M E M O R A N D U M

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SUBJECT: Revised: Estimation of Chlorpyrifos Horizontal Deposition and Air Concentrations for California Use Scenarios

## Background

This memorandum describes modeling procedures used to estimate off-site horizontal deposition and air concentrations associated with California chlorpyrifos use scenarios. The estimates produced with theses modeling procedures are suitable for use in conducting pesticide spray drift human exposure assessments. Horizontal deposition and air concentration estimates associated with primary spray drift from orchard airblast, ground boom, and aerial applications are provided.

## Modeling Methods

Two computer simulation models were used in this analysis: AgDRIFT (Teske et al., 2002) and AGDISP (Teske and Curbishley, 2013). The United States Environmental Protection Agency (US EPA) Office of Pesticide Programs (OPP) uses AgDRIFT for all agricultural deposition analysis and uses AGDISP for mosquito adulticide application scenarios (US EPA, 2014 and 2013a). For the analysis presented in this document, the AgDRIFT 2.0.05 model was used to produce the ground boom and orchard airblast deposition estimates only and AGDISP 8.28 was used to produce all aerial application deposition and air concentration estimates.

For this analysis, the AgDRIFT model was chosen for orchard airblast and ground boom because it is the only accepted model available for these two application scenarios. The AGDISP 8.28 model includes a ground boom algorithm, but that algorithm is still under development.

AgDRIFT estimates horizontal deposition for orchard airblast and ground boom applications using empirical models. The data on which the AgDRIFT empirical models are based were produced by the Spray Drift Task Force (SDTF) and were reviewed in a formal peer review (https://archive.epa.gov/scipoly/sap/meetings/web/html/121097_mtg.html). That peer review led to the current grouping of orchard types and ground boom scenarios. AgDRIFT version 2.0.05 executable file dated 8/2002 was used for all orchard airblast and ground boom simulations in this memorandum. AgDRIFT 2.0.05 is an older version of the model but produces ground boom and orchard airblast deposition results identical to the current regulatory version AgDRIFT 2.1.1. In addition, the 90th percentile ground boom results obtained from AgDRIFT 2.0.05 were identical to deposition results shown in the USEPA guidance on spray drift (White et al., 2013) that USEPA produced using the regulatory version of AgDRIFT 2.1.1. The regulatory version of AgDRIFT 2.1.1 was not available when the analysis presented in this memorandum was conducted.

The AGDISP 8.28 model was used for aerial application deposition and air concentration estimates reported in this memorandum. AGDISP is a well vetted model developed through the work of NASA, USDA Forest Service, and the US Army (Bird, et al., 2002). It is a Lagrangian first principles model that is in the public domain and has a Gaussian handoff module to estimate spray drift beyond 2605 ft. The AGDISP model has ongoing support from partnerships between various government agencies and private sector entities and is under continual improvement to bring the model behavior more accurately into line with field measured data. The AgDRIFT model contains an older version of the AGDISP aerial algorithms incorporated to estimate aerial application spray drift. However, the AgDRIFT model is limited to 2605 ft. In addition, AgDRIFT is a proprietary model developed by the SDTF in cooperation with USEPA Office of Research and Development (ORD) under a Cooperative Research Agreement (CRADA). AgDRIFT 2.1.1 does not include a time step improvement incorporated into AGDISP 8.28 (M. Teske, pers. comm., 2014). The lack of that time step improvement in AgDRIFT 2.1.1 results in higher off-site deposition relative to AGDISP 8.28. Analysis later in this memorandum shows that the regulatory version of AgDRIFT 2.1.1 does produce deposition results greater than AGDISP 8.28.

## Development of Exposure Scenarios

The deposition and air concentration estimates presented in this document were developed to reflect off-site movement expected under California chlorpyrifos use patterns. Key California use scenario patterns were selected for this analysis (Table 1). A range of application sizes were produced for each of the use scenarios was chosen based upon US EPA default (US EPA, 2013a) and/or analysis of the Pesticide Use Report (PUR) (Tuli, 2013). For orchard airblast the largest application is 40 acres, for ground boom the largest application is 300 acres, for aerial the largest acreage for tree fruit and nuts is 350 acres and for high acreage field crops the highest acreage is

900 acres. A preliminary screening deposition of 0.35% of the application rate was used for initial drift model scenario scoping (S. Beauvais, pers. comm., 2014). This preliminary screening deposition was used only to rank aircraft according to the distance downwind to the deposition fraction of 0.35%. The fixed wing and rotary aircraft showing the longest distance to 0.35% were then chosen to estimate exposures due to horizontal deposition and air concentrations. This process is described in more detail below.

Table 1. Application type scenarios for chlorpyrifos deposition estimates (all application methods) and chlorpyrifos air concentration estimates (aerial application methods only).

| Application type | Sub-Type |
|---|---|
| Orchard Airblast | Sparse/Young |
| | Dormant Apple |
| | Vineyard |
| Ground Boom Medium/Coarse | Low Boom (20 in above the canopy) |
| | High Boom (50 in above the canopy) |
| Aerial | Fixed Wing |
| | Helicopter |

The SDTF orchard airblast data is categorized into 5 composite orchard types. The sparse/young orchard airblast is the average of small grapefruit and dormant apple orchards field data. Small grapefruit trees are young, short trees. Dormant apple consists of field data only for apple orchards without leaves. The dormant apple orchard type is based only on the field data for dormant apples. The orchard airblast and ground boom scenarios models are empirical fits to the SDTF field trial data. There are no input variables beyond the orchard type for orchard airblast or spray quality (droplet spectra) and boom height for ground boom. For example, weather conditions cannot be changed. The empirical model outputs reflect the weather conditions at the time of the field trials. For orchard airblast, the only orchard type affected by wind speed was dormant apples where the wind speeds for the field trials varied between 4 mph and 12 mph (SDTF, 1997a). The ground boom field trials were conducted near Plainview, Texas. The weather during the field trials covered a wide range of conditions. The ground boom medium/coarse field trials showed environmental conditions spanning 5 mph to 20 mph wind speeds, 44º F to 91º F air temperatures, and 8% to 82% relative humidity (SDTF, 1997b).

The aerial application model algorithm in both AgDRIFT and AGDISP is a Lagrangian model that tracks droplets released from the nozzles during the simulated application. This type of model is called a first principles model because the deposition and air concentration estimates are obtained using the laws of physics rather than through statistical fit to observed data. Thus, the aerial model allows input of a wide range of important aspects of an aerial application. Choice of aircraft, how that aircraft is configured, and the specifications of how an aerial application is conducted can make a significant difference in the degree of off-site movement. It is important that the aerial application scenarios simulated are representative of the expected use patterns and that the inputs are clearly stated. For this analysis aerial application information obtained by the Enforcement Branch was used to select candidate aircraft and meteorological conditions (R. Sarracino, pers. comm., 2014). The AGDISP model has a large aircraft library that can be accessed to insure that each aircraft is correctly specified in the model runs. The aircraft list obtained from the Enforcement Branch was examined to match with aircraft that were in the AGDISP aircraft library. All aircraft on the Enforcement Branch aircraft list that were in the AGDISP aircraft library were used for the exploratory analysis and are shown in Table 2. For the exploratory analysis, the meteorological inputs were chosen to reflect an early summer morning application in the San Joaquin Valley. The specific meteorological inputs were the mean wind speed, temperature, and humidity for the time of 0600 hrs over 5 years of weather data (2009-2013) for the dates June 1 to August 31 from the Fresno State CIMIS weather station (station #80). Table 2 shows, for each of the candidate aircraft, the distance to 0.35% horizontal deposition of application rate. Based upon the greatest distance to the preliminary screening deposition level of 0.35% of application rate (S. Beauvais, personal communication, January 29, 2014) the AT802A fixed wing and the Bell 205 helicopter were chosen for further refinement in the final modeling scenarios.

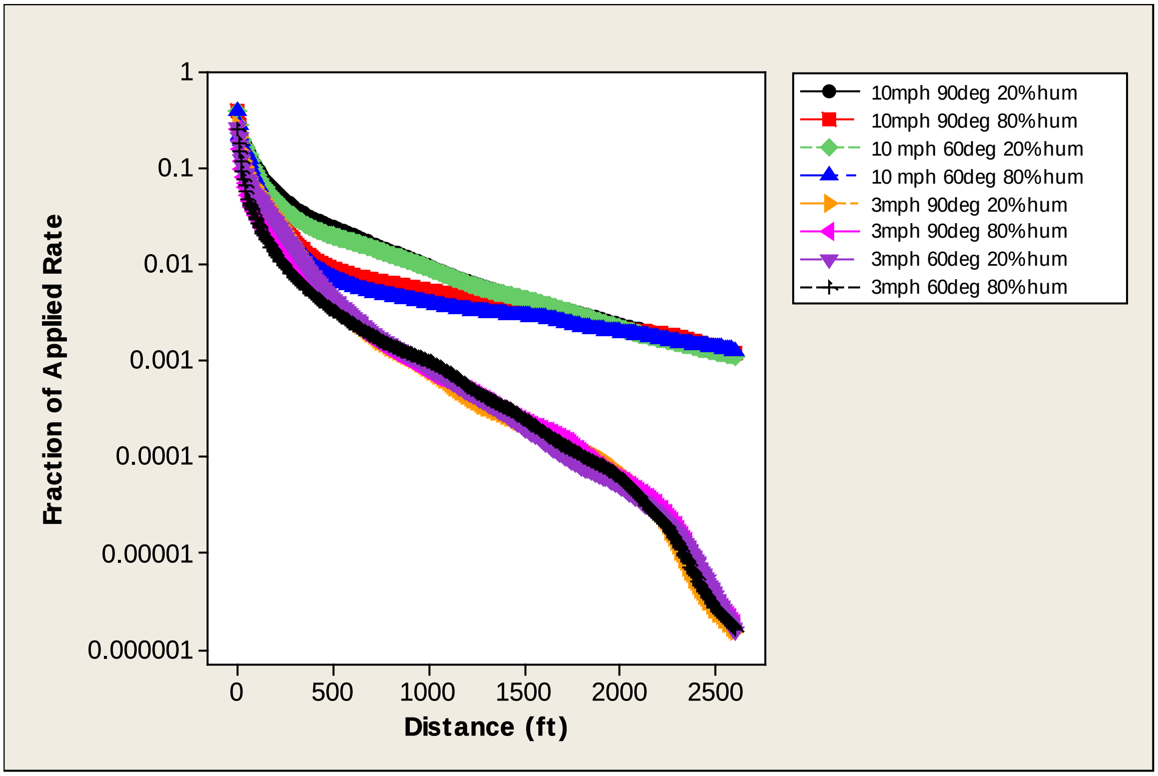
Table 2. Candidate aircraft. All simulations were conducted with a boom length of 76.3% of semi-span or rotor diameter, swath width of 60ft for fixed wing or 1.2x rotor diameter for helicopter, a swath-displacement of 37%, no half-boom effect or swath offset, 2 gal/ac volume, non-volatile active ingredient application rate of 2 lb/ac, 10 mph wind, air temperature 65 deg F, and humidity of 50%. Number of nozzles for each aircraft is the default in the AGDISP library.

