# Fenitrothion Residues in Blueberry Fields after Aerial Forest Spraying

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In recent years blueberry growers in New Brunswick have been concerned about the possible side effects of forest spraying for spruce budworm control near their fields. Some have asked for compensation, claiming decreased production because the spray program has seriously affected the supply of native pollinating insects. Fenitrothion (O, O-dimethyl O -(4 nitro-m-tolyl) phosphorothioate) is presently being used to spray large areas of forest in New Brunswick and the effect of low application rates (140 - 280 g/hectare) on native bees is not fully understood. However, the chemical is rated as highly toxic to honeybees (ATKINS et al., 1970; SOUTHWELL and COOPER, 1973) and this is regarded as sufficient reason to exercise some control over spraying near commercial blueberry land.

Following these expressions of concern by blueberry growers, spray applicators have made concerted efforts to avoid action which might prove harmful to blueberry pollinators. They have agreed not to spray within two miles (3.2 Km) of designated fields during the bloom period and to limit their activities near these fields to periods when the temperature is below 45°F (7.2°C). Even under these restrictions fields cannot be avoided with certainty because of the difficulty of absolute compliance with flight plans and the drift associated with aerial application of insecticides.

This paper presents the findings of surveys carried out in 1972, 1973 and 1974 to determine the extent of fenitrothion drift into blueberry fields during sprays for spruce budworm control.

## MATERIALS AND METHODS

### Sample Collection

Information on the proposed spray program was provided by the applicators in advance of each season's activity and commercial blueberry fields in the vicinity of the area to be sprayed were selected for monitoring. Field locations ranged from approximately three to sixteen



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Km from the nearest designated spray block. A few days before spraying began clean glass plates (5.08 cm x 30.5 cm) were set out in each field at intervals of one hundred meters. In 1972, six plates per field were used and in 1973 and 1974, three plates per field. Controls were obtained by placing similar plates in remote fields.

Between one-half and two hours after nearby forest areas were sprayed, the glass plates were collected and washed immediately with acetone (1972) or benzene (in 1973 and 1974). The washings were collected in clean amber-colored glass jars and stored at 0°C until the analysis for fenitrothion was made. These acetone washings containing small amounts of water were transferred to 100 ml Erlenmeyer flasks and concentrated to about 3 ml on an all-glass rotary evaporator. This solution was shaken twice with 25 ml portions of benzene and the suspension transferred to 100 ml separatory funnels, centrifuged and the aqueous layer discarded. The benzene layer was evaporated to dryness on a rotary evaporator and the residues taken up in 3 ml of dry acetone. When the plates were washed with benzene the washings were centrifuged in separatory funnels to remove water droplets, and concentrated similarly. All concentrated residue solutions were kept at 0°C until suitable aliquots were analyzed by gas chromatography. Reagent blanks were carried through the analytical procedure.

Residues were determined with a Tracor MT-220 gas chromatograph fitted with a dual flame-photometric detector. Both P & S modes were operated simultaniously using a dual electrometer and dual recorder. The P mode was used for quantitative measurement as its response was linear and the S mode for qualitative confirmation. Standard curves were prepared at frequent intervals. In 1972 and 1973 peak heights were plotted vs fenitrothion injected; in 1974 peak areas (determined with the Infotronics CRS-208E automatic digital integrator) were used.

A 6 ft x 1/4 in (182.88 cm x 0.635 cm) Pyrex glass column packed with 3% OV-1 on chromosorb W was employed. The oven temperature was 195°C and carrier gas was nitrogen at 60 ml/minute. The retention time of fenitrothion was 3.5 minutes.

Sampling Sites

1972 survey. Two fields in Charlotte County (Fig. 1, Area 1) and five fields in Kings County (Figure 1, Area 2) were sampled on May 26. All fields were located about 3 km from sprayed forest.

1973 survey. Fields were sampled in Charlotte County (Fig. 1, Area 1) between May 27 and June 4. Five fields were approximately three kilometers from the sprayed area, five were located three to eight kilometers from the sprayed area and four were approximately sixteen kilometers distant.

1974 survey. Glass plates were set out in 25 fields located about three kilometers from the spray area and in eight fields located three to eight kilometers from the nearest spray area. Sampling was done in Charlotte (Area 1), Kings (Area 2), Westmorland (Area 3), Gloucester and Northumberland (Area 5) Counties between May 22 and June 12.

