COMPARISON OF GROUND AND AERIAL APPLICATION SPRAY DRIFT ON THE UNION CAMP CORPORATION SOUTHERN STATES LOBLOLLY PINE SEED ORCHARD IN CLAXTON, GA

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Abstract.--Ground application of a spray solution containing Rhodamine WT and water applied with a FMC 757 Speed Sprayer resulted in less drift than did the application from a Cessna Ag Truck fixed wing aircraft. Spray drift was at detectable levels in small amounts to 1000 feet for the aircraft and 250 feet for the ground sprayer directly downwind of the spray block .

Keywords: Loblolly pine, Pinus taeda L, Rhodamine WT, Bullseye, Cessna Ag Truck, drift.

INTRODUCTION

The production of seed is vital to seed orchard managers and the limiting factor reducing production is damage from a variety of seed and cone insects. Various control strategies have been developed in the past to address the damage from insect pests. Presently, most orchard managers use repeated applications of a liquid insecticide applied either by ground sprayer or aircraft. The insecticide most commonly used is azinphos-methy (Guthion) applied via aircraft. In the past two years many orchard managers have switched to Foray 48B, a Bacillus thuringiensis (Bt) formulation.

The USDA Forest Service has focused on improving pesticide application deposition while minimizing off-site spray drift. All groups concerned with the application of pesticides to southern pine seed orchards recognize the importance of minimizing pesticide drift from the orchard to adjoining land or water areas. In 1980 Jack Barry (Barry et al. 1980, and Barry et al. 1982) first determined the feasibility of aerially applying pesticides to southern pine seed orchards on the State of Florida, Withlacoochee Seed Orchard near Brooksville, FL. Drift in this study was confined within 133 meters downwind of the spray source.

In the Withlacoochee Trials both a Hughes 500C and a Stearman aircraft were used. The volume median diameter (VIVID) of the five gallon per acre spray was 525 tm for the Hughes and 524 p.m

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for the Stearman. The ratio of deposition 15 meters downwind from the orchard edge to within-orchard deposition ranged from 0.06 to 0.49 (J. W. Barry et al. 1983). Wind speed ranged up to 2.8
meters per second. In an additional test over open field conditions, spray deposit ratios at 133 meters were 0.002 with deposits of 1 oz/acre. Wind ranged from 2.7 to 5.8 meters per second. From this report Barry concluded that drift deposits 60 meters downwind of seed orchards in flat terrain is about 8 percent of the amount deposited in the treatment area and can be expected to 100 meters. They also concluded that large amounts of spray are deposited with a 15 meter zone surrounding orchards.

In 1991 a study was undertaken to compare ground and aerial application on the Union Camp Southern States loblolly pine seed orchard. This study evaluated deposition within the tree canopy, forest floor and downwind (Barber and Mangini 1993).

MATERIALS AND METHODS

Scope

This was a cooperative project between the USDA Forest Service and Union Camp Corporation conducted August 20-22, 1991. There were two trials each morning that compared ground and aerial application.

Site Description

The orchard is located 4.5 mi south and west of Claxton, Ga. The orchard has tree spacing of 22 x 22 ft (6.7m) . The test site was the 8.9 acre Alabama rust resistant loblolly pine, Pinus taeda L., area of the orchard.

Meteorological Measurement

Meteorological conditions were measured with: 1) a Handar 540A on a 22 ft (6.7 m) tower located near the center of the spray block, 2) another Handar 540A on a 55 foot (16.8 m) tower located 600 ft (182.9 m) northeast of the spray block and 3) a Forest Technology System F11 on a 6 ft (1.8 m) tower located 300 ft (91.4 m) east of the spray block in an open field.

Application

The aircraft sprayed a mixture of Bullseye dye and water and the ground sprayer applied a mixture of Rhodamine WT dye and water. The aircraft application was 1.19 gal/acre (4.5 1) while the ground sprayer application rate was 2.88 gal/acre (10.9 1) for days 1 and 2 and 5.76 gal/acre (21.8 1) for day 3. The aircraft was a Cessna Ag truck Model 185 flying at 110 mi/h (177 km). The ground sprayer was a FMC 757 Speed Sprayer traveling at 2.5 mi/h (4.0 km).