| Aircraft | Distance to 0.35% of application rate (ft) | Air Speed (mph) | Aircraft Weight (lbs) | Semi-span or Rotor Radius (ft) | Number of Nozzles |
|---|---|---|---|---|---|
| Fixed Wing | | | | | |
| AT802A | 1174 | 145 | 11160 | 29 | 39 |
| AT401 | 1122 | 120 | 6000 | 24.5 | 42 |
| Trush | 1102 | 140 | 7665 | 23.75 | 32 |
| AT502 | 1096 | 155 | 6660 | 25 | 34 |
| AT301 | 1037 | 120 | 5600 | 22.6 | 30 |
| AgCat* | 1437 | 150 | 5022 | 21.25 | 29 |
| Helicopter | | | | | |
| Bell 205 | 1122 | 92 | 7697 | 24 | 32 |
| Bell 47G-3B-2 | 1056 | 58 | 2422 | 18.6 | 25 |
| Hiller UH-12E3 | 1056 | 58 | 2430 | 17.7 | 24 |
| Hiller UH-12E3T | 1056 | 58 | 2370 | 17.7 | 24 |
| Aerodyne Wasp | 1050 | 62 | 2090 | 17.4 | 24 |
| Bell 206 Jet Ranger II | 1037 | 69 | 2053 | 16.7 | 23 |
| Bell 206 Jet Ranger III | 1037 | 69 | 2398 | 16.7 | 23 |
| Robinson R-44 Raven | 1037 | 130 | 1829 | 16.5 | 22 |

*Biplane

Once the AT802A and the Bell 205 aircraft were chosen, the weather conditions were refined for potential worst case conditions. The information gathered by the Enforcement Branch indicated that late afternoon summer applications were expected (R. Sarracino, pers. comm., 2014). Thus, range of weather conditions were chosen to span the possible conditions from sunrise to late afternoon. AGDISP model runs were conducted using all combinations of weather conditions as follows: winds speed 3 mph and 10 mph, temperature 60 deg F and 90 deg F, humidity 20% and 80%. A total of 8 combinations of the chosen wind speed, temperature, and humidity values were simulated for the AT802A aircraft to determine the reasonable worst case weather scenario. The reasonable worst case weather scenario was then used to produce both the deposition and air concentration estimates for the AT802A and the Bell 205 aircrafts. Figure 1 shows the deposition results from those 8 model runs. The 10 mph/20% humidity model runs show the overall highest deposition. The 10 mph/20%humidity/90 deg F scenario shows generally the higher deposition than the 10mph/20% humidity/60 deg F scenario. Thus, the 10 mph/20%humidity/90 deg F meteorology combination was used to produce the deposition and the accompanying air concentrations for the AT802A and the Bell 205 application method scenarios.

Figure 1. AGDISP estimated deposition for the AT802A aircraft under 8 combinations of wind speed, temperature, and humidity.




## Uncertainty

No uncertainty factors were added to the modeled deposition or the air concentration estimates. Reasoning for the three application methods of aerial, orchard airblast and ground will be considered separately.

**Orchard Airblast**. The AgDRIFT orchard airblast empirical model outputs the value of the empirical function. In the case of the least squares fit empirical function this value is the 50$^{th}$ percentile deposition estimate for three orchard types:  normal, dense, and sparse. Sparse orchard type was used for this analysis to generally represent California orchards during the dormant spray season, which is reasonable worst case for near field deposition. A refined estimate for specific orchard types is also available. The dormant apples orchard type was simulated as a California specific scenario. The AgDRIFT user manual does not state why a 90$^{th}$ percentile is not estimated for the orchard airblast empirical equations. At the 1999 SAP OPP staff did present tolerance bounds for orchard airblast (U.S. EPA, 1999) but these bounds were not implemented.

**Ground Boom**. The AgDRIFT ground boom empirical model outputs the value of the empirical function. In the case of the least squares fit empirical function this value is the 50$^{th}$ percentile deposition estimate. In addition, the AgDRIFT ground boom empirical model has the choice to output 90$^{th}$ percentile. However, the derivation of the 90$^{th}$ percentile is not clear. This estimated deposition value does not appear to be large enough, compared to the mean at each distance, to be a tolerance interval capturing the 90$^{th}$ percentile at each distance with a 90% or 95% confidence. More likely what is labeled as the 90$^{th}$ percentile is actually the 90% prediction interval on the empirical function. There is no information provided in the AgDRIFT user manual about exactly how 90$^{th}$ percentile was derived. In the absence of the details of this estimate, and to maintain uniformity in approach between orchard airblast and ground boom, it is preferable to use the 50$^{th}$ percentile estimate (the value on the deposition curve).

**Aerial**. The AGDISP model produces an ensemble average deposition at a particular distance. For aerial applications all input variables were reasonable worst case. Thus, with all inputs selected for reasonable worst case, the results can be argued to represent a reasonable upper bound on the mean deposition. The AGDISP model algorithm has been compared to numerous field studies and found to produce estimates that are within a factor of two to six of field measured deposition (Bird et al., 2002; Teske and Thistle, 2003; Teske et al., 2003). The AGDISP model algorithm has been found to over-predict deposition in the far field (Bird, et al., 2002). The AGDISP air concentrations estimates have not been compared to field data. However, as mentioned earlier, AGDISP is a first principles model. In addition, mass balance is a feature of the model (Teske and Curbishley, 2013). The air concentration estimated at a particular location includes all the mass in the vertical plane at that location that is present after deposition. Thus, it is likely that the air concentrations will not be sustainably underestimated.

## Deposition Estimate Development

**Number of swaths**. The AgDRIFT and AGDISP models have a maximum number of swaths for each application type. Application sizes are not specified. Instead, the downwind deposition reflects the number of upwind swaths. For these simulations it is assumed that the wind direction is perpendicular to the swath direction and that the deposition estimated is the deposition expected directly downwind from the middle of the swath. Thus, application size was modeled based upon the width in feet of a particular number of swaths. It was further assumed that the field to which the application was made is square. So, the width of the field and the length of the field are assumed to be equal (for aerial applications swath displacement is not considered). The acreage is calculated as the length times the width. For all three application types (orchard airblast, ground boom, and aerial), the width of the desired maximum acreage exceeded the width of the maximum number of swaths the model can simulate. For orchard airblast and ground boom a maximum of 20 swaths can be simulated. For aerial applications a maximum of 50 swaths can be simulated. Table 3 shows a summary of swath width, maximum number of swaths and the resulting maximum acreage the model will directly produce for each application type.

Table 3. Swath parameter and limits in the AgDRIFT and AGDISP models.

| Application Type | Swath Width | Max Number of Swaths | Width of Max Number of Swaths | Equivalent Square Acreage |
|---|---|---|---|---|
| Orchard Airblast | 16 ft | 20 | 320 ft | 2.35 ac |
| Ground Boom | 45 ft | 20 | 900 ft | 18.6 ac |
| Aerial Fixed-wing AT802A | 60 ft | 50 | 3000 ft | 206.6 ac |
| Aerial Helicopter Bell 205 | 57.6 ft | 50 | 2880 ft | 190.4 ac |

The PUR analysis indicates that use patterns in California for orchard airblast and ground boom are commonly much larger than the maximum 20 swath simulations available out of the AgDRIFT model. In order to obtain deposition estimates for applications larger than the maximum single model run limit of 20 swaths the deposition curves from one or more single 20 swath applications were overlaid after being offset upwind by the appropriate distance. Table 4 and Figure 1 show the process for orchard airblast. For orchard airblast, the AgDRIFT model estimates deposition to a maximum downwind distance of 997.4 ft (the prediction domain of the model). A model run of the maximum number of 20 swaths, assuming that rows of the orchard are 16 ft apart (16 ft wide), represents an orchard that is 320 ft wide (20 swaths × 16 ft). With the assumption of a square orchard (320 ft × 320 ft) this results in an orchard that is 2.35 ac. If a second set of 20 swaths is added to the upwind side of this initial orchard then the resulting orchard is 40 swaths, or 640 ft, wide. A square 640 ft by 640 ft orchard is 9.4 ac. Although assuming the next size up orchard is twice as wide and twice as long may seem arbitrary, for the purposes of estimating drift that assumption is not critical because only the width in the upwind direction is most important in determining the downwind deposition. The square orchard is a simplifying assumption. The grape vineyard scenario did not require extension beyond one set of 20 swaths (Table 5). The same extension procedure is used to increase the ground boom application size. Details of the ground boom process are shown in Table 6.

Table 4. Orchard airblast swath extension details. Each set of 20 swaths is 320 ft wide. Downwind deposition curves are offset by the appropriate number of feet and then overlaid. When overlaying, upwind deposition curves are allowed to drop to zero at the model domain limit of 997.4 ft.

| Swath Set | Swath Width (ft) | Number of Swaths | Total Application Area Width (Sum of Set Widths) | Upwind Offset (ft) | Total Number of Swaths | Resulting Application Size (acres) | Deposition Curve Distance at Set 1 Downwind Edge (ft) | Section of Deposition Curve added to Set 1 Deposition Curve (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 16 ft | 20 | 320 ft | 0 ft | 20 | 2.35 ac | 0 ft | 0 ft to 997.4 ft |
| 2 | 16 ft | 20 | 640 ft | 320 ft | 40 | 9.4 ac | 320 ft | 320 ft to 997.4 ft |
| 3 | 16 ft | 20 | 960 ft | 640 ft | 60 | 21.2 ac | 640 ft | 640 ft to 997.4 ft |
| 4* | 16 ft | 20 | 1280 ft | 960 ft | 80 | 37.6 ac | 960 ft | 960 ft to 997.4 ft |

*Set 4 is too far up wind to reliably estimate residue contributions to the downwind deposition curve.

Table 5. Grape Vineyard. Conventional and wrap-around sprayers. Each set of 20 swaths is 240 ft wide. Downwind deposition curves for these scenarios are not overlaid with additional upwind blocks because the deposition is so low that overlays are not necessary.

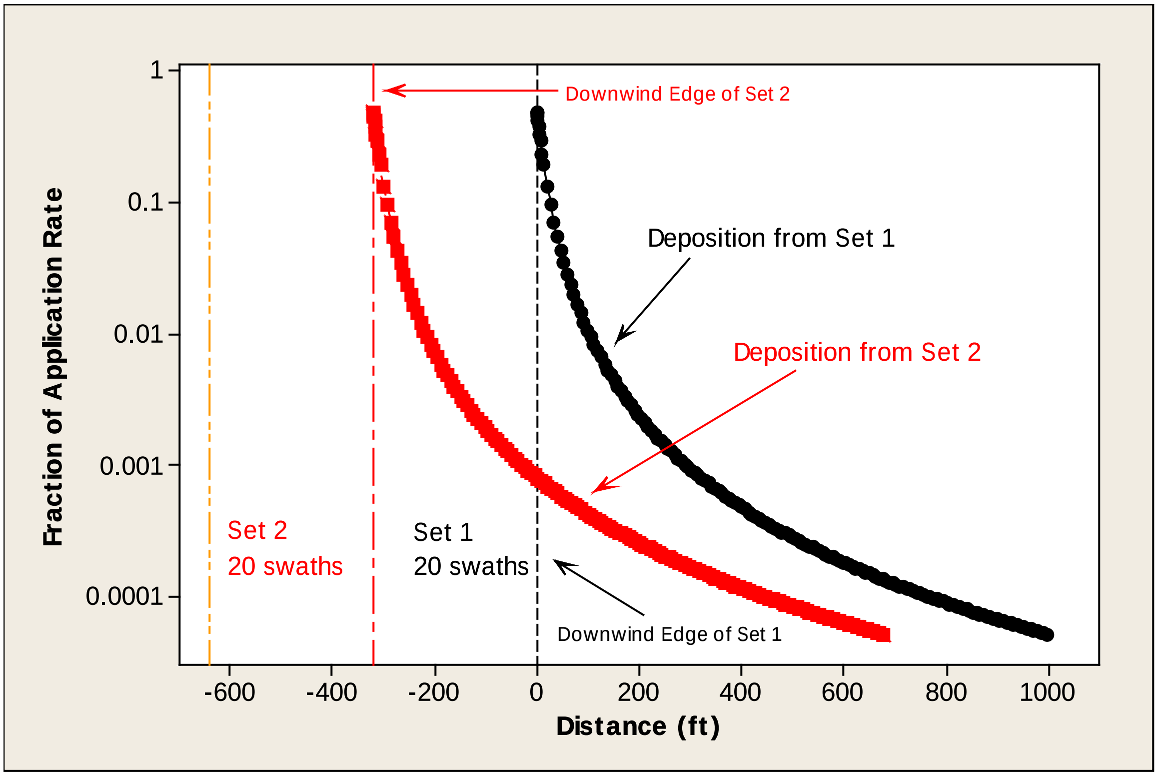
| Set | Swath Width (ft) | Number of Swaths | Total Application Area Width (Sum of Set Widths) | Upwind Offset (ft) | Total Number of Swaths | Resulting Application Size (acres) | Deposition Curve Distance at Set 1 Downwind Edge (ft) | Section of Deposition Curve added to Set 1 Deposition Curve (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 12 ft | 20 | 240 ft | 0 ft | 20 | 1.32 ac | 0 ft | 0 ft to 997.4 ft |

