

**OFF-TARGET DRIFT OF MCPA:
"REAL-TIME" AIR SAMPLING**

by

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A B S T R A C T

The drift of MCPA downwind of an aerial application was measured using short air sampling intervals in an attempt to estimate "real-time" concentrations. Prior drift studies examined deposition patterns or measured air concentrations downwind of pesticide applications using long sampling intervals (1 to 24 hours). This preliminary study was designed to determine: 1) the feasibility of "real-time" sampling and 2) if these "real-time" concentrations were significantly different from long-term concentrations. At present, no apparatus measures instantaneous pesticide concentrations in air, therefore conventional air sampling equipment operated at 5-minute intervals was employed to estimate "real-time" concentrations. High and low volume air samplers were employed, with high volume samplers yielding more consistent results. Concentrations as high as 52.30, 30.46 and 31.10 $\mu\text{g}/\text{m}^3$ were measured at 25, 50 and 100 m downwind of the application, respectively, using "real-time" sampling techniques. An analysis of variance indicated a significant linear decline in air concentrations with distance from the field and significantly higher concentrations from high vs. low volume samplers. A polynomial regression of the form: concentration = $693 - 551(\log \text{ distance}) + 114(\log \text{ distance})^2$ best described the relationship between air concentration and distance downwind. Comparisons between "real-time" and long-term concentrations were confounded by a marked change in wind direction during application therefore results for this objective were not conclusive. Another field trial will be conducted to determine if "real-time" and long-term concentrations are significantly different.

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INTRODUCTION

The problem of pesticide drift was recognized as early as 1945, when calcium arsenate, used to control tomato worms, contaminated nearby alfalfa fields subsequently killing 75 dairy cows (Brooks 1947). Since that time, the contamination of off-target areas by pesticide drift has been a growing concern to agricultural producers, government agencies, and the public.

Pesticide residues from drift (especially chlorophenoxy herbicides) have been shown to damage crops such as grapes (Vitis vinifera L.), (Kasimatis et al., 1968), soybeans (Glycine max L.) , and rape (Brassica napus L.) (Betts and Ashford, 1976). Studies have been conducted on some of these herbicides including propanil (3',4'-dichloropropionanilide), MSMA (monosodium methanearsonate), dicamba (3,6-dichloro-o-anisic acid), picloram (4-amino-3,5,6-trichloropicolinic acid) (Wax et al., 1969), 2,4-D[(2,4-dichlorophenoxy) acetic acid] and MCPA [(4-chloro-2-methylphenoxy) acetic acid] (Bode & McWorter, 1977; Wax et al., 1969). These investigations examined pesticide deposits on foliage or artificial surfaces to ascertain off-target movement.

In addition to pesticide deposition patterns, minimization of off-target movement using specific application procedures has been extensively studied. It was estimated that off-target movement of insecticides and herbicides ranged from 50 to 95%, and 15 to 30% of total mass applied to a field, respectively (Miller, 1980). By carefully selecting the spray formulation, application equipment, liquid pressure, nozzle orientation, and thickening additives, pesticide drift can be reduced (Akesson, et al., 1972; Argauer, et al., 196;, Bode, et al., 1976;

Isler and Carlton, 1965). Meteorological conditions during application also affect off-target movement. Generally, drift can be minimized by applying pesticides during unstable atmospheric conditions, i.e. when a thermal inversion is not present (Yates et al., 1974; Lawson and Uk, 1979).

Few studies have examined the concentrations of pesticides in air as they drift off-target (Maddy et al., 1983; Oshima et al., 1980). Estimates of dermal and respiratory exposures to pesticide drift were made using deposition and air concentration data (Chassemi, et al. 1982). However, air-sampling intervals used in these studies were generally long (1-24 hours) and information about air concentrations during short sampling intervals, or what is termed "real-time" (less than 15 minutes) was not found in the literature. Peak concentrations occurring during long sampling intervals will be averaged out yielding no information about dose variance with time. The effect of realistic pesticide exposures on humans can only be determined by medical toxicologists, yet if these concentrations are never estimated, their significance will not be known.

This study was designed to: (1) test the feasibility of measuring "real-time" concentrations using 5-minute sampling intervals (the shortest time interval physically possible with our equipment and manpower) and (2) determine if "real-time" concentrations are significantly different from long-term concentrations.

MATERIALS AND METHODS

Study Site

In San Luis Obispo County, 25 km east of Paso Robles, a 30 hectare plot (500 x 600 m) was established within a 600 hectare barley field (Figures 1 and 2). This plot size was critical because one tankfull of pesticide could be aeriially applied without reloading and a continuous series of 5-minute samples could be taken without disruption.

On February 6, 1985, MCPA [acetic acid, (4-chloro-2-methylphenoxy)-isooctyl ester] was applied via fixed wing aircraft (Thrush) equipped with 50-D846 nozzles, using a boom pressure of 1.27 kg/cm^2 , producing a swath width of about 16 m. The application rate of MCPA was 2.34 l/ha applied with a spreader at a rate of 1.25 ml/l of water and a total of 46.77 l/ha of water. The application was delivered in a north-south direction starting along the western 600-m edge of the test plot at a height of 3 to 4 m. The pilot made seven passes over the test plot during the first 5-minute sampling interval, each pass moving progressively further away from the air samplers (Figure 2). The second, third, and final sampling intervals required seven, eight, and seven swaths, respectively.

