwind distance.

(4) To examine the distribution of 2,4-D compounds in vegetation on and downwind of the sprayed areas.

SCOPE

4. Two successful trials are required in each of the cases stated under SRC/CDA objectives. A double sampling layout will be provided so that two trials can be done under identical weather conditions.

SITE

5. A suitable area near the Vertical Grid Layout.

WEATHER

- 6.
 - a) Wind direction: any
 - b) Wind speed: 8-16 mph
 - c) Temperatures:
 - (1) Air - NOT higher than 95°F for trials with 2,4-D dimethylamine
 - (2) Ground - near 75°F and 100°F for two sets of trials with 2,4-D isooctyl ester
 - d) Precipitation: NIL for 24h prior to and during a trial
 - e) Stability: Neutral to moderate lapse

MATERIAL

- 7.
 - a) 2,4-D dimethylamine and 2,4-D isooctyl ester, tagged C¹⁴; 20 mCi of each compound at 5-10 mCi/m.mole.
 - b) The above materials, untagged, provided by CDA.
 - c) Boom sprayers with modified stainless steel tank operated at 40 psi.
 - d) Nozzles No. 650067 and No. 65015 provided by SRC.

- e) Pie plates - 60 (for duplicate trials)
- f) Cascade impactors - 18 (for duplicate trials)
- g) Chromatographic (silica gel) paper, 4" x 4" - 256 (total)
- h) Rotary droplet samplers - 14 (for duplicate trials)
- j) Silica gel samplers - 264 (total)
- k) Gasoline pumps - 54 plus spares
- l) High volume air samplers - 5 (single layout)
- m) 5KVA electrical generator

LAYOUT

8. Two sampling layouts with detail as shown in Figure 1 are required.

9. Sampling Methods:

a) Ground deposits - dry pie plates, with lid, each containing a 4" x 4" sheet of silica gel chromatographic paper, will be placed on the sprayed area to measure ground deposits and downwind to measure drift.

b) Spray - Rotary droplet samplers will be used to collect sprayed droplets for sizing. Electric power is required for this purpose.

c) Vapour and Aerosol - silica gel samplers, operated at 30 l.min^{-1} by gasoline pumps, will be used to collect vapour and aerosol samples. The samplers will be oriented downwind at all sampling positions for measurement of vapour components. Vapour and aerosol components will be measured at certain sampling positions by means of silica gel samplers oriented upwind. Samples of airborne particulates will also be collected for sizing by means of Cascade impactors. High volume air samplers, operated at 830 l.min^{-1} will also be used to obtain particulate samples. Electrical power is also required for these devices.

METEOROLOGICAL OBSERVATIONS

10. A meteorological station will be established close to the upwind edge of the layout to obtain the following information:

- a) Wind speeds at 1/2, 2 and 4m
- b) Wind direction at 2m
- c) Air temperatures
- d) Ground temperatures
- e) Temperature gradient 4m - 1/2m
- f) Relative humidity
- g) Cloud conditions and sunshine

PROCEDURE

11. Initial dilution of tagged 2,4-D compounds, with untagged materials, will be done in Room 223P Central Laboratory. Subsequent addition of water will be done at the trial site.
12. The layout will be oriented on the basis of the forecast wind direction and spray areas will be marked across wind. Duplicate layouts (Figure 1) separated by at least 25m are required.
13. Samplers will be emplaced and tested on both halves of the layout. When this work is completed a dry run will be made with the boom sprayer to check that a traverse speed of 8 mph can be maintained. The boom sprayer will be charged with the appropriate 2,4-D formulation and the weight of charge will be determined. A sample of the charge will be taken after initial agitation.
14. Aspirated samplers and rotary droplet samplers will be started and pie plate lids will be removed. On instructions from H/TSS the layout will be sprayed in a single pass. The weight of charge remaining in the tank will be determined and a sample of the charge will be taken. The charge residue will be drained into a suitable container and retained for future use. Zero for a trial will be the start of spraying. Recharging of the boom sprayer and adjustments to nozzles, as necessary, will be done in the gap between layouts.
15. Following the spraying operations on any day the boom sprayer will be thoroughly rinsed with water in readiness for subsequent work.
16. Pie plates will be capped and picked up as soon as a spray pass is completed. Rotary droplet samplers will be switched off and collected thereafter. These samples will be returned to the Central Laboratory as soon as possible after spraying.
17. Silica gel samplers will be oriented as follows at 1/2, 1 and 2m heights.