Table 6. Ground boom. Each set of 20 swaths is 900 ft wide. Downwind deposition curves are offset by the appropriate number of feet and then overlaid. When overlaying, upwind deposition curves are allowed to drop to zero at the model domain limit of 997.4 ft.

| Set | Swath Width (ft) | Number of Swaths | Total Application Area Width (Sum of Set Widths) | Upwind Offset (ft) | Total Number of Swaths | Resulting Application Size (acres) | Deposition Curve Distance at Set 1 Downwind Edge (ft) | Section of Deposition Curve added to Set 1 Deposition Curve (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 45 ft | 20 | 900 ft | 0 ft | 20 | 18.6 ac | 0 ft | 0 ft to 997.4 ft |
| 2 | 45 ft | 20 | 1800 ft | 900 ft | 40 | 74.4 ac | 900 ft | 900 ft to 997.4 ft |

As an example, the deposition curves from two sets of 20 swaths (Set 1 and Set 2) are overlaid to estimate the composite deposition from the 40 swaths (the total deposition resulting from joining two sets of 20 swaths). The deposition curve from Set 2 is constrained to be used only to 997.4 ft relative to the downwind edge of set 2 (Figure 2). Thus, residues from the Set 2 set of 20 swaths contribute to the downwind deposition from the orchard (Set 1 + Set 2) as a whole only between 0 ft and 677.4 ft on the deposition curve of the Set 1 set of 20 swaths. This process can be repeated for multiple sets of 20 swaths until the upwind setback is so large that the farthest upwind deposition curve extending beyond the downwind edge of the initial set of 20 swaths has a portion too small to sufficiently estimate the residues from the upwind set of swaths. For example, Set 4 in the orchard airblast scenario is too far up wind to reliably estimate residues from Set 4 that might be deposited downwind of Set 1.

Figure 2. Illustration of the deposition curve overlay process to obtain a composite deposition curve for a 40 swath orchard. Two separate 20 swath deposition curves are overlaid as shown below. The Set 2 (red deposition curve) residues only contribute to the total downwind deposition beyond the downwind edge of Set 1. The Set 2 deposition curve is not extended beyond 997.4 ft relative to the downwind edge of Set 2. So, the portion of the composite deposition curve between 667.4 ft and 997.4 ft the Set 1 downwind edge does not receive any deposition from Set 2. This is illustrated by the end of the red deposition curve.

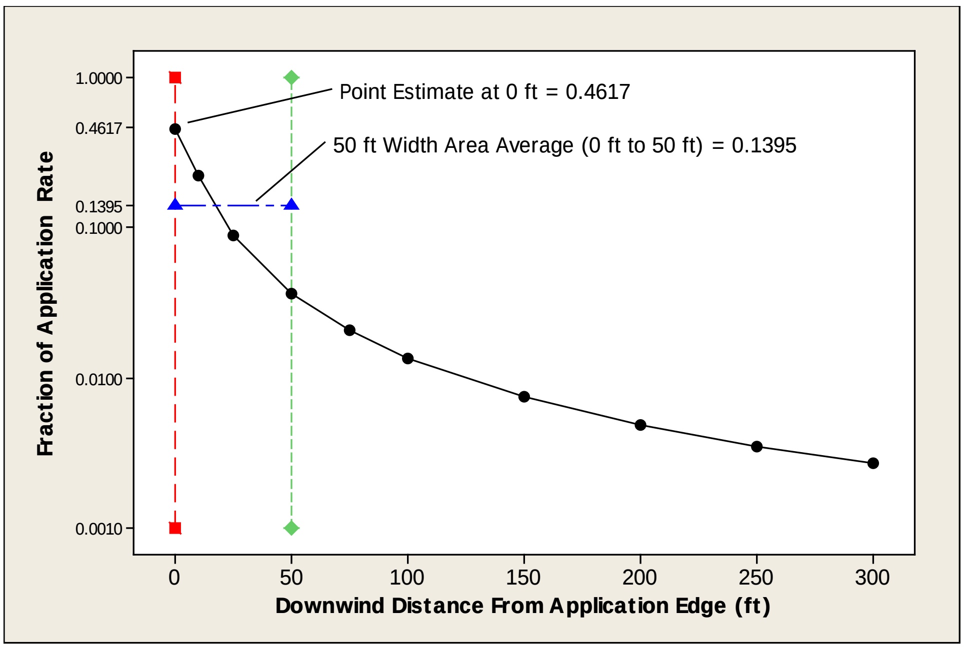


As stated above, this procedure was only implemented if the resulting deposition from the offset upwind swaths was within the prediction domain of the model. The aerial algorithm estimates deposition up to 2605 ft directly downwind of the application (the far field Gaussian handoff was not used in this analysis). The width of the first 50 swaths is 3000 ft for the fixed-wing and 2880 ft for the helicopter. So, the deposition curve from a second set of 50 swaths would fully land on the area of the application comprised by the first 50 swaths. Essentially, all of the deposition from the second set of 50 swaths lands on target. Thus, no new residue would be added to the downwind deposition curve of the first 50 swaths. For this reason the deposition curve overlay procedure was not used for aerial applications. The aerial results were obtained directly out of the AGDISP model.

Once the appropriate composite deposition curves were assembled for 40 swaths and 60 swaths, the point estimates and 50 ft width average deposition at desired distances were produced by fitting an empirical function using TableCurve 2D (AISN, 2000). The purpose of this curve fit was strictly to faithfully reproduce the modelled deposition curve, not as an explanatory analysis. This provided a convenient way to find the deposition at any desired downwind distance. All composite deposition curves were fit in TableCurve2D. Deposition estimates for orchard airblast and ground boom start at 25 ft from the downwind application edge. The SDTF field studies on which the empirical models are based did not include any sampling closer than 25 ft. Thus, the AgDRIFT empirical equations between the field edge and 25 feet are an estimation based on the assumed empirical functions for each of the application methods. These assumed empirical functions may be correct, however, with the data currently available it is impossible to verify that they reflect the actual pattern of deposition very close to the field edge. The deposition fraction likely changes rapidly close to the field. Thus, without measurements it is difficult to place confidence in the empirical estimates between 0 ft and 25 ft. For the ground boom model, the AgDRIFT manual (Teske et al., 2002) shows that a segmented approach is used to produce deposition estimates with two separate functions for 0ft to 25 ft and greater than 25 ft. The orchard airblast does not include a segmented function but the same concerns apply. Reliability of the empirical fit in the downwind direction is also a concern but the empirical functions in the far field decrease slowly and more likely over estimate deposition rather than underestimate. The AgDRIFT manual includes a detailed discussion of far field deposition distances (Teske, et al., 2002). The aerial algorithm is a first principles physics based model so estimates closer than 25 ft are provided.

Two types of estimates were provided, point estimate and an average estimate over a 50 ft width. The 50 ft width is the USEPA standard lawn scenario (USEPA, 2013b). Figure 3 compares the point estimates to the 50ft width area average. This is a generic example not related to chlorpyrifos specifically. The Average Area Deposition is calculated by integrating the area under the deposition curve between a starting downwind distance and a desired width and then dividing by the width. For example, as shown in Figure 3, integrating between 0 ft and 50 ft and then dividing by 50 ft. In essence this spreads the area under the curve evenly between 0 ft and 50 ft. The difference between the point estimate and the area average is greatest near the application edge because the deposition curve is steep near the application edge (the slope of the curve is steeply negative).

Figure 3. Illustration of the 50 ft Width Average Deposition calculation. The 50 ft width is a moving 50 ft wide segment that depends on the starting downwind distance. In this illustration the starting downwind distance is 0 ft (the application edge) and the segment extends to 50 ft downwind. However, the process is the same regardless of the start and end point of the interval or the width of the interval. See the text for calculation details.




## Deposition Estimates

Deposition estimates at selected distances for each scenario are shown in this section. The 20 swath estimates are output directly from either the AgDRIFT or AGDISP model. As described above, all 40 swath and 60 swath estimates are obtained by fitting a function to closely replicate the overlaid deposition curves ($R^2$ > 99.9%). The 40 swath and 60 swath point and 50ft width average deposition at the selected distances was then evaluated in TableCurve 2D.

**Orchard Airblast.** Sparse orchard (Tables 7 to 9), dormant apples (Tables 10 to 12), and grapevines (Tables 13 and 14) were simulated. The AgDrift sparse orchard scenario combines the deposition results from young grapefruit and dormant apples. Dormant apples show higher deposition than sparse orchards near field but lower deposition in the far field (Figure 4).