Sampling Equipment

Continuous recordings of wind speed and wind direction were taken using a Weather Measure Meteorological Station located 70 m north-west of the test plot (Figure 2). Air samples were collected using high volume air samplers (hivols) (General Metal Works) and low volume air samplers (lovols) (Gast Model 2531 with a carbon vane pump) oriented vertically and calibrated at 1,000 and 20-26 l/min, respectively. Glass jars 18 cm long by 10 cm ID were packed with 125 ml of pre-cleaned XAD-2 resin (20/50 mesh, Rohm and Hass) and mounted on hivols. Glass

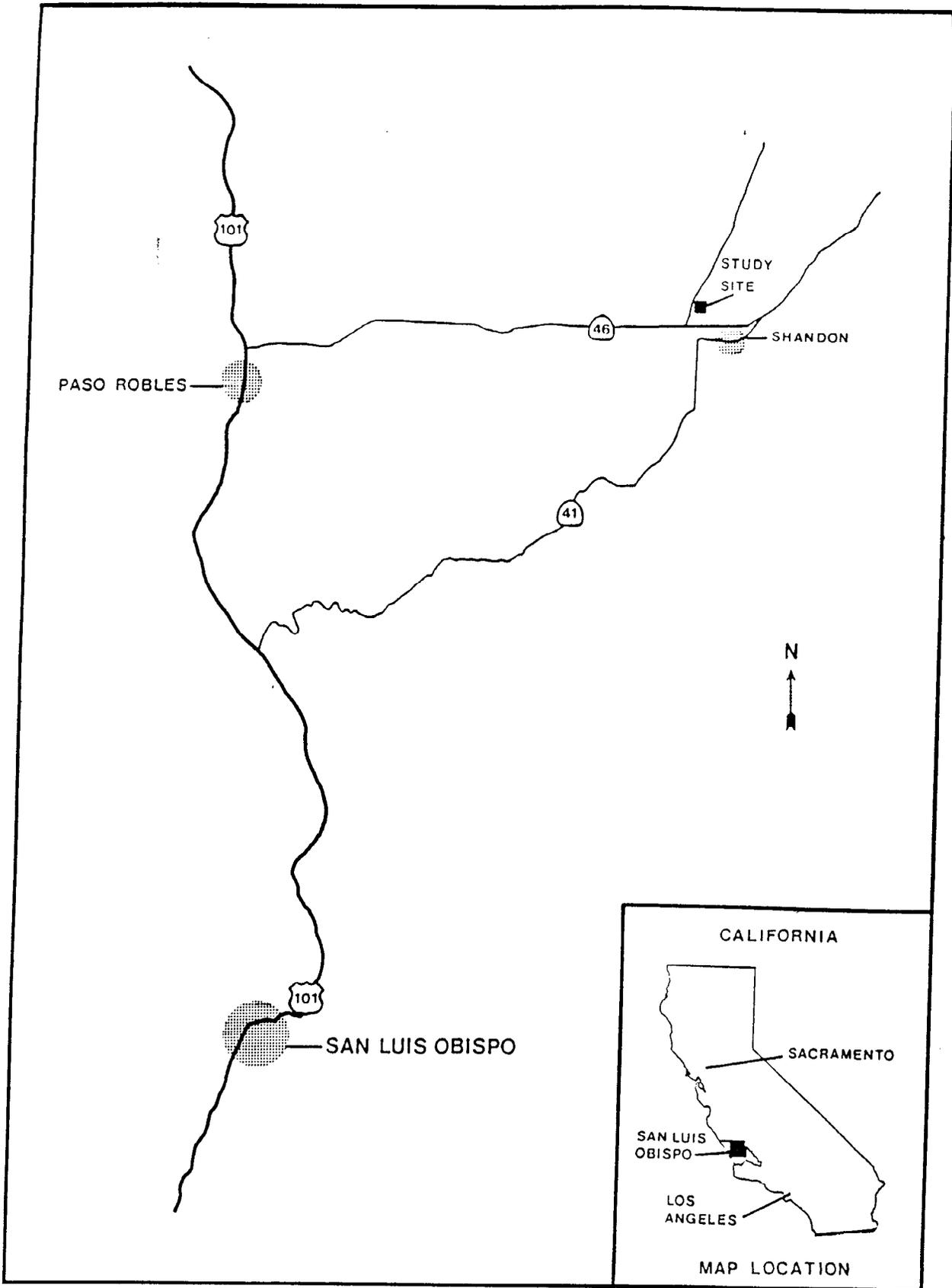


Figure 1. Study site location.