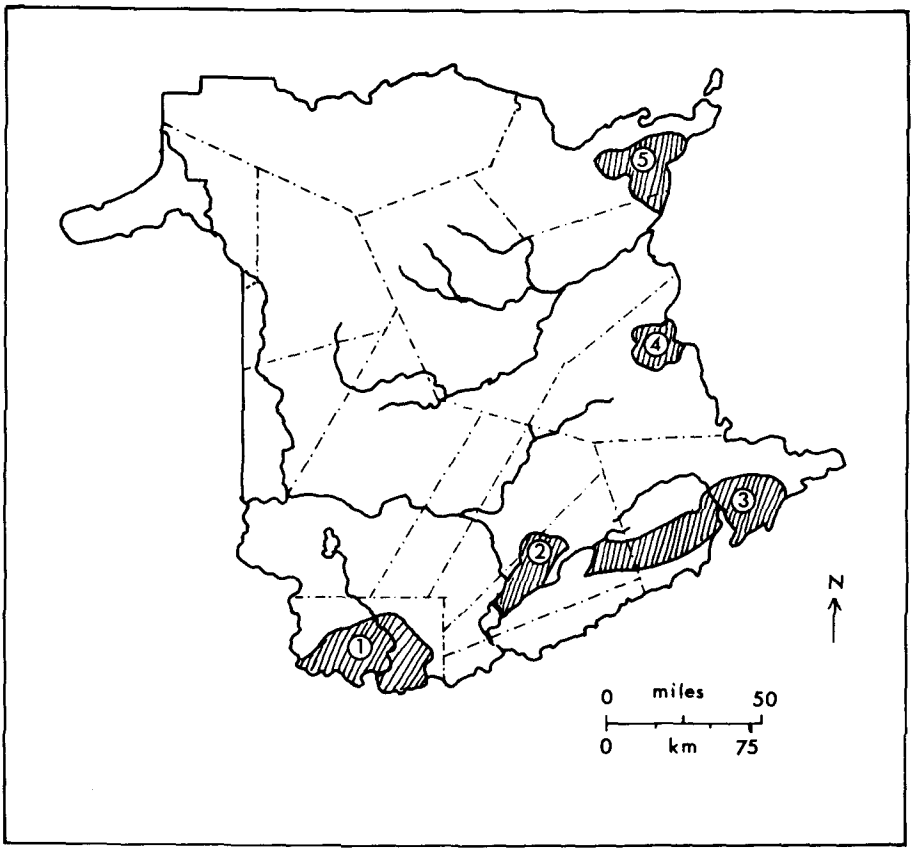


Figure 1. Map of New Brunswick showing the location of the major blueberry-producing areas of the province. Fields in Area 1 were monitored for fenitrothion residue in 1972, 1973 and 1974; fields in Area 2 were monitored in 1972 and 1974; fields in Areas 3 and 5 were monitored in 1974.

## RESULTS AND DISCUSSION

1972 survey. All sample fields showed evidence of fenitrothion residues ranging from 0.17 g/hectare to 13.84 g/hectare (Table 1). The low standard errors of the mean indicate that the spray deposit was fairly uniform in each field and suggest that this method of estimating spray deposits was satisfactory.

TABLE 1

Fenitrothion residues in N.B. blueberry fields - 1972

| Location | Distance from sprayed area | Residue g/hectare[a] |
|---|---|---|
| Area 1 - field 1 | ca. 3 kilometers | 6.92 ± 0.49 |
| field 2 | " | 13.34 ± 0.49 |
| Area 2 - field 1 | " | 1.63 ± 0.22 |
| field 2 | " | 1.14 ± 0.17 |
| field 3 | " | 0.30 ± 0.02 |
| field 4 | " | 13.84 ± 0.74 |
| field 5 | " | 0.17 ± 0.02 |

[a]Means of 6 replicates with standard errors.

Although all seven fields were approximately three kilometers from the sprayed areas the amount of residue varied greatly. This variability may have resulted from wind patterns at the time of spraying, but it also suggests that some aircraft may have come closer to the sample fields than others. Flight plans call for a 3.2 kilometer separation from the blueberry fields; during the actual operation it is very difficult to determine such distances accurately.

1973 survey. All fields at distances of approximately 3 kilometers from sprayed forests contained some fenitrothion spray residues with amounts ranging from 0.99 to 18.04 g/hectare (Table 2). Fields located between three and eight kilometers from the sprayed area had detectable fenitrothion residues. Again the degree of adherence of the spray planes to flight plan and wind character were probably responsible for the variability in residues between fields. Samples collected at three locations within an area directly below an operational spray of 215 g fenitrothion/hectare showed deposits of 36.8, 61.8, and 133.4 g/hectare. In another field where a private applicator used fenitrothion at the rate of 280 g/hectare deposits of 22.7, 39.0, and 40.5 g/hectare were found.