Table 7. Sparse orchard 20 swath 50$^{th}$ percentile deposition estimates. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of App | 2 lb/ac µg/cm$^2$ | | Start | End | Fraction of App | 2 lb/ac µg/cm$^2$ |
| 25 | 0.10070 | 2.2574 | | 25 | 75 | 0.04430 | 0.9931 |
| 50 | 0.03730 | 0.8362 | | 50 | 100 | 0.02000 | 0.4483 |
| 75 | 0.01810 | 0.4057 | | 75 | 125 | 0.01100 | 0.2466 |
| 100 | 0.01030 | 0.2309 | | 100 | 150 | 0.00680 | 0.1524 |
| 150 | 0.00440 | 0.0986 | | 150 | 200 | 0.00320 | 0.0717 |
| 200 | 0.00230 | 0.0516 | | 200 | 250 | 0.00180 | 0.0404 |
| 250 | 0.00140 | 0.0314 | | 250 | 300 | 0.00110 | 0.0247 |
| 300 | 0.00090 | 0.0202 | | 300 | 350 | 0.00080 | 0.0179 |

Table 8. Sparse orchard 40 swath 50$^{th}$ percentile deposition estimates. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac µg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac µg/cm$^2$ |
| 25 | 0.10138 | 2.2726 | | 25 | 75 | 0.04472 | 1.0025 |
| 50 | 0.03783 | 0.8480 | | 50 | 100 | 0.02033 | 0.4558 |
| 75 | 0.01850 | 0.4147 | | 75 | 125 | 0.01142 | 0.2560 |
| 100 | 0.01078 | 0.2418 | | 100 | 150 | 0.00729 | 0.1635 |
| 150 | 0.00492 | 0.1103 | | 150 | 200 | 0.00371 | 0.0831 |
| 200 | 0.00279 | 0.0626 | | 200 | 250 | 0.00224 | 0.0502 |
| 250 | 0.00180 | 0.0403 | | 250 | 300 | 0.00150 | 0.0336 |
| 300 | 0.00125 | 0.0280 | | 300 | 350 | 0.00107 | 0.0240 |

Table 9. Sparse orchard 60 swath 50$^{th}$ percentile deposition estimates. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac μg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac μg/cm$^2$ |
| 25 | 0.10151 | 2.2756 | | 25 | 75 | 0.04488 | 1.0060 |
| 50 | 0.03799 | 0.8517 | | 50 | 100 | 0.02044 | 0.4581 |
| 75 | 0.01860 | 0.4169 | | 75 | 125 | 0.01148 | 0.2574 |
| 100 | 0.01085 | 0.2431 | | 100 | 150 | 0.00733 | 0.1644 |
| 150 | 0.00495 | 0.1110 | | 150 | 200 | 0.00373 | 0.0836 |
| 200 | 0.00281 | 0.0630 | | 200 | 250 | 0.00225 | 0.0505 |
| 250 | 0.00181 | 0.0405 | | 250 | 300 | 0.00151 | 0.0338 |
| 300 | 0.00126 | 0.0282 | | 300 | 350 | 0.00108 | 0.0242 |

Table 10. Dormant apples 20 swath 50$^{th}$ percentile deposition estimates. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac μg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac μg/cm$^2$ |
| 25 | 0.14380 | 3.2236 | | 25 | 75 | 0.05520 | 1.2374 |
| 50 | 0.04350 | 0.9751 | | 50 | 100 | 0.02090 | 0.4685 |
| 75 | 0.01820 | 0.4080 | | 75 | 125 | 0.01010 | 0.2264 |
| 100 | 0.00930 | 0.2085 | | 100 | 150 | 0.00560 | 0.1255 |
| 150 | 0.00330 | 0.0740 | | 150 | 200 | 0.00230 | 0.0516 |
| 200 | 0.00160 | 0.0359 | | 200 | 250 | 0.00120 | 0.0269 |
| 250 | 0.00090 | 0.0202 | | 250 | 300 | 0.00070 | 0.0157 |
| 300 | 0.00050 | 0.0112 | | 300 | 350 | 0.00040 | 0.0090 |

Table 11. Dormant apples 40 swath 50th percentile deposition estimates. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac µg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac µg/cm$^2$ |
| 25 | 0.14416 | 3.2317 | | 25 | 75 | 0.05530 | 1.2397 |
| 50 | 0.04380 | 0.9818 | | 50 | 100 | 0.02101 | 0.4711 |
| 75 | 0.01846 | 0.4139 | | 75 | 125 | 0.01028 | 0.2305 |
| 100 | 0.00948 | 0.2125 | | 100 | 150 | 0.00583 | 0.1306 |
| 150 | 0.00350 | 0.0784 | | 150 | 200 | 0.00244 | 0.0548 |
| 200 | 0.00169 | 0.0379 | | 200 | 250 | 0.00128 | 0.0288 |
| 250 | 0.00097 | 0.0217 | | 250 | 300 | 0.00077 | 0.0173 |
| 300 | 0.00061 | 0.0136 | | 300 | 350 | 0.00049 | 0.0111 |

Table 12. Dormant apples 60 swath 50th percentile deposition estimates. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac µg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac µg/cm$^2$ |
| 25 | 0.14422 | 3.2330 | | 25 | 75 | 0.05535 | 1.2409 |
| 50 | 0.04385 | 0.9830 | | 50 | 100 | 0.02106 | 0.4721 |
| 75 | 0.01851 | 0.4150 | | 75 | 125 | 0.01033 | 0.2315 |
| 100 | 0.00952 | 0.2135 | | 100 | 150 | 0.00587 | 0.1315 |
| 150 | 0.00353 | 0.0792 | | 150 | 200 | 0.00248 | 0.0555 |
| 200 | 0.00172 | 0.0386 | | 200 | 250 | 0.00131 | 0.0294 |
| 250 | 0.00099 | 0.0223 | | 250 | 300 | 0.00079 | 0.0178 |
| 300 | 0.00063 | 0.0141 | | 300 | 350 | 0.00051 | 0.0115 |

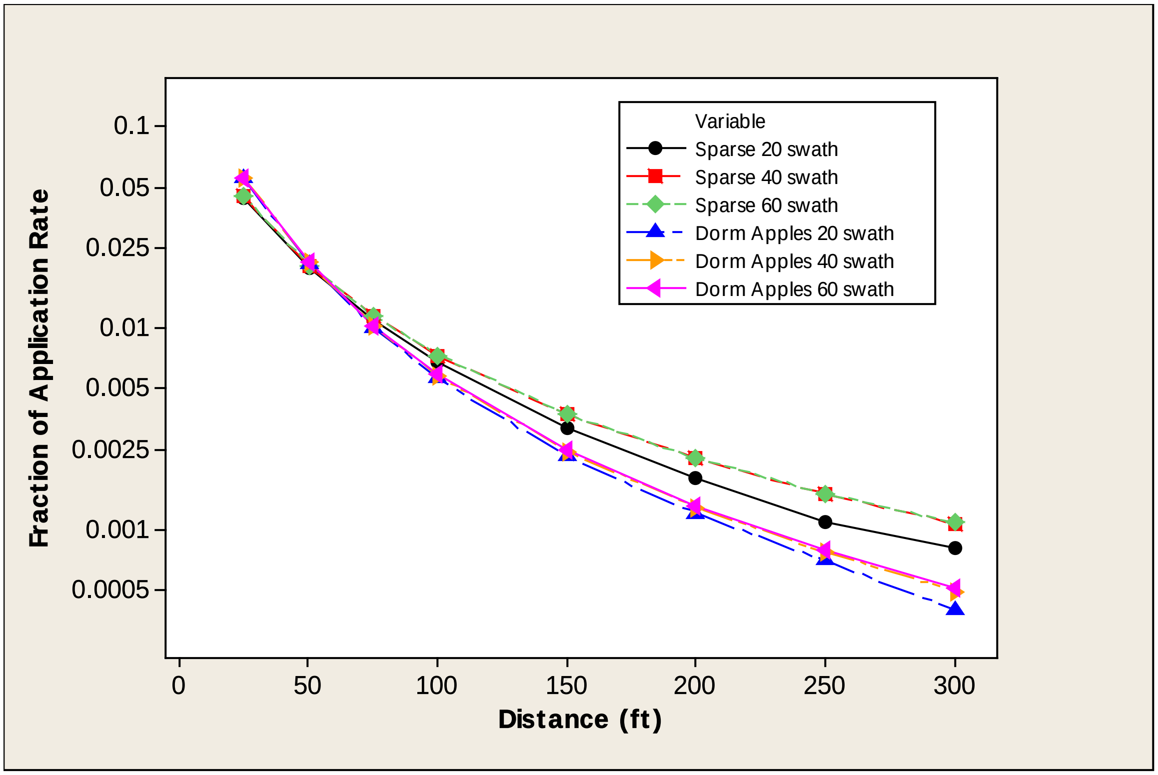
Table 13. Grape vineyard conventional sprayer 20 swath 50th percentile deposition estimates. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac µg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac µg/cm$^2$ |
| 25 | 0.0047 | 0.10000 | | 25 | 75 | 0.0022 | 0.04960 |
| 50 | 0.0019 | 0.04290 | | 50 | 100 | 0.0012 | 0.02660 |
| 75 | 0.0011 | 0.02500 | | 75 | 125 | 0.0008 | 0.01770 |
| 100 | 0.0008 | 0.01710 | | 100 | 150 | 0.0006 | 0.01300 |
| 150 | 0.0004 | 0.01000 | | 150 | 200 | 0.0004 | 0.00828 |
| 200 | 0.0003 | 0.00687 | | 200 | 250 | 0.0003 | 0.00592 |
| 250 | 0.0002 | 0.00511 | | 250 | 300 | 0.0002 | 0.00451 |
| 300 | 0.0002 | 0.00399 | | 300 | 350 | 0.0002 | 0.00359 |

Table 14. Grape vineyard wrap-around sprayer 20 swath 50th percentile deposition estimates. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac µg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac µg/cm$^2$ |
| 25 | 0.0007 | 0.01620 | | 25 | 75 | 0.0004 | 0.00971 |
| 50 | 0.0004 | 0.00902 | | 50 | 100 | 0.0003 | 0.00646 |
| 75 | 0.0003 | 0.00624 | | 75 | 125 | 0.0002 | 0.00487 |
| 100 | 0.0002 | 0.00478 | | 100 | 150 | 0.0002 | 0.00392 |
| 150 | 0.0001 | 0.00325 | | 150 | 200 | 0.0001 | 0.00283 |
| 200 | 0.0001 | 0.00247 | | 200 | 250 | 0.0000 | 0.00221 |
| 250 | 0.00009 | 0.00199 | | 250 | 300 | 0.0000 | 0.00182 |
| 300 | 0.00007 | 0.00166 | | 300 | 350 | 0.0000 | 0.00154 |

Figure 4. Orchard airblast application 50 ft width average deposition. Comparison between sparse orchard and dormant apples. The development procedure for these deposition estimates is described in the text.




**Ground Boom.** Low boom (Tables 15 and 16) and high boom (Tables 17 and 18) applications were simulated. A comparison of all deposition estimates is shown in Figure 5. As expected, high boom shows higher deposition than low boom both in the near field and the far field. The 40 swath applications show only slightly higher deposition than the 20 swath applications. This is expected because the 20 swath application is 900 feet wide, only 97 feet less than the domain of the Set 2 deposition curve.