- air sampling sites (A,B,C,D)
- Weather Measure sites

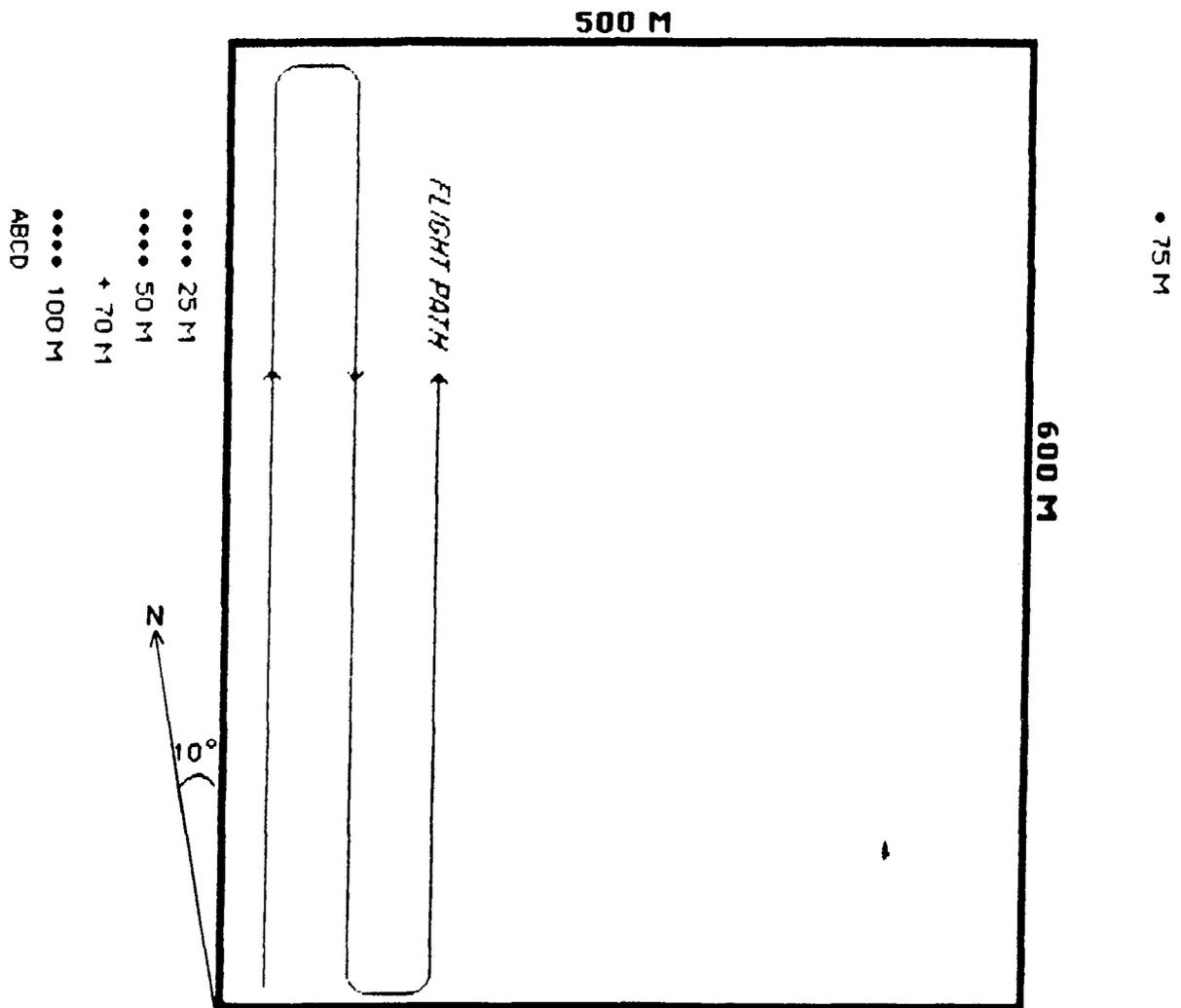


Figure 2. The test plot was oriented 10° east of due north. Four sets of samplers (A,B,C, and D) were located at 25, 50, and 100 m west of the field border. A background sampler was placed 75 m east and a Weather Measure Meteorological station located 70 m west of the field.

tubes, 15 cm long by 16 mm ID, were packed with 15 ml of resin and mounted on lovals. All air samplers were powered by portable AC generators.

Experimental Design and Sample Collection

Air samples were collected at 25, 50 and 100 m west of the north-west border of the test plot, an area believed to be downwind of the application. At each distance, air samplers were arranged in a row consisting of 4 sets of samplers (labeled A,B,C, and D in Figure 2) located 6-m apart. Each set consisted of two hivol and two loval with one person assigned to operate this equipment. At sites A, C, and D, samplers were operated at 5-minute intervals with one hivol and one loval running simultaneously. During this 5-minute interval the other two samplers were prepared with clean jars and tubes. At the 5-minute signal, idle samplers were turned on simultaneously and the other pair shut off. During the next 5-minute sampling interval, exposed jars were removed and replaced with clean ones. At the end of the next 5-minute interval, the procedure was repeated. The application began at 12:09 p.m. and lasted for a total of 20 minutes.

Samplers located at site B (a hivol and a loval at each distance) collected air samples for 30 minutes prior to application, continuously for 20 minutes during application, and for 30-minutes immediately following application. At the 25-m distance only (Site B), two hivol jars and two loval tubes were mounted in series during the 20-minute application to test for breakthrough of MCPA through the resin; none was detected. Samplers (one hivol and one loval) set up 75-m east of the test field (presumably upwind) were used to establish background MCPA concentrations before, during and after application.

The experimental design was a split plot in time and was to be analyzed using the S.A.S. General Linear Models program (Helwig and Council, 1979). Results from

hi- and lovol samplers were to be compared with a paired t-test to determine if they were similar. A regression equation was calculated (Helwig and Council, 1979) to correlate distance with air concentrations. The dependent variable (MCPA concentration in $\mu\text{g}/\text{m}^3$) was regressed on distance to the air sampler. In addition, a t-test comparison of continuous and 5-minute interval sampling was made to determine if concentrations were different from these two sampling procedures.