<u>POSITION</u>	<u>DIMETHYLAMINE</u>	<u>ISOCTYL ESTER</u>
1	1U + 2D	1U + 4D
2	1D	1D
3	1D	1D
4	1U + 2D	1U + 4D
5	1D	1D
6	1D	1D
7	1U + 2D	1U + 4D
8	1U + 1D	1D
9	1U + 1D	1D
10	1U + 1D	1D

U = Upwind, D = Downwind

18. Vapour and aerosol sampling will proceed according to the following schedule:

a) Aerosol

- (1) Silica gel samplers: Z to Z + 3 min
- (2) Cascade impactors: Z to Z + 3 min
- (3) High Volume Air Samplers: Z to Z + 3 min

b) Vapour

(1) Silica gel samplers at Positions 1, 4 and 7:

(a) 2,4-D dimethylamine:

- Z to Z + 3 min
- Z + 3 to Z + 30 min

(b) 2,4-D isooctyl ester:

- Z to Z + 3 min
- Z + 3 to Z + 30 min
- Z + 30 to Z + 90 min
- Z + 90 to Z + 180 min

(2) Silica gel samplers at remaining positions:

(a) 2,4-D dimethylamine:

- Z to Z + 30 min

(b) 2,4-D isooctyl ester:

- Z to Z + 180 min

19. It is expected that the trials will be done in the following order commencing on or about 24 May 1972:

- a) 2,4-D isooctyl ester: ground temperature near 75°F
- b) 2,4-D dimethylamine: 5 oz/acre at 10 gal/acre and 10 oz/acre at 10 gal/acre
- c) 2,4-D isooctyl ester: ground temperature near 100°F
- d) 2,4-D dimethylamine: 5 oz/acre at 10 gal/acre and 10 oz/acre at 10 gal/acre

Details of formulations and nozzle sizes for these trials are listed in Annex 1.

PHOTOGRAPHY

20. A still, black and white photographic record of the layout and sampling equipment will be taken on one trial occasion. Black and white negatives of Cascade impactor slides, at magnification to be specified by SRC, are required for all trials.

ANALYSIS

21. Ground deposits, vapour and aerosol recoveries will be analyzed by liquid scintillation counting. Droplet sizing from rotary sampler papers will be done by stain count/size technique. Analysis of Cascade impactor slides will be carried out by SRC.
22. It is expected that a total of 40 mCi of C^{14} tagged 2,4-D dimethylamine and isooctyl ester will be at DRES prior to this series of trials. The amount of C^{14} to be used in any one trial will be nominally 5.0 mCi. On receipt, the tagged 2,4-D ester and 2,4-D amine will be kept in the Radioactive Storage Building. All mixing of these materials for spraying will be done at that location.
23. Film badges will be worn by all personnel engaged in the trials with radioactive material.
24. The vehicle used to transport tagged material from the mixing site to the layout will carry "Radioactive Material" signs front and rear and on both sides. The boom sprayer reservoir will carry a trifoil radiation warning sign.
25. The boom sprayer will be flushed three times with water and once with isopropyl alcohol following each trial with tagged material. Unused residues from the trials will be collected on site in suitable containers which will be dumped in the Radioactive Disposal Area.
26. Rooms 222E and 222P, Central Laboratory, are designated as the areas in which samples from trials with tagged materials will be handled. The rooms will be signed accordingly (medium level laboratory) and access to them will be restricted to personnel directly concerned with this field experiment.
27. A post trial survey will be conducted to follow the decay of beta activity in the sprayed area. It is expected that this will not be measurable for more than 30 days.

