Determination and Measurement of Insecticide Dust Particles in Atmospheres Adjacent to Orchards[1]

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The effect of topography and weather on movement and dispersion of aerially applied dusts from target orchards to adjacent environments has been investigated for several years. Initially this work used quantitative analyses of the fallout of pesticide dust particles on exposed glass fiber filters in petri dishes at or close to ground level, as well as analyses of selected vegetative samples. This technique gave accurate drift residue levels for the sampling area. A clearer picture of drift and dispersion could be obtained if the number and size of dust particles from known air volumes, taken simultaneously at several sites downwind from the target orchard

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were ascertained. Such data would permit correlation of dust concentrations in the air over sampling sites with actual dust particle deposition at ground level.

A modification of the technique described by Jacobs et al. (1) was used, where a known volume of air was passed through a Millipore field monitor aerosol filter No. MHWG037A0 16' above ground level. Such filters, with an effective filtration area of 9.6 cm^2, were attached to Staplex Low Volume air sampler (Model LV-1), calibrated to draw 10 l. of air per minute. During the field sampling, herein described, each air sampler was run for 5 min., giving a volume of 50 l. of air per sample, with the plastic cover of each filter being removed just prior to, and replaced just after, each sampling procedure.

In a dust-free laboratory each filter was then removed by clean stainless steel forceps and carefully placed, grid side up, on a 2"x 3" glass slide to which had been added 7 drops of cedar oil (N_r = 1.5). The filter was placed directly on top of the cedar oil; it cleared immediately with no excess oil on the edges. A circular cover slip was then put over the cleared filter to prevent evaporation, drying of the cedar oil, and contamination by extraneous dust particles. This technique was tried repeatedly under the microscope to make sure that no particles were dislodged during clearing or placing the cover slip.

The number and size of particles on exposed filters were counted by a microscope (sometimes used with a microprojector) and recorded per grid square.

Data in Table 1 show size distribution and number of particles downwind, downslope at three locations from a target orchard. Smaller particles ($< 10\ \mu$) can remain airborne for prolonged periods when climatic conditions are suitable. This is consistent with earlier work (2) where particles of $< 10\ \mu$ comprised a greater percentage of the total particulates collected at the maximum sampling distance.

TABLE 1

Analysis of Air Samples 16' Above Ground Level

Time from application	Total particles (x2000)/m^3 Distance from orchard Miles			Particles (x2000)$<10\ \mu$/m^3 Distance from orchard Miles		
Minutes	0	1/4	1	0	1/4	1
0	19,200	320	0			
10	3,200	2560	15	1940	2368	6
20	1,280	30	15	1280	15	15
45	336	50	10	336	50	10
60	40	12	16	40	12	16

[1]Samples taken downwind, downslope, wind velocity averaging 0.25 to 2 mph, 2° F temperature inversion.

In addition to counting and sizing of dust particles, it was also possible to count fluorescent particles. A fluorescent pigment was added as tracer particles to the dust mixture at the time of formulation in the same concentration as the actual chemical toxicant. This technique gives a rapid visual indication of the presence of the dust, by UV light after dark, as well as a quick quantitative analysis in the laboratory. Fluorescent analyses and actual chemical residues could then be correlated. Dust microscopy employing reflected UV light of 3600 A. revealed that the fluorescent pigments could be easily identified and counted separately from the talc particles (Table 2). These techniques gave data to show the dust particle movement at specified intervals over mapped terrain during known weather conditions.

TABLE 2

Total Count on Particles from Air Sample Taken 16'

Above Ground Level [1]

Time from application	Total particles (x2000)/m^3 Distance from orchard		Total fluorescent particles (x2000)/m^3 Distance from orchard	
	Miles		Miles	
Minutes	0	1/4	0	1/4
CK	0	0	0	0
0	880	27	308	0
5	0	260	0	38
15	7	0	1	0
30	4	2	1	0
45	1	1	1	0

[1] Samples taken downwind, downslope, wind velocity averaging 2 to 3 mph, strong inversion.

All the dusts used in this study were formulated with either Tetradifon or Morestan, two toxicants commonly used to control the European red mite. The objective of these studies was to determine Morestan or Tetradifon residues on forages adjacent to orchards. The interpretation of these residues would then be applicable to any pesticide chemical used in orchard pest control, provided the pesticide was formulated in the same manner and applied under similar climatic conditions and terrain.

Filters used for counting and sizing particles were analyzed by gas chromatography (Table 3). Values for the actual residues present on the filters are conservative; clearing of the filter reduced the residue values by approximately 13%, according to laboratory evaluation of 10 replicates of cleared versus noncleared filters.

TABLE 3

Analysis of Air Samples 16' Above Ground Level[1]

Time from application	Total μg Morestan/m^3 Distance from orchard		
	Miles		
Minutes	0	1/4	1
0	230.00	7.60	3.60
10	22.00	38.00	1.40
20	14.00	5.00	0.00
45	6.00	2.40	2.40
60	3.40	3.00	0.00

[1]Samples taken downwind, downslope, wind velocity averaging 0.25 to 2 mph, 2° F temperature inversion.

Millipore filters were removed with the cover slip from the slide and placed in a pint mason jar containing 25 ml of highly purified benzene. The 2x3 slide was broken to aid in extraction and then added to the jar, and the jar rolled for 30 minutes and the extract poured off.

The data presented in Table 3 represent analyses from the same filters used for dust particle counts in Table 1. Comparison of these figures indicates that the presence of visually observed talc particles does not necessarily mean the presence of the toxicant, and conversely that the toxicant may be present in the absence of talc particulates by microscopy. Variables such as wind, temperature, and volatilization of toxicant on the filter surface can all affect the results. However, the technique described does permit the investigator to ascertain the presence or absence of dust particulates, and/or the total micrograms of particulate toxicant in a known volume of air.

References

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