Table 15. Ground boom deposition. Low boom and medium/coarse spray quality 20 swath 50$^{th}$ percentile. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac µg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac µg/cm$^2$ |
| 25 | 0.0083 | 0.1861 | | 25 | 75 | 0.0047 | 0.1054 |
| 50 | 0.0043 | 0.0964 | | 50 | 100 | 0.0032 | 0.0717 |
| 75 | 0.0031 | 0.0695 | | 75 | 125 | 0.0024 | 0.0538 |
| 100 | 0.0024 | 0.0538 | | 100 | 150 | 0.0020 | 0.0448 |
| 150 | 0.0017 | 0.0381 | | 150 | 200 | 0.0015 | 0.0336 |
| 200 | 0.0013 | 0.0291 | | 200 | 250 | 0.0012 | 0.0269 |
| 250 | 0.0011 | 0.0247 | | 250 | 300 | 0.0010 | 0.0224 |
| 300 | 0.0009 | 0.0202 | | 300 | 350 | 0.0009 | 0.0202 |

Table 16. Ground boom deposition. Low boom and medium/coarse spray quality 40 swath 50$^{th}$ percentile. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac µg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac µg/cm$^2$ |
| 25 | 0.0085 | 0.1898 | | 25 | 75 | 0.0050 | 0.1119 |
| 50 | 0.0046 | 0.1029 | | 50 | 100 | 0.0034 | 0.0767 |
| 75 | 0.0034 | 0.0753 | | 75 | 125 | 0.0026 | 0.0582 |
| 100 | 0.0026 | 0.0573 | | 100 | 150 | 0.0020 | 0.0459 |
| 150 | 0.0017 | 0.0381 | | 150 | 200 | 0.0015 | 0.0340 |
| 200 | 0.0014 | 0.0304 | | 200 | 250 | 0.0012 | 0.0274 |
| 250 | 0.0011 | 0.0247 | | 250 | 300 | 0.0010 | 0.0228 |
| 300 | 0.0009 | 0.0212 | | 300 | 350 | 0.0009 | 0.0197 |

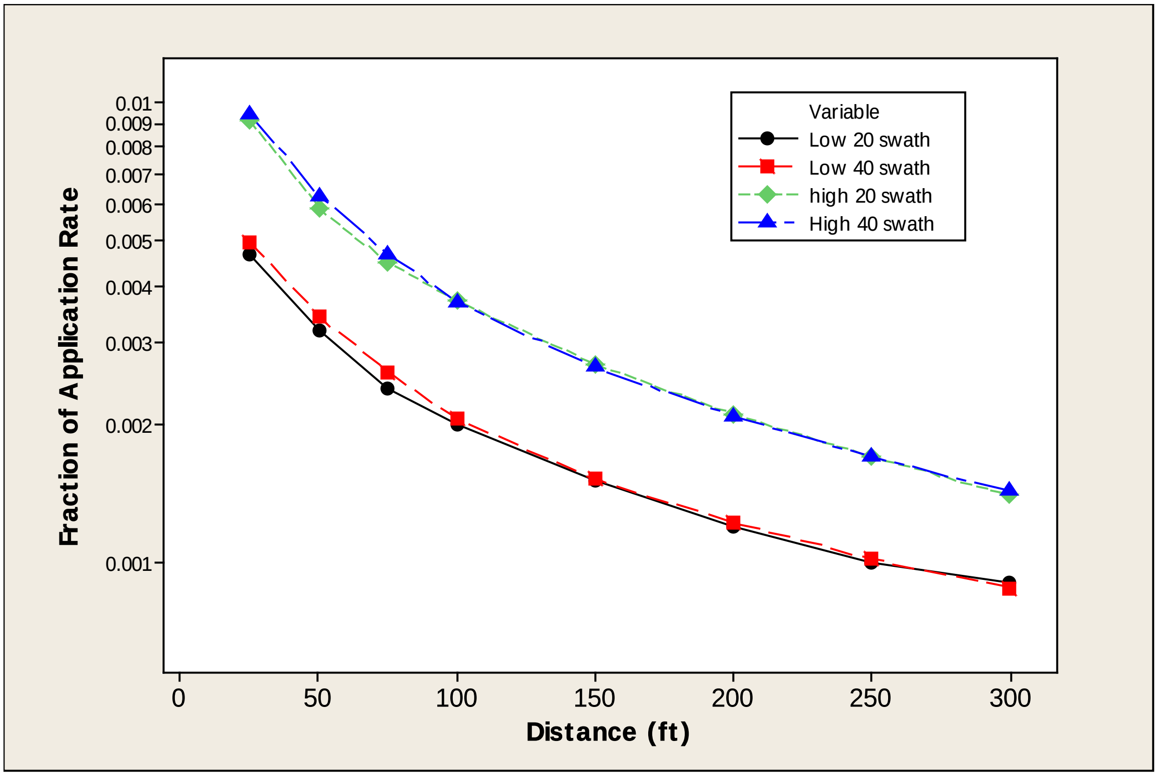
Table 17. Ground boom deposition. High boom and medium/coarse spray quality 20 swath 50th percentile. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac μg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac μg/cm$^2$ |
| 25 | 0.0165 | 0.3699 | | 25 | 75 | 0.0092 | 0.2062 |
| 50 | 0.0083 | 0.1861 | | 50 | 100 | 0.0059 | 0.1323 |
| 75 | 0.0057 | 0.1278 | | 75 | 125 | 0.0045 | 0.1009 |
| 100 | 0.0044 | 0.0986 | | 100 | 150 | 0.0037 | 0.0829 |
| 150 | 0.0031 | 0.0695 | | 150 | 200 | 0.0027 | 0.0605 |
| 200 | 0.0023 | 0.0516 | | 200 | 250 | 0.0021 | 0.0471 |
| 250 | 0.0019 | 0.0426 | | 250 | 300 | 0.0017 | 0.0381 |
| 300 | 0.0015 | 0.0336 | | 300 | 350 | 0.0014 | 0.0314 |

Table 18. Ground boom deposition. High boom and medium/coarse spray quality 40 swath 50th percentile. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac μg/cm$^2$ | | Start | End | Fraction of Rate | 2 lb/ac μg/cm$^2$ |
| 25 | 0.0166 | 0.3716 | | 25 | 75 | 0.0095 | 0.2121 |
| 50 | 0.0086 | 0.1937 | | 50 | 100 | 0.0063 | 0.1408 |
| 75 | 0.0061 | 0.1375 | | 75 | 125 | 0.0047 | 0.1054 |
| 100 | 0.0046 | 0.1034 | | 100 | 150 | 0.0037 | 0.0827 |
| 150 | 0.0030 | 0.0679 | | 150 | 200 | 0.0027 | 0.0596 |
| 200 | 0.0023 | 0.0524 | | 200 | 250 | 0.0021 | 0.0467 |
| 250 | 0.0019 | 0.0417 | | 250 | 300 | 0.0017 | 0.0380 |
| 300 | 0.0016 | 0.0348 | | 300 | 350 | 0.0014 | 0.0321 |

Figure 5. Ground boom 50 foot width average deposition. Medium/coarse spray quality. Comparison between low boom and high boom. The development procedure for these deposition estimates is described in the text.




**Aerial.** Deposition estimates for the fixed wing and helicopter scenarios are shown in Tables 19 and 20. A comparison between the AT802A fixed wing aircraft and the Bell 205 helicopter is shown in Figure 6. With the exception of the field edge, the Bell 205 helicopter generally shows less deposition than AT802A fixed wing. The application efficiency is approximately 98% for both the AT802A fixed wing aircraft and the Bell 205 helicopter. This means approximately 98% of the active ingredient released during the application is deposited on-site and 2% is lost by spray drift. The aerial application scenario is 50 swaths, so the application efficiency is higher than a smaller application. For example, a 20 swath application of the same aircraft scenario shows an application efficiency of approximately 95%. However, due to the higher total number of swaths, the downwind horizontal deposition is higher at all distances for the 50 swath application. Therefore, the 50 swath application is the reasonable worst case scenario.

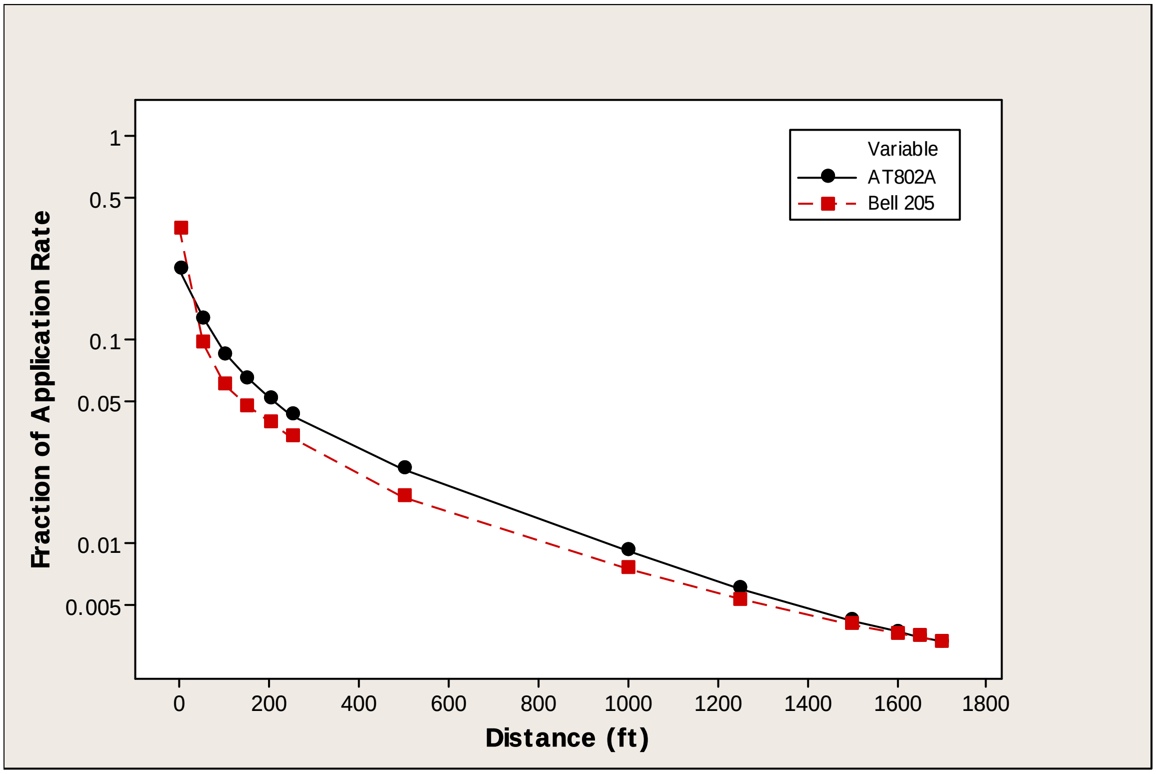
Table 19. Fixed wing aerial application deposition - AT802A medium spray quality 50 swath $50^{th}$ percentile. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac $\mu g/cm^2$ | | Start | End | Fraction of Rate | 2 lb/ac $\mu g/cm^2$ |
| 0 | 0.3945 | 8.8435 | | 0 | 50 | 0.2259 | 5.0640 |
| 50 | 0.1644 | 3.6854 | | 50 | 100 | 0.1286 | 2.8828 |
| 100 | 0.1026 | 2.3000 | | 100 | 150 | 0.0859 | 1.9256 |
| 150 | 0.0733 | 1.6432 | | 150 | 200 | 0.0652 | 1.4616 |
| 200 | 0.0577 | 1.2935 | | 200 | 250 | 0.0524 | 1.1747 |
| 250 | 0.047 | 1.0536 | | 250 | 300 | 0.043 | 0.9639 |
| 500 | 0.0245 | 0.5492 | | 500 | 550 | 0.0234 | 0.5246 |
| 1000 | 0.0096 | 0.2152 | | 1000 | 1050 | 0.0092 | 0.2062 |
| 1250 | 0.0062 | 0.1390 | | 1250 | 1300 | 0.006 | 0.1345 |
| 1500 | 0.0043 | 0.0964 | | 1500 | 1550 | 0.0042 | 0.0942 |
| 1600 | 0.0038 | 0.0852 | | 1600 | 1650 | 0.037 | 0.8294 |
| 1650 | 0.0036 | 0.0807 | | 1650 | 1700 | 0.0035 | 0.0785 |
| 1700 | 0.0034 | 0.0762 | | 1700 | 1750 | 0.033 | 0.0740 |

Table 20. Helicopter aerial application deposition. Bell 205 medium spray quality 50 swath $50^{th}$ percentile. The development procedure for these deposition estimates is described in the text.

