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THE PERSISTENCE OF FENITROTHION INSECTICIDE IN BALSAM FIR ABIES BALSAMEA (L.) MILL. DEER BROWSE

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From 30 September 1976 to 30 September 1977, 2 vegetation plots were monitored bimonthly to establish fenitrothion concentrations on balsam fir browse. The data obtained indicate persistence of fenitrothion on the sprayed and control plots. The sprayed quadrant had an average concentration of 0.31 ppm over the 12 month period whereas the control plot, which was not sprayed in 1976 or 1977, had an average concentration of 0.05 ppm. The control plot was sprayed during the 1975 spray program. Fenitroxon was detected in 2 of the samples taken from the sprayed plot. None was detected within the control plot. In reviewing the literature, there is no evidence that a fenitrothion concentration of the magnitude detected would have obvious effects on deer populations.

Introduction

Fenitrothion, 0, 0-dimethyl 0-(4 nitro-m-tolyl) phosphorothioate, has been used since 1969 to control spruce budworm *Choristoneura fumiferama* (Clemens) in the forest of the Canan Game Reserve, New Brunswick. Various workers (Shishido 1972; Miyamoto 1969; Nigam 1971) have previously shown the short persistence and fate of fenitrothion in a natural environment. Furthermore Yule and Duffy (1972) and Sundaram (1974) demonstrated that fenitrothion can persist in a coniferous forest in concentrations ranging from 0.80 to 0.14 ppm over a 5 year period.

This project evaluated residual concentrations of fenitrothion and its oxygen analogue in balsam fir *Abies balsamea* (L.) Mill. Previous studies by Crête (1976) and unpublished data obtained from the monitoring of deer yards in southeastern New Brunswick indicate that balsam fir plays an important role in the diet of the Whitetail deer *Odocoileus virginianus* (Zimmermann) during late spring yarding. It was anticipated that a high concentration of fenitrothion might have a negative effect on the intestinal rumen flora.

Study Area and Methods

The field experiment was located in the Canaan Game Reserve area 21 miles northwest of Moncton within longitude 65° 30′ and latitude 46°20′. The experimental spray plot T-1 was 20 ft from Alward Brook inside spray block 279 of the 1977 spray program. The control plot C-1 was along the south side of Canaan River about 11 miles from the sprayed plot. The control plot was not sprayed during the 1976 and 1977 programs.

The sampling plots were forested areas dominated by red spruce *Picea rubens* Moench and black spruce *Picea mariana* (L.) Mill. Logging of these species occurred 10 years ago in the areas where the experimental plots were established. A young growth of balsam fir varying from 4 to 7 ft in height formed the major, lower vegetation canopy within the plots. The upper canopy was composed of red maple (*Acer rubrum* K. Koch), grey birch (*Betula populifolia* Marsl.), and aspen (*Populus tremuloides* Michx.). Both habitats selected were identical in vegetation composition, and these plots were located in areas where deer browsing had been observed during the winter of 1977. The sprayed plot was sprayed with 2 applications of 3 oz AI/acre of fenitrothion in an oil emulsion between 26 May and 3 June 1977.

The sampling plots measured 10 m^2. Samples were collected on the 30th and 15th

day of each month from 30 September 1976 to 30 September 1977; a total of 38 samples was collected and processed.

The browse samples were clipped with pole and hand pruners. About 10 cm were cut at random from terminal twigs ensuring a representative sampling of the entire tree. Twenty to 30 g were cut into small pieces and placed in 110 ml glass bottles. While in the field, the bottles were filled with pesticide-grade ethyl acetate and covered with plastic snap lids which had previously been lined with aluminum foil. Within 2 hours these bottles were refrigerated at 2°C until extraction.

Extraction of the insecticide and its derivatives from 20 g samples of foliage was accomplished within 15 days following the collection date. The macerated samples were placed in a Waring blender with enough ethyl acetate (pesticide grade) to bring the volume to 150 ml. Using an external rheostat, the sample was blended at gradually increasing speed until it formed a uniform pulp. A Buchner funnel, grade 202 (Reeve Angel) filter paper, and 2 cm pad of anhydrous Na_2SO_4 were used to separate solid plant residues from the extract. Plant solids remaining in the funnel were rinsed with ethyl acetate to ensure total recovery of the residue. The resulting dark-green solution was evaporated to about 10 ml in a 500 ml round-bottom boiling flask on a Buchli Roto vapro R evaporator. This residue was dissolved in 50 ml of pesticide-grade acetonitrile, and was partitioned twice with 25 ml of pesticide-grade hexanes. The polar layers were evaporated to about 20 ml and placed on an activated charcoal column previously rinsed with 50 ml pesticide grade benzene. A 20 mm ID column was used with the following packing: glass wool; 10 g Na_2SO_4; mixture of 9 g activated charcoal (BDH), 6 g Celite 503 and 10 g Na_2SO_4. An electrical vacuum pump providing 270 mm Hg suction was used for elution by 100 ml benzene: ethyl acetate (25:75), followed by 10 ml benzene. The eluate was flushed to a small volume of about 10 ml for analysis. This sample was refrigerated until analysis.