The split-plot ANOVA originally designed for these data could not be applied because a 70° shift in wind direction caused a large drop in air concentrations making the data distribution bimodal and the variances heteroscedastic. Since transformation of the data could not correct these problems, a 2-way ANOVA was devised to examine the spatial change in MCPA concentrations collected using hivols and lovols during the first 5-minute interval only. Analysis of the data from subsequent time intervals was not useful since concentrations were very low or less than the minimum detectable level (MDL).

Chemical Analysis

Air samples were analyzed for both MCPA and its breakdown product, 4-CLOC (4-chloro-o-cresol). Hivol samples were extracted with 150 ml of a solvent mixture of 50:50 acetone: hexane by sonication for 15 to 30 min. Resin and solvent were transferred into a 500 ml chromatographic column, eluted at a rate of 4-5 ml/min and rinsed with another 50 ml of solvent mixture. Lovol samples were extracted by eluting with 100 ml of the solvent poured through the lovol tube. The collected solvent for both sample types was rotoevaporated to 1-2 ml, brought to final volume and analyzed for MCPA and 4-CLOC with a Varian 3700 Gas Chromatograph equipped with a Hall Detector in chlorine mode and a 50% phenylmethyl silicone, 10 m wide bore capillary column. Injector and detector

temperatures were both 220°C. For MCPA analysis, the oven temperature was run isothermally at 200°C with solvent venting for 1 min. For 4-CLOC analysis the oven temperature was programmed from 100°C (2 min initial hold) to 210°C at 10°C/min (final temperature was held for 3 min). Recoveries were 94-101% and 83-93% for MCPA and 4-CLOC, respectively.

RESULTS AND DISCUSSION

Wind Direction and Field Orientation

The field was oriented 10° east of due north (Figure 2) and prior to application, the wind direction averaged 178° (Table 1). Winds from 100° would flow directly down the sampling line and a wind from any other angle would indicate a drift distance larger than the specified distances of 25, 50 and 100 m. During application, in the first 5-minute interval, the wind was from 175° (Table 1). Distance to the air samplers was adjusted using trigonometric functions (Figure 3). Subsequently, the winds shifted and blew from the south east (Table 1), a direction from behind the air samplers. No mathematical adjustments for this circumstance could be made, therefore data from the first 5-minute interval were predominantly used for analyses and distances were adjusted based on the 75° differential.

Air Concentrations

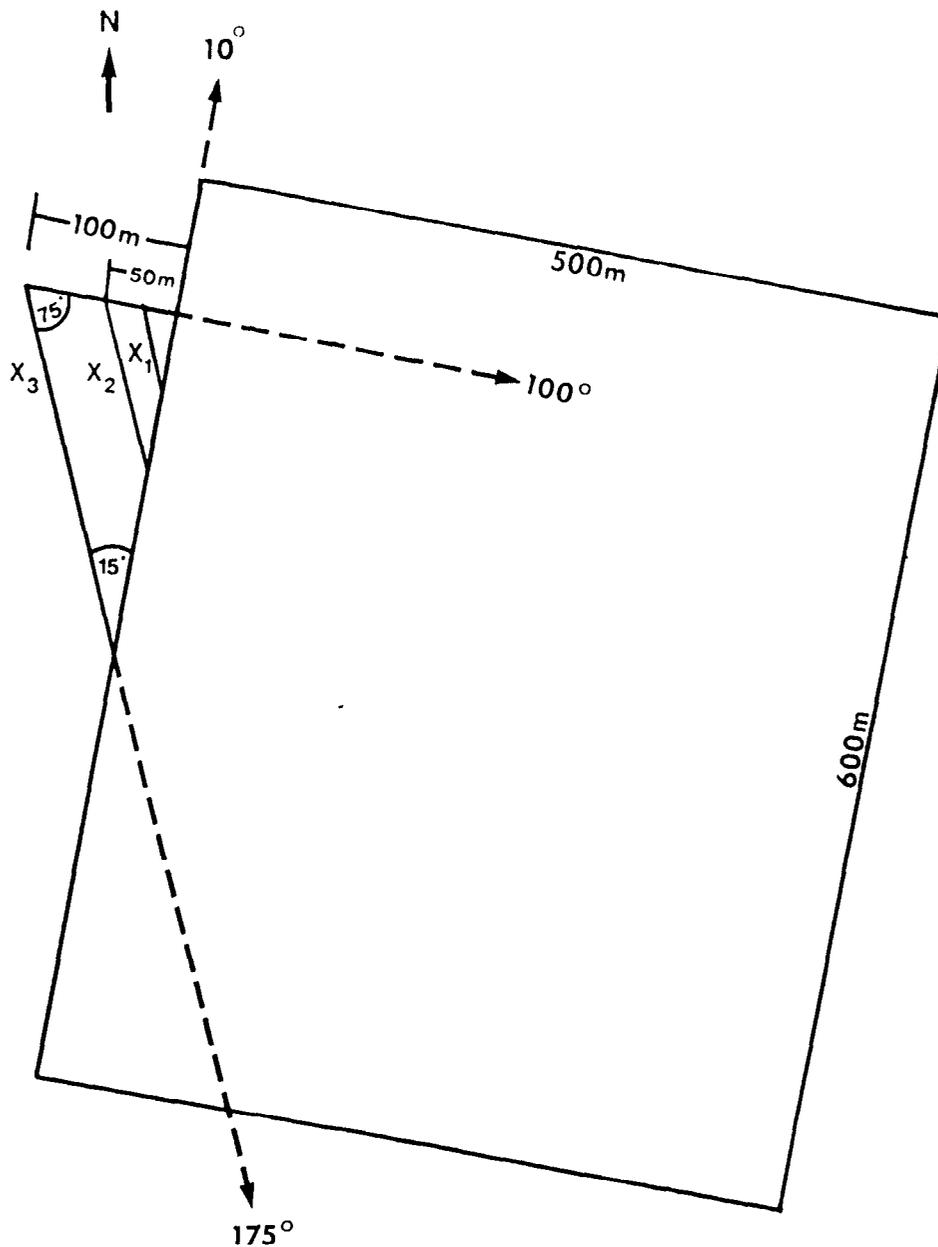
Concentrations of MCPA in air samples collected prior to application were below the MDL of 0.27 and 0.42 µg/sample for hivols and lovols, respectively. Post-application samples were about 100 times lower than concentrations found during application (Appendix I). Air samplers 75 m east of the test plot picked up MCPA during application probably after the shift in wind direction. Samples collected throughout the entire study were below the MDL of 4-CLOC (0.15 µg/sample).