Drift Sampling

During each spray application, drift lines were established beginning 50 ft (15.3 m) within the orchard and extending out from the spray block downwind in 50 ft increments. Drift line samplers were Kromekote cards 4 x 5 in (10.2 x 12.7 cm).

Stain Deposit Measurement

Stains on Kromekote cards were measured by placing each card under a dissecting microscope fitted with a graduated measuring reticule. On each card a minimum of 50 stains were counted and the area observed did not exceed 16 cm^2. Spray stain numbers and sizes were analyzed using the Automated Spot Counting and Sizing program (ASCAS, Continuum Dynamics) to convert drop counts into spray volumes. The spray volume and numbers of drops/cm^2 were adjusted for the ground sprayer application rate to equal the aircraft application rate. When equivalent deposition is used it is noted.

RESULTS

Characterization

Volume median diameter (VIVID) for the aircraft was 196, 136, and 127 microns for days 1, 2, and 3 respectively. The effective swath width (eight drop/cm^2 minimum deposition) for days 1, 2, and 3 were calculated to be 90, 110, and 100 ft respectively. No swath width was determined for the ground sprayer, however, the VMD for day 3 was 202 microns.

Meteorological Conditions

On day 1 maximum wind ranged from 5.5 mi/h to 7.2 mi/h and was out of the west-southwest with temperatures in the lower eighties with relative humidities from 69.5 to 89 percent. During day 2 the wind was from the west at less than 2 mi/h. On day 3 wind was 2.6 mi/h from the north-northwest. The temperature ranged from 72.4 F° to 82.3 F° with the relative humidity from 68.7 to 90 percent.

Spray Drift

Day 1

Deposition on the ground within the orchard and at the orchard edge for both the aircraft and ground sprayer ranged from 44.9 to 46.5 fl oz/acre (tables 1 and 2). Aircraft deposition dropped off rapidly with increased distance from the orchard edge and at 150 feet only 6.26 fl oz/acre were detected. Here a ratio of only 0.2:1 was found as compared to within the orchard (table 3). This is 20 percent deposition compared to within the orchard . At 300 feet 0.15 fl oz/acre were detected or 0.1 percent of the deposition within the orchard. Ground sprayer deposition 150 feet

outside the orchard was 3.95 fl oz/acre or 11 percent of within orchard deposition. At 300 feet deposition was 0.1 fl oz/acre or 0.1 percent of within orchard deposition.
Day 2

Aircraft deposition directly downwind of the spray block at 150 feet from the orchard edge was 6.89 fl oz/acre or 18 percent of the deposition within the orchard. Ground sprayer deposition however was 0.38 fl oz/acre or 3 percent of the within orchard deposition. All cards beyond 150 feet received spray deposition but were wet and unreadable.

Day 3

Spray deposition from the aircraft at 150 feet from the orchard edge was 25.08 fl oz/acre or 111 percent of that found within the orchard. At 300 feet the deposition fell to 4.19 fl oz/acre and at 400 feet was 0.78. This represented 5 and 1 percent respectively of the deposition within the orchard. Aircraft deposition was 0.02 fl oz/acre at 1000 feet. Ground sprayer deposition at 150 ft was 0.17 fl oz/acre and 0.09 fl oz/acre at 250 ft with no further deposition detected to 1000 feet.

Table 1 - Ground spray deposition on drift line samplers - Claxton Spray Trials, 1991

Drift line 1

Card position	Day I Fluid ounces/acre	Day 2 Fluid ounces/acre	Day 3 Fluid ounces/acre
-50.00	44.90	6.19	31.04
0.00	29.75	20.18	17.33
50.00	12.18	56.10	26.55
100.00	21.14	4.20	1.97
150.00	3.95	0.38	0.17
200.00	0.73	we	0.17
250.00	1.10	we	0.09
300.00	0.01	we	0.00

Table 2 - Aircraft spray deposition on drift line samplers - Claxton Spray Trials, 1991.