ADMINISTRATION

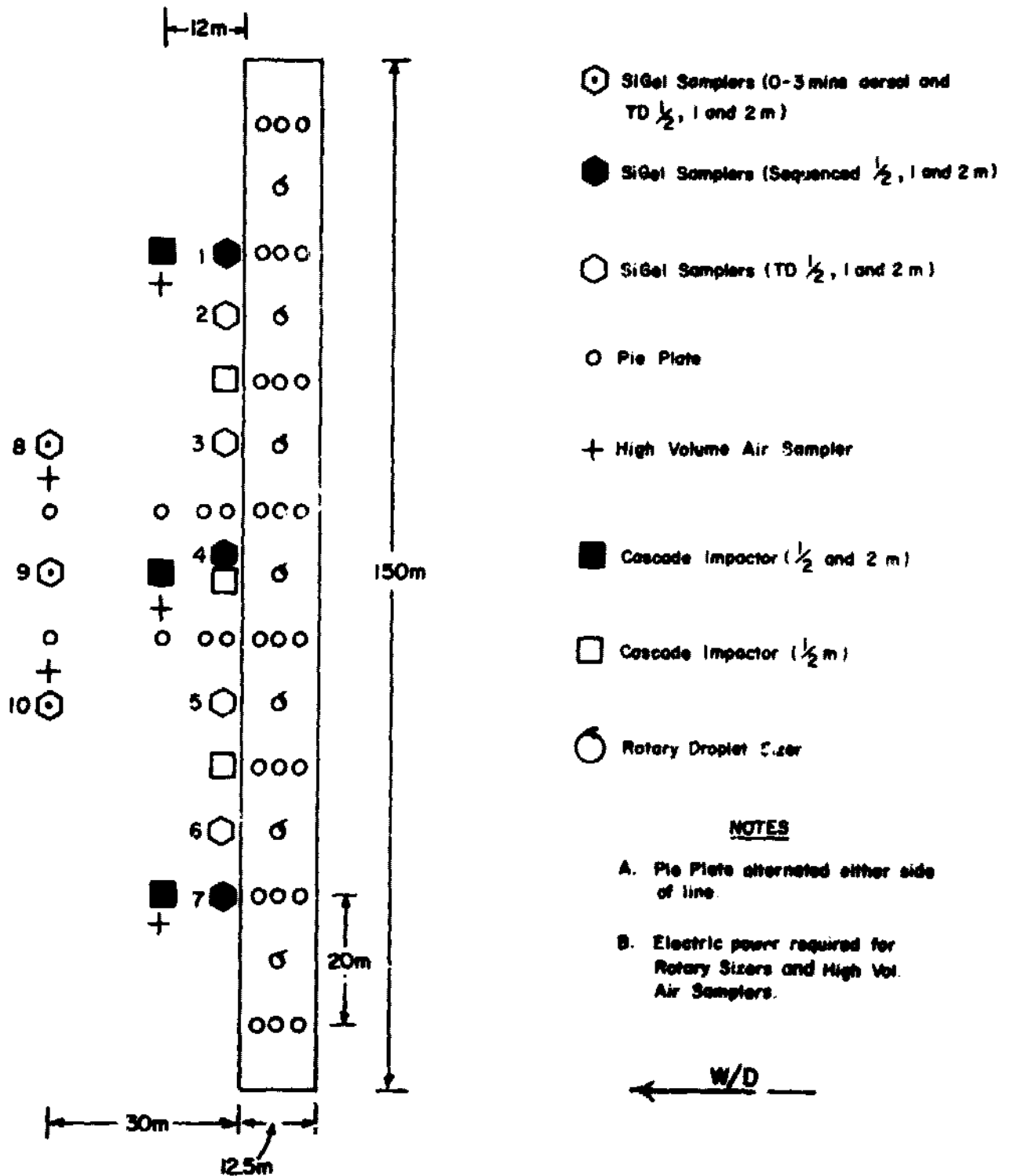
28. a) H/Chem Provide Radiation Safety Officer, Chemical test team, co-ordinate sampling schedule and record sampling times. Provide sampling equipment; arrange for purchase of C^{14} tagged materials; assist in analysis; prepare report dealing with DRES objectives. Provide film badges as required.
- b) H/TSS In charge of trial. Layout preparation. Record zero and spray run times. Provide spray apparatus. Sample of sprayed materials taken before and after each spray run to Chem Section. Mix 2,4-D materials and water as directed by SRC. Provide "Radioactive Material" signs for Munitions vehicle as required. Record of amount of agent dispersed.

- c) H/Met Forecast and meteorological observations.
- d) SRC/CDA Provide untagged 2,4-D esters and amine, photographic paper for droplet sizing studies and nozzles. Assist in layout and sample preparation and analysis. Prepare report dealing with SRC/CDA objectives.
- e) e) H/Photo Group Still photography.

F.E. 593 - DOWNWIND TRAVEL OF HERBICIDES

SUMMARY OF TRAILS 15-22

SERIAL	2,4-D FORMULATION	GROUND TEMPERATURE (-°F)	NOZZLE NO.	APPLICATION RATES		REMARKS
				oz/acre	gal/acre	
1	Isooctyl ester	~ 75	65015	10	10	-
2	Isooctyl ester	← Duplicate of Serial 1 →				On same day as Serial 1, as soon as possible thereafter.
3	Dimethylamine	~ 80	650067	5	10	Air temperature ≤ 95°F
4	Dimethylamine	~ 80	65015	10	10	Air temperature < 95°F. On same day as Serial 3, as soon as possible thereafter.
5	Isooctyl ester	~100	65015	10	10	-
6	Isooctyl ester	← Duplicate of Serial 5 →				On same day as Serial 5, as soon as possible thereafter.
7	Dimethylamine	~ 80	650067	5	10	Air temperature ≤ 95°F
8	Dimethylamine	~ 80	65015	10	10	Air temperature < 95°F. As soon as possible after Serial 7.



- ⬡ SiGel Samplers (0-3 min cascade and TD 1/2, 1 and 2 m)
- ⬢ SiGel Samplers (Sequenced 1/2, 1 and 2 m)
- ⬠ SiGel Samplers (TD 1/2, 1 and 2 m)
- o Pie Plate
- + High Volume Air Sampler
- Cascade Impactor (1/2 and 2 m)
- Cascade Impactor (1/2 m)
- ⊙ Rotary Droplet Sizer

NOTES

- A. Pie Plate alternated either side of line.
- B. Electric power required for Rotary Sizers and High Vol. Air Samplers.

LAYOUT DIAGRAM F.E. 593 (TRIALS 15-22)

FIGURE 1