Concentrations of MCPA in air during the spray trial reflected measured wind patterns (Table 2, Appendices II and III). During the first 5-minute interval air concentrations ranged from 24.70 to 52.30 µg/m³ in hivols and from 12.32 to 45.25 µg/m³ in lovol samples. After the change in wind direction, concentrations did not exceed 1.65 µg/m³ or the MDL in hivol and lovol samples, respectively. The

Table 1. Wind speed and direction before, during, and after MCPA application.

<u>Time Interval</u>	<u>n^a</u>	<u>Mean (Standard Deviation)</u>	
		<u>Speed (m/s)</u>	<u>Direction(°)</u>
Pre-application			
11:00-12:00	7	2.17(0.70)	178(37)
During application			
12:09-12:14	2	1.79(0.00)	175(7)
12:14-12:19	2	2.69(0.60)	245(7)
12:19-12:24	2	4.03(1.27)	245(7)
12:24-12:29	2	3.36(0.32)	235(7)
Post-application			
12:30-13:30	7	4.28(0.89)	239(12)

a/ Sample size.



$$X_1 = \frac{25\text{m}}{\text{COSINE } 75^\circ} = 97\text{m}$$

$$X_2 = \frac{50\text{m}}{\text{COSINE } 75^\circ} = 193\text{m}$$

$$X_3 = \frac{100\text{m}}{\text{COSINE } 75^\circ} = 386\text{m}$$

Figure 3. A southeastern wind of 100° would blow directly into the air sampling path as indicated. During the first five-minute sampling interval the wind blew at a 175° angle. The values x_1 , x_2 , and x_3 were calculated to determine exact pesticide drift distance to the air samplers set at 25, 50, and 100 m from the field border, respectively.

Table 2. Mean concentrations of MCPA over time at three distances downwind of application.

Distance(m) ^a	TIME INTERVAL			
	12:09-12:14	12:24-12:19	12:13-12:24	12:24-12:29
	<u>μg/m³</u>			<u>Hivols</u>
25	47.27(4.36) ^b	0.69(0.13)	0.18(0.05)	0.13(0.01)
50	27.76(2.63)	1.26(0.16)	0.34(0.06)	0.26(0.10)
100	28.63(3.44)	1.22(0.39)	0.17(0.01)	0.12(0.02)
				<u>Lovols</u>
25	27.97(15.63)	N.D. ^c	N.D.	N.D.
50	26.58(8.83)	N.D.	N.D.	N.D.
100	14.03(3.53)	N.D.	N.D.	N.D.
	<u>ppb(v/v)</u>			<u>Hivols</u>
25	3.73(0.35)	0.06(0.01)	0.01(0.01)	0.01(0.00)
50	2.19(0.21)	0.10(0.01)	0.03(0.01)	0.02(0.01)
100	2.26(0.27)	0.10(0.03)	0.01(0.00)	0.01(0.00)
				<u>Lovols</u>
25	2.19(1.22)	N.D.	N.D.	N.D.
50	2.08(0.69)	N.D.	N.D.	N.D.
100	1.17(0.23)	N.D.	N.D.	N.D.

a/ This is the ground distance between air samplers and field border.

b/ Values are a mean (standard deviation) of three replicates.

c/ None Detected, minimum detection limits are 0.27 and 0.42 μg per sample for hivols and lovols, respectively.

coefficient of variation, a measure of variability standardized by the mean, ranged from 9 to 12% and 20 to 56% for hivol and lovol samples, respectively, collected during the first 5-minute interval (Table 2). This indicated that replicate concentrations obtained with hivols were more consistent (i.e. had lower variance) than those obtained with lovols. The cause of the difference in variability is not known but may be related to the accuracy of measuring low flow rates typical in lovol sampling. Also, lovols were not calibrated at the same exact flow rate. Flow differences influence the range of droplet sizes captured, thereby changing the total mass captured by individual samplers. A direct comparison of hivol and lovol results indicated that hivol concentrations were higher than lovols 94% of the time. During the first 5-minute interval, hivols were higher in 7 of the 9 paired results (Figure 4).