| Point Estimates | | | | 50 ft Wide Lawn Estimates | | | |
|---|---|---|---|---|---|---|---|
| | | | | Location of 50 ft wide Lawn | | 50 ft Width Average Deposition | |
| Dist (ft) | Fraction of Rate | 2 lb/ac $\mu g/cm^2$ | | Start | End | Fraction of Rate | 2 lb/ac $\mu g/cm^2$ |
| 0 | 0.8698 | 19.4983 | | 0 | 50 | 0.3584 | 8.0343 |
| 50 | 0.1427 | 3.1989 | | 50 | 100 | 0.0969 | 2.1722 |
| 100 | 0.0683 | 1.5311 | | 100 | 150 | 0.0603 | 1.3517 |
| 150 | 0.0535 | 1.1993 | | 150 | 200 | 0.0479 | 1.0738 |
| 200 | 0.0434 | 0.9729 | | 200 | 250 | 0.0396 | 0.8877 |
| 250 | 0.0363 | 0.8137 | | 250 | 300 | 0.0334 | 0.7487 |
| 500 | 0.018 | 0.4035 | | 500 | 550 | 0.0171 | 0.3833 |
| 1000 | 0.0077 | 0.1726 | | 1000 | 1050 | 0.0075 | 0.1681 |
| 1250 | 0.0055 | 0.1233 | | 1250 | 1300 | 0.0053 | 0.1188 |
| 1500 | 0.0041 | 0.0919 | | 1500 | 1550 | 0.004 | 0.0897 |
| 1600 | 0.0037 | 0.0829 | | 1600 | 1650 | 0.0036 | 0.0807 |
| 1650 | 0.0035 | 0.0785 | | 1650 | 1700 | 0.0035 | 0.0785 |
| 1700 | 0.0034 | 0.0762 | | 1700 | 1750 | 0.0033 | 0.0740 |

Figure 6. Aerial application 50 foot width average deposition. Comparison between fixed wing (AT802A) and helicopter (Bell 205). The development procedure for these deposition estimates is described in the text.




## Air Concentration Estimates

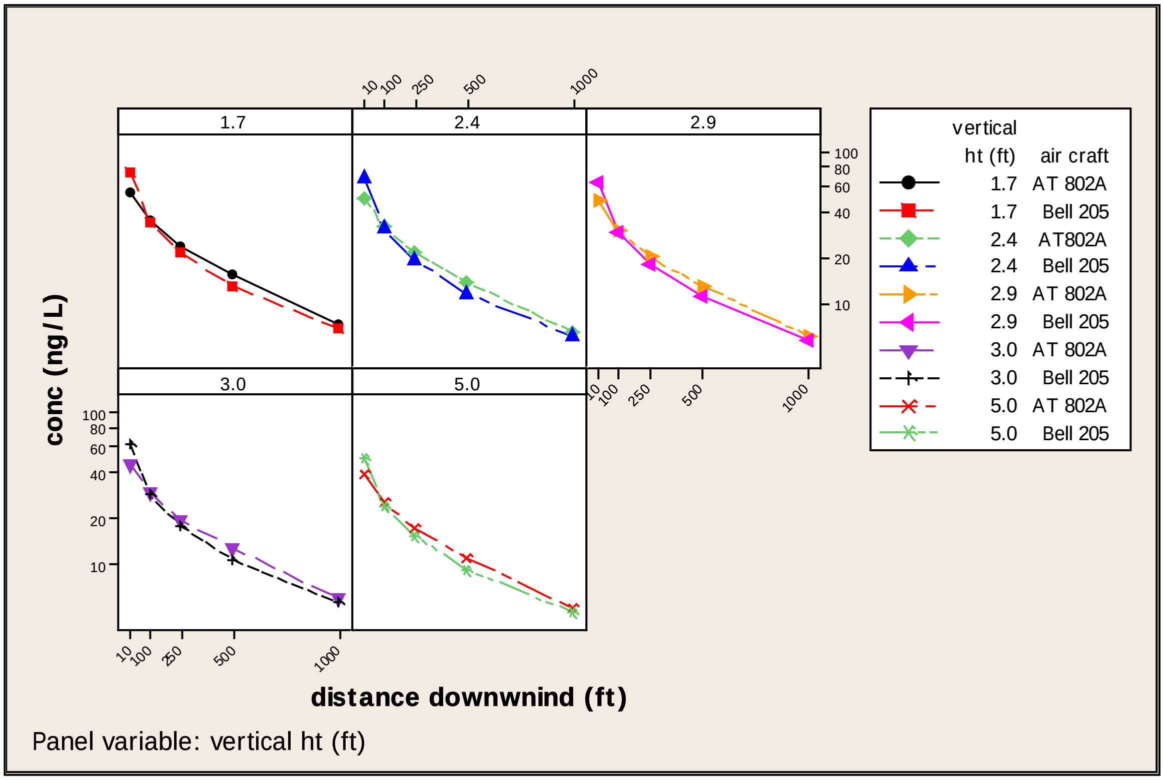
The AGDISP model produces estimated 1-hr time weighted average (TWA) air concentrations in a vertical plane at user specified downwind distances from the application edge. The air concentration estimates for both the AT802A and Bell 205 were obtained from the same model runs that produced the deposition estimates. Thus, air concentrations were estimated for both the AT802A and Bell 205 aircraft using the 10 mph, 90 deg F, and 20% humidity weather scenario. The vertical plane was set at selected downwind distances, starting with the minimum federal label buffer zone of 10 ft from the application area edge. The 1-hr TWA air concentrations for the vertical plane at the minimum federal buffer zones of 10 ft and at selected heights above ground level are shown in Table 21. Figure 7 shows the change in 1-hr TWA air concentration with height for the vertical planes between 10 ft and 1000 ft downwind of the application edge. At the minimum federal label buffer zone of 10 ft, for the breathing heights of toddlers to adults (1.7 ft and 5 ft, respectively) the Bell 205 helicopter shows the highest 1-hr TWA air concentration in the vertical plane. As the elevation above ground level increases, however, the 1-hr TWA air concentrations for the AT802A become higher than the Bell 205. The switch occurs at approximately 10 ft above ground level. The AGDISP user manual defines the 1-hr TWA air concentration as: “average concentration of active spray material through a vertical plane at the Transport Distance.” Not all the mass in the cloud passing through the vertical plan at a particular distances will be contained is droplets that are in the inhalable size range. The AGDISP model can output the droplet spectra present and the air concentration vertical plan. Therefore, if desired, a respirable fraction adjustment can be made to the concentration passing through a vertical plan. Complete AGDISP aerial application results are shown in Appendix A.

Table 21. Selected 1-hr time weighted average (TWA) air concentrations (ng/L) in a vertical plane at the federal label minimum buffer zone distance of 10 feet downwind of a 206.6 acres application (20 swaths) with the AT802A fixed wind air craft and a 190.4 acre (20 swaths) application with the Bell 205 helicopter. Development procedures for these air concentration estimates are described in the text.

| Height Above Ground | | 1-Hr TWA Air Concentration (ng/L) | |
|---|---|---|---|
| | | Aircraft Model | |
| Inches | Feet | AT802A Fixed Wing[1] | Bell 205 Helicopter[2] |
| 0 | 0 | n/a[3] | n/a[3] |
| 20 | 1.7 | 54.6 | 72.8 |
| 29 | 2.4 | 49.6 | 66.4 |
| 35 | 2.9 | 47.0 | 62.5 |
| 36 | 3.0 | 46.5 | 61.8 |
| 60 | 5.0 | 39.9 | 50.0 |

[1]Fraction of droplets 10µm or less = 0.0285
[2]Fraction of droplets 10µm or less = 0.0366
[3]The AGDISP model does not estimate air concentrations at ground level.

Figure 7. One hour time weighted air concentrations (ng/L) in a vertical plane at distances between 10 ft and 1000 ft downwind of a 206.6 acres application (20 swaths) with the AT802A fixed wind air craft and a 190.4 acre (20 swaths) application with the Bell 205 helicopter. The development procedure for these air concentration estimates is described in the text.




## Comparison of Deposition and Air Concentrations as a function of Finished Spray Volume (GPA) and Application Rate (lb/ac)

The effects of finished spray expressed as gallons per acre (GPA) and the active ingredient (ai) application rate (lb ai/ac) within the same aircraft type and meteorological conditions are examined in this section. There is at least one chlorpyrifos label that requires a minimum of 15 GPA finished spray for certain aerial applications (Cheminova NUFOS 4E USEPA Reg. No. 67760- 28-AA). Based on this label, the two levels of finished spray are modeled: 2GPA (US EPA default) and 15 GPA. Three levels of application rate are also modeled: 1 lb ai/ac, 2 lb ai/ac, and 2.3 lb ai/ac.

The application tank mix scenarios shown in Table 22 were simulated using AGDISP for the fixed wing aircraft AT802A and the rotary wing aircraft Bell205. The 2 GPA tank mix scenarios retain the original aircraft set-ups used in sections above for the chlorpyrifos spray drift analysis.

The 15 GPA scenarios used an aircraft set-up with 60 nozzles on the boom to deliver the higher spray volume. This 60 nozzle spray boom set-up is typical of spray booms used for application of products that require a high GPA finished spray. For example, most propanil labels require a minimum of 10 GPA finished spray for aerial applications with 12-15 GPA recommended in low humidity conditions (e.g. SuperWham!CA  EPA Reg. No. 71085-5-ZA and Stam 80 EDF-CA EPA Reg. No. 710085-38-AA). Booms on aircraft performing propanil applications are typically equipped with 50 to 70 nozzles (Rice Research Board, 2001; Rice Research Board, 2002).

The CPF 60 nozzle medium ASAE spray quality aerial boom set-up parameters for the 15 GPA scenario were input into the Aircraft Calibration, Droplet Calculator, and USDA Atomization Model Excel files available for download from the Transland/CP Products Droplet Calculation Tools – Aerial Spray Systems website (http://www.translandllc.com/download/ - Accessed August 8, 2017). The calculators show that several nozzles exist that can deliver a 15 GPA finished spray in the ASAE medium spray quality range using the recommended pressure between 25 and 60 psi. The AGDISP model uses generic inputs of ASAE spray quality, number of nozzles, nozzle spacing, and boom length together with air speed and release height independent of a specific brand of nozzle. Therefore, use of the CP Product calculators is employed simply as a boom system check. It is not required to assume that CP Product nozzles are actually used for this scenario to the exclusion of other nozzle brands.

The base scenario of 2 GPA finished spray volume is the default in both the AGDISP and AgDRIFT models and is the default finished spray volume typically used by USEPA (Dawson et al., 2012). The base scenario application rate is designated as 2 lb ai/ac. Thus, for this analysis the base scenario tank mix is 2 GPA finished spray volume and 2 lb ai/ac. All other tank mix combinations are compared to this base. As stated above, the Cheminova NUFOS 4E insecticide chlorpyrifos formulation (EPA Reg. No. 67760- 28-AA) that has 4 lb ai/gallon (0.5 lb/pint) was used for this simulation because this label requires a minimum of 15 GPA finished spray for some aerial applications. The ai is 45% by volume in this formulation. For all tank mix scenarios the ai is declared non-volatile. The remainder of the product is assumed to be volatile. While other components of the NUFOS 4E formulation may be non-volatile, the exact properties are unknown so the remainder of the formulation is considered volatile. In addition, it is assumed no tank mix additives were used so only the ai is non-volatile.