Analysis

Fenithrothion in the extract was analysed by gas-liquid chromatography done on a gas Tracor Model MT 270 equipped with an automatic sampler; Hewlett-Packard, Model 7671A with interface, and an automatic calculator Spectra physics auto lab I, the detector was a FPD system. Operating conditions of the gas chromatograph were: glass column 1.83 m x 0.64 cm, column packing chromasorb W 80/100 mesh, liquid phase 3.6% OV 101, 5.5 wt. The carrier gas was helium with a flow rate of 26 lb/in^2.

Results

Results of analyses as given in Table I are as ppm of the sample. Concentrations of fenitrothion varied from 0.51 ppm to 0.10 ppm within the sprayed plots and from 0.08 to 0.00 ppm within the control plot. Concentrations obtained after the 1977 spray operation were lower than those observed following the 1976 spray application. In 1976, I obtained an average concentration of 2.5 ppm from 5 samples, these samples were collected in an open area with no canopy cover. However the 1977 collections were from samples selected within the entire branch structure of the tree and this may explain the lower analytical results. The oxygen analogue of fenitrothion, fenitro-oxon, was detected in only two samples taken from the sprayed plots at concentrations of 0.04 and 0.15, whereas no detection was obtained from samples taken from the control plots. Results from both sample areas indicate a persistence of the pesticides throughout the entire sampling period on both the sprayed and control plots with a higher concentration in sprayed plots.

Table I. Fenitrothion residues in balsam fir *Abies balsamea* browse for the 1977 spray program.

Time relative to application (days)	Fenitrothion - ppm	
	Sprayed plot	Control plot
+240	0.37	0.05
+225	0.27	
+210	0.36	0.04
+195	0.24	
+180	0.38	0.06
+165	0.27	
+150	0.19	0.00
+135	0.26	
+120	0.36	0.06
+105	0.28	
+ 90	0.24	0.09
+ 75	0.31	
+ 60	0.10	0.04
+ 45	0.31	
+ 30	0.10	0.02
+ 15	0.25	
spray	0.13	0.07
- 1	0.51	0.05
- 15	0.43	0.08
- 30	0.41	0.05
- 45	0.35	
- 60	0.39	0.02
- 75	0.34	
- 90	0.45	0.08
-105	0.39	
-120	0.44	0.08

\+ days before spray
\- days after spray

Discussion

Oral administration of ^{14}C fenitrothion at a dose level of 0.5 mg/kg results in absorption of the pesticide and its appearance into the blood and internal organs of rats. After 4 days the concentration in the blood was less than .001 ppm (Miyamoto 1964). Hollingworth and Metcalf (1967) have indicated that the greater part of ^{32}P and ^{14}C fenitrothion is excreted in the urine within 24 hours and that excretion is virtually complete within 96 hours. Barber and Nagy (1971) studied the influence of several pesticides on rumen bacteria of deer. With concentrations of 1, 10, 100, and 1000 ppm of fenitrothion, cellulose digestion was respectively 83%, 63%, 25% and 12.6% of the control. After a period of 72 hours all inhibition had ceased. Production of volatile fatty acids was little affected at 1 ppm or 10ppm of the pesticide. At 100 ppm, fenitrothion caused a slight decrease in fatty acid concentrations. Schwartz et al. (1973) studied the effects of certain pesticides on rumen function;

they concluded that fenitrothion did not affect the digestion of dry matter and cell wall constituents.

In relating my findings to the previous work, I can find no evidence to support the hypothesis that a concentration of fenitrothion of the magnitude which I have detected would affect the deer population of this area.

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References

Barber, T.A. and **Nagy, J.G.** 1971. Effects of pesticides on mule deer rumen bacteria. *Trans. N.A. Wildlife Nat. Res. Conf.* 36: 153-162.

Crete, M. 1976. Importance of winter climate in the decline of Deer Harvest in Quebec. *Can. Field-Nat.* 90:404-409.

Hollingworth, R.M., Metcalf, R.L., and **Fukuto, T.R.** 1967. The selectivity of Sumithion compared with methyl parathion. Metabolism in the white mouse. *J. Agric. Food Chem.* 15:242-249.

Miyamoto, J. 1964. Studies on the mode of action of organophosphorus compounds. Part III. Activation and degradation of Sumithion and methyl parathion *in vivo*. *Agric. Biol. Chem.* 28:411-421.

Miyamoto, J. 1969. Mechanism of low toxicity of Sumithion towards mammals. *Residue Rev.* 25:251-264.

Nigam, P.C. 1971. Summary of laboratory evaluation of insecticides against forest insect pests during 1971. *Chemical Control Research Institute, Inf. Rep.* CC-X-12. 14 pp.

Schwartz, C.C., Nagy, J.G. and **Streeter, C.L.** 1973. Pesticide effect on rumen microbial function. *J. Anim. Sci.* 37:821-826.

Shishido,T., Usui, K., Sato, M. and **Fukami, J.** 1972. Enzymatic conjugation of diazinon with glutathione in rat and American cockroach. *Pestic. Biochem. Physiol.* 2:51-63.

Sundaram, K.M.S. 1974. Distribution and persistence of fenitrothion residues in foliage, soil and water in Larose Forest. *Chemical Control Research Institute, Inf. Rep.* CC-X-64. 43 pp.

Yule, W.N. and **Duffy, J.R.** 1972. The persistence and fate of fenitrothion insecticide in a forest environment. *Bull. Environ. Contam. Toxicol.* 8:10-18.