TABLE 2

Fenitrothion residues in N.B. blueberry fields - 1973

| Location | | Distance from sprayed area | Residue g/hectare[a] |
|---|---|---|---|
| Area 1 - | field 1[a] | ca. 3 kilometers | 12.60, 18.04 |
| | field 2 | " | 8.15, 5.44, 5.68 |
| | field 3 | " | 7.66, 5.68, 6.18 |
| | field 4 | " | 1.73, 1.48, 0.99 |
| | field 5 | " | 0.99, 0.99, 0.99 |
| | field 6 | 3-8 kilometers | 0.03, 0.07, 0.12 |
| | field 7 | " | 0.02, trace[b] |
| | field 8 | " | 0.02, 0.07, 0.07 |
| | field 9 | " | 0.15 |
| | field 10 | " | trace, trace, trace |
| | field 11 | 16 kilometers | nil[c], nil, nil |
| | field 12 | " | nil, nil, nil |
| | field 13 | " | nil, nil, nil |
| | field 14 | " | nil, nil, nil |

[a]Field designations apply only to the year of analysis.
[b]Trace <0.01 g/hectare but identified as fenitrothion.
[c]Nil <0.01 g/hectare - fenitrothion not detected.

1974 survey. Twenty-two of the twenty-five fields located three kilometers from sprayed forest had detectable fenitrothion residues - one field having a deposit of 77.59 g/hectare (Table 3). There was a detectable level of fenitrothion in only one field located more than three kilometers from a sprayed block.

Collection of residues from glass plates was superior to their extraction from blueberry foliage because the lack of interferences in the washings eliminated the need for clean-up and permitted the concentrations of extracts to a low volume, thus increasing the sensitivity of the method. Benzene absorbed less water than acetone when used to dissolve the fenitrothion residues from glass plates but because of its higher freezing point it presented some problems in the field and in cold storage.

TABLE 3

Fenitrothion residues in N.B. blueberry fields - 1974

| Location | Distance from sprayed area | Residue g/hectare |
|---|---|---|
| Area 1 - field 1 | ca. 3 kilometers | 0.17, 0.05, nil |
| field 2 | " | nil, nil |
| field 3 | " | nil, nil, nil |
| field 4 | " | nil, nil, nil |
| field 5 | " | 1.26, 0.86, 0.82 |
| field 6 | " | 8.23, 7.22, 3.46 |
| field 7 | " | 0.42, 0.25, 0.17 |
| field 8 | " | 3.93, 3.78 |
| field 9 | " | 0.67, nil, nil |
| field 10 | " | 0.25, 0.20, 0.07 |
| field 11 | " | 0.15, 0.15, 0.12 |
| field 12 | " | 31.58, 29.45, 25.13 |
| field 13 | " | 9.79, 9.17, 7.17 |
| field 14 | " | 9.04, 0.64, 0.10 |
| field 15 | " | 2.55, 0.82, 0.02 |
| Area 2 - field 1 | " | 77.59, 74.48, 39.73 |
| field 2 | " | 6.28, 5.58, 5.36 |
| field 3 | " | 11.27, 9.96, 7.63 |
| Area 3 - field 1 | " | 0.25, trace, nil |
| field 2 | " | 1.58, 1.33, 1.31 |
| field 3 | " | trace, trace, trace |
| field 4 | " | 64.74, 52.88, 38.84 |
| Area 5 - field 1 | " | trace, nil, nil |
| field 2 | " | trace, nil, nil |
| field 3 | " | 1.36, 1.26, 1.24 |
| Area 1 - field 16 | " | 0.79, trace, nil |
| field 17 | " | nil, nil, nil |
| field 18 | " | nil, nil, nil |
| field 19 | " | nil, nil, nil |
| field 20 | " | nil, nil, nil |
| field 21 | " | nil, nil, nil |
| field 22 | " | nil, nil, nil |
| field 23 | " | nil, nil, nil |

This study indicates that fenitrothion residues were deposited in most blueberry fields sampled within three kilometers of sprayed forest and that detectable amounts were found in some fields at distances up to eight kilometers from the nearest spray application. The biological significance of these findings is not known because the effects of these levels of fenitrothion on organisms affecting the blueberry crop are yet to be determined.

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