Table 22. Tank mix calculations for the AGDISP tank mix comparison runs. Cheminova NUFOS 4E insecticide chlorpyrifos formulation (US EPA Registration Number 67760- 28-AA).

| 2 GPA Finished Spray (16 pints) | | | |
|---|---|---|---|
| ai[1] rate per acre | formulation volume per acre | Proportion of ai in the tank mix volume | Percent ai in the tank mix volume[2] |
| 1 lb | 2 pints | 2/16*0.45 = 0.56 | 6% |
| 2 lb | 4 pints | 4/16*0.45 = 0.113 | 12% |
| 2.3 lb | 4.6 pints | 4.6/16*0.45 = 0.129 | 13% |
| 15 GPA Finished Spray (120 pints) | | | |
| ai rate per acre | formulation volume per acre | Proportion of ai in the tank mix volume | Percent ai in the tank mix volume[3] |
| 1 lb | 2 pints | 2/120*0.45 = 0.008 | 0.8% |
| 2 lb | 4 pints | 4/120*0.45 = 0.015 | 1.5% |
| 2.3 lb | 4.6 pints | 4.6/120*0.45 = 0.017 | 1.7% |

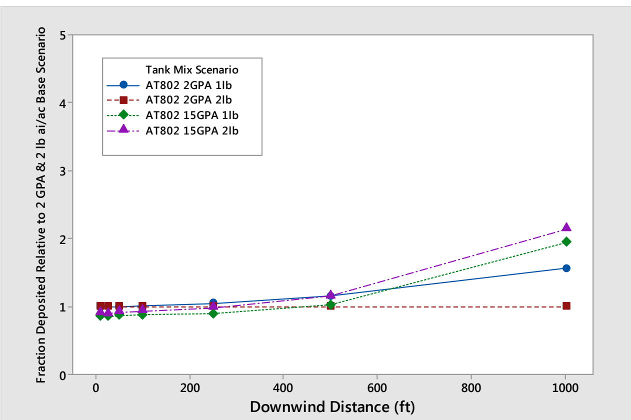
[1]Active ingredient
[2]Rounded up to the nearest 1%
[3]Not rounded up to the nearest 1% because the proportion of ai in the tank mix is small.

Figure 8 presents results for the AT802A fixed-wing aircraft tank mix scenarios relative to the base tank mix of 2GPA and 2 lb ai/ac (at each distance the scenario result is divided by the result for 2GPA and 2 lb/ac). Comparison of relative changes with scenario and distance can be made between horizontal fraction deposition, horizontal mass deposition, and air concentration in Figure 8 because the results are ratios and the plots are on the same scale. Figure 8a and 8b show the relative deposition of fraction and mass for each scenario, respectively. Figure 8c shows the relative air concentration for each scenario.

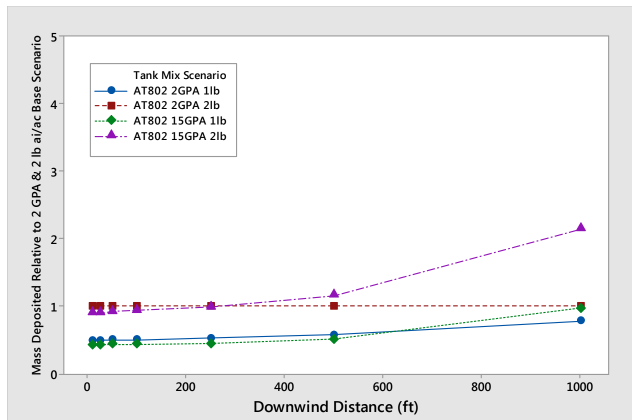
Across combinations of finished spray volume and application rates, near field (within about 200 ft of the application edge) the relative horizontal fraction results are reasonably similar (e.g., the fraction of application rate deposition ratio of base tank mix to scenario tank mix is close to 1.0) (Figure 8a). However, the far field results differ between scenarios, ranging from about 1.5 to 2 times the base scenario. Changes in relative fraction deposition are not proportional to differences in tank mix scenarios. Figures 8b and 8c show that changes in relative mass deposition and air concentrations are also not proportional to tank mix scenarios. The 15 gal/ac scenarios show the largest differences regardless of application rate. These results indicate: 1) simple multiplication of a base application rate deposition curve (fraction or mass) to obtain other application rates at the same GPA volume does not produce the same results compared to running the AGDISP model (or AgDRIFT model) separately for each tank mix scenario and 2) finished spray volume likely affects deposition and air concentration results through differences in the percent of ai in the tank mix. Therefore, these results imply a potential tank mix effect that is not considered if the default inputs alone are used to produce horizontal deposition and air concentration estimates. The higher finished spray volume per acre appears to increase deposition in the far field and increase air concentrations throughout the model domain.

Figure 8. Horizontal deposition (fraction of application rate and mass) and air concentration relative to the base scenario of AT802A aircraft 2GPA finished spray and 2 lb ai/ac application rate (AT802A 2GPA 2lb). Additional scenarios vary combinations of volume of finished spray (GPA) and application rate (lb ai/ac). Results at each distance for each scenario are divided by the result for the base scenario (the vertical axis is dimensionless).

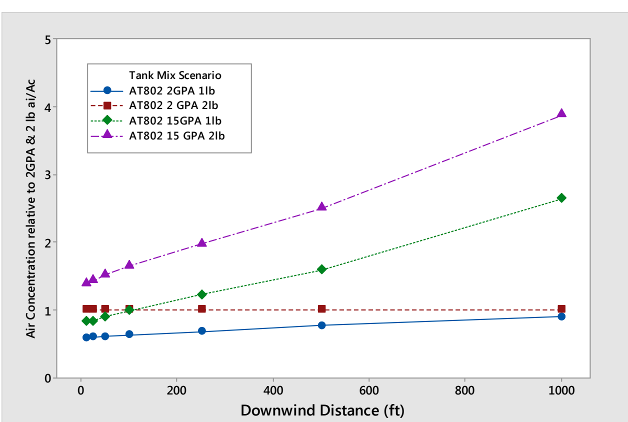
a. Horizontal Fraction Deposition




b. Horizontal Mass Deposition




c. Air Concentration



## Comparison with US EPA Results

Both this analysis and the analysis from US EPA used computer simulation models to produce horizontal deposition and air concentration estimates for chlorpyrifos. Inputs for some scenarios modeled were similar. For other scenarios the inputs were quite different.

For orchard airblast and ground boom this analysis used AgDRIFT 2.0.05 because when this analysis was conducted staff did not have access to AgDRIFT 2.1.1 regulatory version. For orchard airblast and ground boom AgDRIFT 2.0.05 yielded identical results to AgDRIFT 2.1.1 public version. After this analysis was finished staff obtained the regulatory version of AgDRIFT 2.1.1. As expected, results for orchard airblast and ground boom were identical between AgDRIFT 2.0.05 and AgDRIFT 2.1.1 regulatory version. That is because the empirical models that produce the orchard airblast and ground boom results have not changed since the versions of AgDRIFT developed following the expert panel review in the mid-1990's. The user manual supplied with AgDRIFT 2.1.1 is the user manual for AgDRIFT 2.0.07 (Teske et al., 2003).

**Orchard Airblast**. This analysis and US EPA orchard airblast simulations used consistent inputs. The only differences are due to US EPA rounding up to 2 decimal places for the horizontal deposition. US EPA presented only the sparse orchard scenario. This analysis presents sparse orchard, dormant apples, and grape vineyard (non-wrap-around). A side-by-side comparison for sparse orchard and 2 lb ai/ac application rate is shown in Table 23.

Table 23. Comparison of 50$^{th}$ percentile sparse orchard horizontal deposition (lb ai/ac) across a 50ft wide lawn for 20 rows and 2 lb ai/ac application rate as estimated using the AgDRIFT model.

| Distance Downwind (ft) | This Analysis | USEPA |
|---|---|---|
| 0 | *[1] | 0.57[2] |
| 10 | * | 0.16 |
| 25 | 0.0886 | 0.09 |
| 50 | 0.04 | 0.04 |
| 75 | 0.022 | 0.02 |
| 100 | 0.0136 | 0.01 |
| 125 | 0.009 | 0.01 |
| 150 | 0.0064 | 0.01 |
| 200 | 0.0036 | 0.00 |
| 250 | 0.0022 | 0.00 |
| 300 | 0.0016 | 0.00 |

[1]This analysis did not report estimates for empirical model fits between 0 and 25 feet because no field measurements were made within that distance range. The empirical model fit starts at 25 ft downwind of the treated field.
[2]The US EPA field edge horizontal deposition estimates are in error (References: Personal Communication with Charles Peck; US EPA 2014).

**Ground Boom**. There are no differences between this analysis and USEPA for ground boom simulation inputs. Both used the same scenarios of ASAE Fine to Medium/Coarse droplet spectra for low and high boom applications. However, USEPA reported the 90th percentile estimates. This analysis reported the 50th percentile estimates because the orchard airblast and aerial are both 50th percentile estimates. The use of the 50th percentile estimate puts ground boom on the same estimation basis as orchard airblast and aerial. Table 24 shows a side-by-side comparison of ground boom horizontal deposition (lb ai/ac) across a 50ft wide lawn for 20 swaths and 2 lb ai/ac application rate as estimated using the AgDRIFT model.

Table 24. Comparison of ground boom horizontal deposition (lb ai/ac) across a 50ft wide lawn for 20 swaths and 2 lb ai/ac application rate as estimated using the AgDRIFT model.

| Distance Downwind (ft) | This Analysis Low Boom[1] 50th Percentile | USEPA Low Boom 90th Percentile | This Analysis High Boom[2] 50th Percentile | USEPA High Boom 90th Percentile |
|---|---|---|---|---|
| 0 | *[3] | 0.46[4] | * | 0.54[4] |
| 10 | * | 0.02 | * | 0.04 |
| 25 | 0.0094 | 0.02 | 0.0184 | 0.03 |
| 50 | 0.0064 | 0.01 | 0.0118 | 0.02 |
| 75 | 0.0048 | 0.01 | 0.009 | 0.02 |
| 100 | 0.0040 | 0.01 | 0.0074 | 0.01 |
| 125 | 0.0034 | 0.01 | 0.0062 | 0.01 |
| 150 | 0.0030 | 0.01 | 0.0054 | 0.01 |
| 200 | 0.0024 | 0.00 | 0.0042 | 0.01 |
| 250 | 0.0020 | 0.00 | 0.0034 | 0.01 |
| 300 | 0.0018 | 0.00 | 0.0028 | 0.01 |

[1]Low boom height is 20 inches above the target.
[2]High boom is 50 inches above the target.
[3]This analysis did not report estimates for empirical model fits between 0 and 25 feet because no field measurements were made within that distance range. The empirical model fit starts at 25 ft downwind of the treated field.
[4]US EPA field edge deposition estimates are in error (References: Personal Communication with Charles Peck; US EPA 2014).

**Aerial.** Differences between aerial simulation inputs for this analysis and USEPA produces differences in the horizontal deposition. One difference is that this analysis used AGDISP 8.28 (Teske and Curbishley, 2013) to simulate the aerial application scenarios while USEPA used AgDRIFT 2.1.1 regulatory version. Table 25 follows the format of the AgDRIFT 2.0.05 user's manual and shows the AgDRIFT and AGDISP model inputs (Teske et al., 2002). The format of the AgDRIFT user's manual does not change with model version and the Tier I default parameter are the same between AgDRIFT 2.0.05 and AgDRIFT 2.1.1. The AgDRIFT Tier I default inputs shown in Table 25 were not changed by USEPA from those defaults for the AgDRIFT Tier II model runs.