The ANOVA results indicated a significant linear decline in air concentrations with distance and a difference between hivol and lovol concentrations (Table 3). A least significant difference test indicated that concentrations at 97 m (adjusted distance) were higher than those collected at 386 m yet those at 193 and 386 m were not significantly different (Table 3). Larger drops have a faster fall velocity than smaller drops and therefore settle out sooner (Yates and Akesson, 1973). That fact, in combination with the increase in distance from aircraft to samplers during the 5-minute interval, accounts for the decline in concentration with distance. The difference between hivol and lovol results (hivols yielding significantly higher concentrations than lovols) might also be related to droplet size. The higher flow rates used in hivol sampling enables the capture of more, smaller droplets thereby trapping more mass. Also, hivol collection jars have a much larger diameter than lovols allowing more droplets to deposit on the resin.

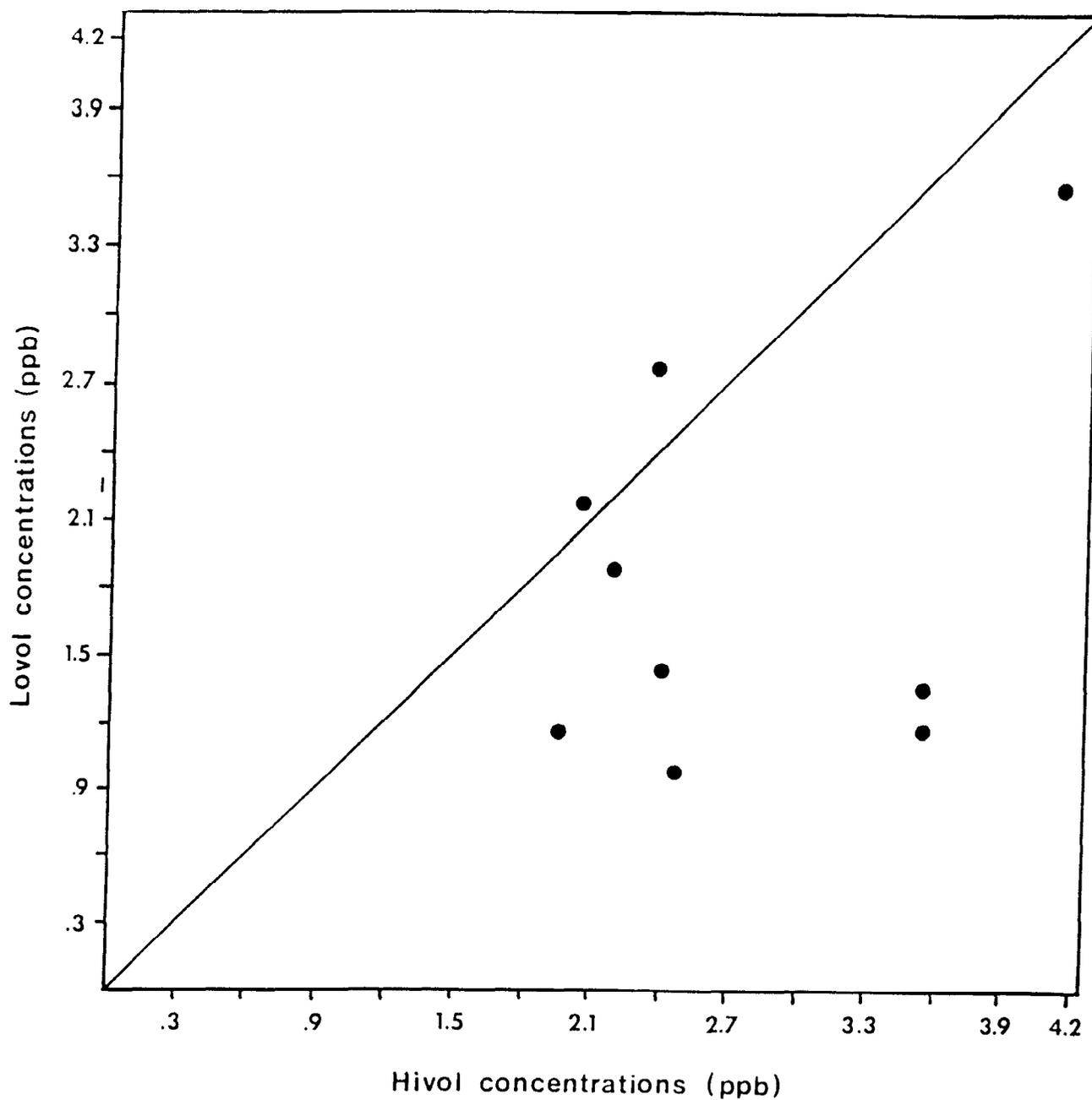


Figure 4. Comparison of hivol and lovol concentrations collected during the first 5-minute interval at 25, 50, and 100 m west of the application. The diagonal line represents perfect positive correlation of hivol and lovol results.