Drift line 1

Card position	Day 1 Fluid ounces/acre	Day 2 Fluid ounces/acre	Day 3 Fluid ounces/acre
-50.00	17.22	76.56	43.72
0.00	46.51	0.98	1.41
50.00	31.21	36.98	31.09
100.00	17.27	48.91	33.81
150.00	6.28	6.89	25.08
200.00	2.63	we	11.57
250.00	5.59	we	4.19

300.00	0.15	WC	4.19
350.00	NA	NA	1.07
400.00	NA	NA	0.78
450.00	NA	NA	0.30
500.00	NA	NA	0.07
550.00	NA	NA	0.20
600.00	NA	NA	0.01
650.00	NA	NA	0.11
700.00	NA	NA	0.17
750.00	NA	NA	0.00
800.00	NA	NA	0.16
850.00	NA	NA	0.01
900.00	NA	NA	0.01
950.00	NA	NA	0.01
1.000.00	NA	NA	0.02

Table 3 - Drift deposit ratios from aerial and ground tank mixes comparing deposition within the orchard to drift sites outside the orchard - Claxton Spray Trials, 1991

Drift line 1

	Day 1		Day 2		Day 3	
Card position	Ground sprayer	Aircraft	Ground sprayer	Aircraft	Ground sprayer	Aircraft
50.00	0.33	0.98	4.25	0.95	1.10	1.38
100.00	0.58	0.54	0.32	1.26	0.08	1.50
150.00	0.11	0.20	0.03	0.18	0.01	1.11
200.00	0.02	0.08	WC	WC	0.01	0.51
250.00	0.03	0.18	WC	WC	0.04	0.19
300.00	0.0002	0.001	WC	WC	0.00	0.05
350.00	NA	NA	NA	NA	0.00	0.03
400.00	NA	NA	NA	NA	0.00	0.01
450.00	NA	NA	NA	NA	0.00	0.003
500.00	NA	NA	NA	NA	0.00	0.01
550.00	NA	NA	NA	NA	0.00	0.0004
600.00	NA	NA	NA	NA	0.00	0.005
650.00	NA	NA	NA	NA	0.00	0.01
700.00	NA	NA	NA	NA	0.00	0.00
750.00	NA	NA	NA	NA	0.00	0.01
800.00	NA	NA	NA	NA	0.00	0.00
850.00	NA	NA	NA	NA	0.00	0.0004
900.00	NA	NA	NA	NA	0.00	0.0004
950.00	NA	NA	NA	NA	0.00	0.0004
1,000.00	NA	NA	NA	NA	0.00	0.0009

DISCUSSION

Spray drift downwind and off-site from a seed orchard spray block appears to be more likely with aerial application compared with ground based sprays where small droplet sizes are used and when comparing equal amounts of spray solution per acre. Under normal orchard aerial spray conditions using the pesticide Guthion, the VMD is usually greater than 350 microns (Barber and Fatzinger 1987). In this test the VMD ranged between 127 and 196 microns. Many orchard managers are currently using Foray 48B applied at 1 gal/acre with VMD's similar to this study. In these cases drift beyond 300 feet from the orchard edge may be expected. This drift may not pose a significant problem on orchards as most orchards have a pollen buffer zone around the orchard. All Federal orchards have a 400 ft buffer to minimize pollen from entering the orchard. Potential drift from the orchard would be deposited on this buffer strip. The resulting off-site deposition in this study would have been less than I fl oz/acre beyond 400 feet of the orchard edge. Using larger droplet sizes would also reduce drift from the orchard.

The ground sprayer solution in this study did not drift far from the orchard but remained on site. On day three, deposits downwind of the orchard were detected to only 250 feet with none found after that point. This compares to aircraft deposition to 1000 feet. Ground sprayers however apply from 10 to 100 times more volume per acre than aircraft under orchard conditions and the resulting spray would result in considerable deposition within the orchard. Unfortunately, this deposition is found on the ground and on the lower branches (Barber and Mangini 1993) while the cone crop is found on the upper half of the crown. Previous work has shown more drift downwind when using ground sprayers (Ware et al. 1969). Possibly this is because the previous work was in open fields. This study was in a mature seed orchard. Under these conditions most of the spray material was deposited on the bottom branches and did not reach the upper crowns in quantities to move above the trees where drift could occur. In comparison the aircraft released its solution 15 to 20 ft above the trees.

CONCLUSIONS

Off-site aerial spray drift using droplet sizes less then 200 microns may result in spray deposition to 1000 feet, however, the majority of the off-site deposition was contained to within 300 ft of the orchard edge. This deposition would fall within a pollen management buffer strip which is located on most orchards. Because most orchard managers apply Guthion at 10 gallons per acre with a VMD of 350 microns or greater, less drift would be expected under these operational parameters.

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