Table 3. Analysis of variance mean squares for MCPA concentrations in air.^a

Source of Variation	dF	Mean Square	F
Replicates	2	5.71	0.08
Distance(D)	2		
Linear(L)	1	796.09	10.85**
Quadratic(Q)	1	21.19	0.29
Air Sampler(A)	1	615.54	8.39*
DL x A	1	16.57	0.23
DQ x A	1	248.48	3.39
Error	10	73.37	
Total	17		

Test of Least Significant Difference (L.S.D.)

L.S.D. = 11.02

L.S.D. = 9.00

Distance(m)	Adjusted		Air Sampler	Mean
	Distance(m)	Mean ($\mu\text{g}/\text{m}^3$) ^b		
25	97	37.62 Y	Hivol	34.55 W
50	193	27.17 YZ	Lovol	22.86 X
100	386	21.33 Z		

* and ** = Significant at 0.05 and 0.01 confidence levels, respectively.

a/ The analysis was conducted using data from the first 5-min sampling interval only.

b/ Means followed by the same letter are not significantly different at $p \leq 0.05$.

Relationship Between Distance Downwind and Concentration

Due to the shift in wind direction, the regression analysis was calculated for data collected during the first 5-minute interval only and should be viewed as preliminary. Independent variables entered into the stepwise procedure included distance, distance², log of distance, log of (distance²) and (log of distance)² while concentration and log concentration were alternated as the dependent variable. The best regression equation generated by this procedure was:

$$\text{Concentration} = 693 - 551(\log \text{ distance}) + 114(\log \text{ distance})^2$$

The R² value was 0.91 and the regression equation and both independent variables were significant at p<0.01. Yates et al. (1978) also found that a second-order polynomial regression best described the relationship between drift deposition (g/ha) and distance downwind (m), with the general form:

$$\text{Log drift deposit} = b_0 + b_1 (\log \text{ distance}) + b_2 (\log \text{ distance})^2$$

where b₀ is the Y intercept and b₁ and b₂ are regression coefficients. These equations indicate that there is a good correlation between drift deposits and drift concentrations and confirm the validity of these concentrations collected during short sampling intervals.

"Real-Time" vs. Long-Term Concentrations

The long-term hivol concentration at 50 m was 0.12 µg/m³, a value much lower than expected given data from 100 m and from lovol concentrations (Appendix II). This may have been due to improper sample collection; if hivol jars are not seated precisely, air may be drawn around the rubber seals rather than through the resin bed. This result illustrates a problem with the sample design, long-term samplers were not replicated. To avoid total loss of information at a site, replicates are necessary. Due to the shift in wind direction after the first 5-minute interval, and the lack of accurate data at the 50 m distance, comparison

between "real-time" and long-term concentrations could not adequately be made. A preliminary comparison of the total μg trapped in 5-minute samples vs. 20-minute samples using a t-test was made and indicated no significant differences in either sampler type (Table 4). Twenty-minute samples collected a similar amount of MCPA as the sum total of 5-minute samples.

Air data expressed on a $\mu\text{g}/\text{m}^3$ (or ppb) basis are subject to time averaging and fluctuations in wind direction. Concentration data in this report represent an extreme case of wind effect (Appendices II and II). When long-term concentrations were adjusted for the actual time winds blew towards the samplers, resultant concentrations were 31.73, 0.41 and 24.07 $\mu\text{g}/\text{m}^3$ for hivols and 47.46, 13.19 and 10.67 $\mu\text{g}/\text{m}^3$ for lovols at 25, 50, and 100 m, respectively. These values were closer to the 5-minute concentrations but still lower. With respect to time averaging, samplers that run for a number of hours during and/or after an application do not reflect higher concentrations occurring at the beginning vs. the end of the sampling period. The total amount sampled is simply divided by the time sampled (see Appendix I) and an average concentration is calculated. Using an average concentration in acute and/or chronic animal exposure studies does not reflect a real field situation where high concentrations may be interspersed among lower concentrations (particularly in areas of multiple applications). What effect these high concentrations have on human health during the course of an exposure has not been examined. If the ability to measure "real-time" concentrations becomes practical, perhaps research on the effects of realistic exposure regimes on human health will be of more concern.

Table 4. t-test comparison of 5-minute and 20-minute sampling.

Distance(m) ^a	Hivol-Total MCPA (µg)		Lovol-Total MCPA (µg)	
	Sum 5-min Interval ^b	20-min Continuous	Sum 5-min Interval	20-min Continuous
25	247.5	190.4	4.15	6.55
50	141.2	2.5	2.55	1.90
100	144.7	134.4	1.74	1.60

Hivols
t_s=1.832

Lovols
t_s=0.572

The t-statistic is calculated as:

Tabled t value at = 0.05 and
df= 2 is 4.303

$$t_s = \frac{\bar{d} - 0^c}{S_{\bar{d}}}$$

Any calculated t-statistic
greater than the tabled t value
is significant at the 0.05 level.

Where:

\bar{d} = Sum of the paired differences (Σd) divided by the sample size (n).

$S_{\bar{d}} = \frac{S}{\sqrt{n}}$ Where:

$$S = \sqrt{\frac{\Sigma d^2 - (\Sigma d)^2/n}{n-1}}$$

- a/ This is the ground distance between air samplers and field border.
 b/ These values are a sum of the average amount of MCPA trapped in resin from
 sampling Site A and C.
 c/ Sokal and Rohlf (1969) p. 205.

CONCLUSIONS

Results indicate that it is possible to measure air concentrations during 5-minute sampling intervals at distances up through 100 m (actual distance 386 m). A polynomial regression best described the relationship between air concentrations and distance downwind, a result in agreement with previous drift deposition research.

Comparisons between "real-time" and long-term concentrations could not be adequately assessed due to the change in wind direction during application. Preliminary information indicated that the total amount trapped during short and long-term intervals was not significantly different. Another field trial will be conducted to confirm these results.

A C K N O W L E D G M E N T S

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DISCLAIMER

The mention of commercial products, their source or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such product.

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Appendix I. Air concentrations found prior to, during, and after aerial application of MCPA.

Distance ^b (m)	MCPA Concentrations ^a Obtained Using Hivols					
	Pre- Application ^c	During Application ^d	Post Application ^e	Pre- Application	During Application	Post Application
	μg/m ³			ppb(v/v)		
75 ^f	N.D. ^g	1.73	0.18	N.D.	0.14	0.01
25	N.D.	9.52	0.18	N.D.	3.00	0.01
50	N.D.	0.12	0.035	N.D.	0.01	0.003
100	N.D.	6.72	0.021	N.D.	0.51	0.002
Air Concentrations Obtained Using Lovols						
75	N.D.	1.01	N.D.	N.D.	0.08	N.D.
25	N.D.	14.24	N.D.	N.D.	1.11	N.D.
50	N.D.	3.96	N.D.	N.D.	0.31	N.D.
100	N.D.	3.20	N.D.	N.D.	0.25	N.D.

a/ Concentrations were calculated using the following formulas:

$$1. \frac{\text{Total } \mu\text{g sampled}}{\text{flow rate/time}} = \mu\text{g/m}^3$$

Flow rate is in m³/min. and time is in min.

2. To convert μg/m³ to ppb at 25°C and 760 mm Hg:

$$(\mu\text{g/m}^3) \left(\frac{24.46}{\text{molecular weight}} \right) = \text{ppb}$$

The molecular weight of MCPA isooctyl ester is 312.5

b/ This is the ground distance between air samplers and field border.

c/ Samplers ran for 30 minutes.

d/ Samplers ran for 20 minutes except at 75 m east of the study plot where the sampler ran for 87 minutes (11:18 through 12:45) due to lack of personnel needed to man all stations.

e/ Samplers ran for 30 minutes.

f/ Samplers at this distance were located 75 m east of the study plot.

g/ None Detected. The minimum detection limits are 0.27 and 0.42 μg per sample for hivols and lovols, respectively.

Appendix II. Concentrations of MCPA over time and distance obtained using high volume samplers.

Site	Air Sampling Interval		Distance to Field Border (m)					
	Time On	Time Off	25	50	100	25	50	100
				$\mu\text{g}/\text{m}^3$			ppb(v/v)	
B	12:09	12:29	9.52	0.12	6.72	0.75	0.01	0.53
B	(adjusted for wind) ^a		31.73	0.41	24.07	2.48	0.03	1.88
A	12:09	12:14	52.30	27.63	24.70	4.13	2.18	1.95
A	12:14	12:19	0.83	1.45	0.89	0.07	0.11	0.07
A	12:19	12:24	0.17	0.34	0.18	0.01	0.03	0.01
A	12:24	12:29	0.12	0.25	0.11	0.01	0.02	0.01
C	12:09	12:14	44.75	25.20	30.08	3.53	1.99	2.37
C	12:14	12:19	0.57	1.17	1.65	0.05	0.09	0.13
C	12:19	12:24	0.14	0.27	0.16	0.01	0.02	0.01
C	12:24	12:29	0.13	0.17	0.12	0.01	0.01	0.01
D	12:09	12:14	44.75	30.46	31.10	3.53	2.40	2.45
D	12:14	12:19	0.66	1.17	1.13	0.05	0.09	0.09
D	12:19	12:24	0.24	0.40	0.16	0.02	0.03	0.01
D	12:24	12:29	0.13	0.37	0.14	0.01	0.03	0.01

^{a/} The wind blew into the sampling path of long-term samplers for about 6 minutes so concentrations were adjusted accordingly.

Appendix III. Concentrations of MCPA over time and distance obtained using low volume air samplers.

Site	Air Sampling Interval		Distance to Field Border (m)					
	Time On	Time Off	25	50	100	25	50	100
			µg/m ³			ppb(v/v)		
B	12:09	12:29	14.24	3.96	3.20	1.11	0.31	0.25
B	(adjusted for wind) ^a		47.46	13.19	10.67	3.72	1.03	0.83
A	12:09	12:14	45.25	17.42	11.67	3.54	1.86	1.16
A	12:14	12:19	N.D. ^b	N.D.	N.D.	N.D.	N.D.	N.D.
A	12:19	12:24	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
A	12:24	12:29	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
C	12:09	12:14	23.83	27.27	18.09	1.36	2.13	2.74
C	12:14	12:19	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
C	12:19	12:24	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
C	12:24	12:29	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
D	12:09	12:14	14.82	35.04	12.32	1.14	1.41	0.96
D	12:14	12:19	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
D	12:19	12:24	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
D	12:24	12:29	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

a/ Wind blew into the sampling path of long-term samplers for about 6 minutes so concentrations were adjusted accordingly.

b/ None detected. Minimum detection limit = 0.42 µg per sample.