Table 25. Details of Aerial Application inputs for AGDISP and AgDRIFT this analysis and USEPA, respectively.

| | This Analysis AGDISP | USEPA AgDRIFT |
|---|---|---|
| Aircraft Model | AT802A | AT401 |
| Weight | 11160 lbs | 6000 lbs |
| Wing Semispan | 29 ft | 24.5 ft |
| Flight Speed | 144.99 mph | 119.99 mph |
| Release Height | 10 ft | 10 ft |
| Number of Nozzles | 39 | 42 |
| Vertical Offset | -0.6601 ft | -1.51 ft |
| Horizontal Offset | -0.5 ft | -0.83 ft |
| Boom Span | 76.3% | 76.32% |
| Spacing (even) | 14 inches | 11 inches |
| ASABE[1] Droplet Spectra Classification | Medium | Tier I Fine to Medium<br>Tier II Medium |
| Wind Speed at 2 m | 10 mph | 10 mph |
| Wind Direction | Perpendicular to Flight Path | Perpendicular to Flight Path |
| Surface Roughness | 0.12 ft (low crops) | 0.0246 ft (bare soil) |
| Stability | Overcast (Neutral) | Overcast (Neutral) |
| Relative Humidity | 20% | 50% |
| Temperature | 90 deg F | 86 deg F |
| Specific Gravity | 1.0 | 1.0 |
| Spray Volume Rate | 2 gal/ac | 2 gal/ac |
| Application Rate | 2 lb/ac[2] | 2 lb/ac |
| Nonvolatile Rate | 2 lb/ac | 3 lb/ac[3] |
| Active Solution % of Tank Mix | 12% | 12% |
| Additive Solution % of Tank Mix | 0% | 5% |
| Nonvolatile Active | 12% | 12% |
| Volatile Fraction | 0.88 | .83 |
| Nonvolatile Fraction | 0.12 | .17 |
| Swath Width | 60 ft | 60 ft |
| Swath Displacement | 37% | 37% |
| Number of Flight Lines | 50 | 20 |

[1]American Society of Agricultural and Biological Engineers. Formerly American Society of Agricultural Engineers (ASAE). The organization change names in 2005.

[2]Application rates of 1, 2, 2.3, 4, and 6 lb/ac were simulated both 2 gal/ac and 15 gal/ac spray volume.

[3]US EPA indicates in D3399483. AppendixF.CPOSDrift.xlsx "…DAS Error Correction Comments/Meetings" for this tank mix but there is no accompanying documents to explain the "correction." Not all chlorpyrifos products are Dow products so this analysis does not include the 1 lb/ac of non-ai nonvolatile material in the tank mix. https://www.regulations.gov/document?D=EPA-HQ-OPP-2008-0850-0107

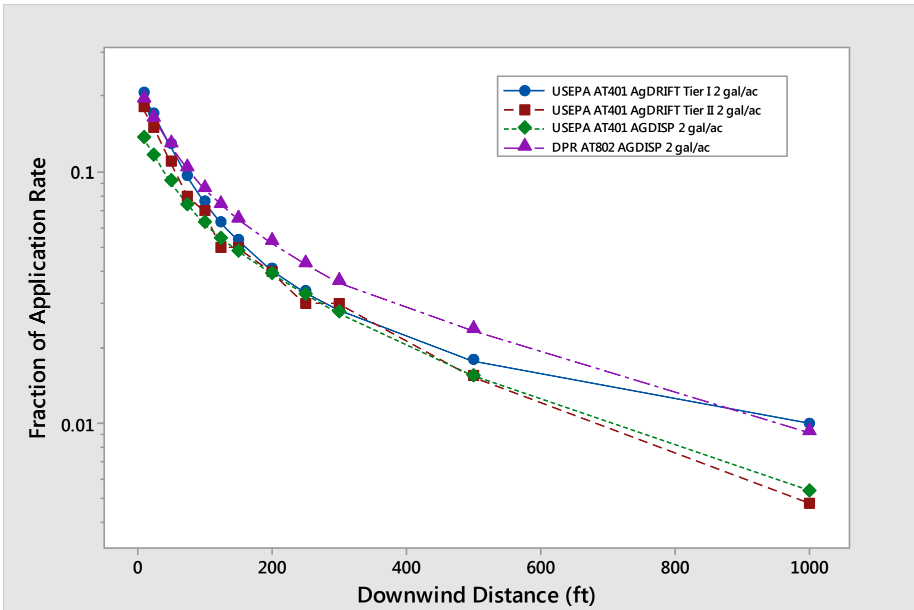
Deposition estimates for 2 lb ai/ac application rate are compared in Table 26 and shown in Figure 9. For this comparison, USEPA AgDRIFT estimates were extended to 1000 ft downwind to match the AGDISP estimates. In addition, the USEPA AgDRIFT inputs were used in AGDISP to provide a comparison of AgDRIFT and AGDISP horizontal deposition estimate for the AT401 aircraft. The AgDRIFT 2.1.1 aerial algorithm does not include an evaporation time-step refinement that was incorporated into AGDISP 8.28 to improve mass accountancy (H. Thistle, pers. comm., 2014). This results in the AgDRIFT horizontal deposition being higher than AGDISP for the same scenario (AT401 aircraft/20 swaths) due to the lack of the refined evaporation time-step. This effect is apparent in Figure 9 because the AGDISP results using the USEPA AT401 inputs show lower horizontal deposition relative to the AgDRIFT AT401horizontal deposition results. This analysis used AGDISP. However, the horizontal deposition estimates reported in this analysis are higher relative to USEPA horizontal deposition estimates for several reasons: 1) the AT802A was selected as the California aircraft based on common use in California and higher horizontal deposition estimates, 2) this analysis used 50 swathes (USEPA used 20 swaths) to reflect the largest application sizes in California, 3) the meteorological conditions used in this analysis are California specific, and 4) the tank mix fractions used in this analysis are California specific.

Table 26. Comparison of aerial horizontal deposition (fraction of application rate) across a 50ft wide lawn for 2 lb ai/ac application rate as estimated using the AgDRIFT and AGDISP models.

| Downwind Distance (ft) | USEPA AgDRIFT 2 gal/ac 20 swath AT401 Tier I | USEPA AgDRIFT 2 gal/ac 20 swath AT401 Tier II | USEPA Inputs AGDISP 2 gal/ac 20 swath AT401 | This Analysis AGDISP 2 gal/ac 50 swath AT802A |
|---|---|---|---|---|
| 10 | 0.20 | 0.1840 | 0.1374 | 0.1929 |
| 25 | 0.17 | 0.1475 | 0.1170 | 0.1640 |
| 50 | 0.13 | 0.1125 | 0.0914 | 0.1286 |
| 75 | 0.10 | 0.0854 | 0.0742 | 0.1034 |
| 100 | 0.08 | 0.0682 | 0.0627 | 0.0859 |
| 125 | 0.06 | 0.0570 | 0.0546 | 0.0739 |
| 150 | 0.05 | 0.0496 | 0.0483 | 0.0652 |
| 200 | 0.04 | 0.0394 | 0.0394 | 0.0524 |
| 250 | 0.03 | 0.0324 | 0.0327 | 0.0430 |
| 300 | 0.03 | 0.0271 | 0.0275 | 0.0365 |
| 500 | 0.02 | 0.0154 | 0.0155 | 0.0234 |
| 1000 | *[1] | 0.0048 | 0.0054 | 0.0092 |

[1]AgDRIFT Tier I does not estimate to 1000 ft.

Figure 9. Aerial application horizontal deposition estimates expressed as fraction of 2 lb ai/ac application rate as modeled by 4 different AgDRIFT and AGDISP scenarios.

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Appendix A – AGDISP Full Results for Aerial Application Scenarios

AT802A
2 GPA
1 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.1922 | 31.8 | 23.4 | 0.0341 |
| 25 | 0.1639 | 29.2 | 21.8 | 0.0357 |
| 50 | 0.1290 | 26.4 | 19.4 | 0.0376 |
| 100 | 0.0869 | 22.0 | 16.3 | 0.0406 |
| 250 | 0.0453 | 16.1 | 11.8 | 0.0471 |
| 500 | 0.0270 | 11.7 | 8.5 | 0.0570 |
| 1000 | 0.0144 | 6.5 | 4.7 | 0.0852 |
| 1320 | 0.0094 | 4.6 | 3.3 | 0.1072 |
| 2608 | 0.0017 | 1.6 | 1.2 | 0.2290 |

Bell205
2 GPA
1 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.2454 | 40.9 | 28.8 | 0.0440 |
| 25 | 0.1553 | 33.6 | 24.0 | 0.0472 |
| 50 | 0.0951 | 27.4 | 19.7 | 0.0510 |
| 100 | 0.0578 | 21.9 | 15.8 | 0.0558 |
| 250 | 0.0369 | 15.3 | 11.1 | 0.0662 |
| 500 | 0.0219 | 10.2 | 7.4 | 0.0831 |
| 1000 | 0.0107 | 5.8 | 4.2 | 0.1178 |
| 1320 | 0.0075 | 4.5 | 3.2 | 0.1410 |
| 2608 | 0.0012 | 2.0 | 1.5 | 0.2500 |

AT802A
2 GPA
2 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.1929 | 54.6 | 39.9 | 0.0285 |
| 25 | 0.1640 | 49.3 | 36.7 | 0.0300 |
| 50 | 0.1286 | 43.7 | 32.0 | 0.0321 |
| 100 | 0.0859 | 35.0 | 25.9 | 0.0355 |
| 250 | 0.0430 | 23.7 | 17.4 | 0.0440 |
| 500 | 0.0234 | 15.3 | 11.1 | 0.0589 |
| 1000 | 0.0092 | 7.2 | 5.2 | 0.0999 |
| 1320 | 0.0054 | 4.9 | 3.6 | 0.1300 |
| 2608 | 0.0010 | 1.6 | 1.2 | 0.2800 |

Bell205

2 GPA
2 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.2471 | 72.8 | 50.0 | 0.0366 |
| 25 | 0.1574 | 58.0 | 40.4 | 0.0400 |
| 50 | 0.0969 | 45.8 | 32.2 | 0.0445 |
| 100 | 0.0603 | 34.5 | 24.6 | 0.0500 |
| 250 | 0.0334 | 21.5 | 15.4 | 0.0640 |
| 500 | 0.0171 | 13.0 | 9.3 | 0.0867 |
| 1000 | 0.0075 | 6.8 | 4.9 | 0.1329 |
| 1320 | 0.0048 | 4.99 | 3.61 | 0.1600 |
| 2608 | 0.0008 | 2.19 | 1.59 | 0.2887 |

AT802A
2 GPA
2.3 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.1929 | 58.3 | 42.8 | 0.0283 |
| 25 | 0.1639 | 52.6 | 39.4 | 0.0302 |
| 50 | 0.1284 | 46.4 | 34.1 | 0.0324 |
| 100 | 0.0856 | 37.1 | 27.5 | 0.0360 |
| 250 | 0.0428 | 25.0 | 18.3 | 0.0451 |
| 500 | 0.0227 | 15.9 | 11.5 | 0.0605 |
| 1000 | 0.0088 | 7.5 | 5.4 | 0.1026 |
| 1320 | 0.0050 | 5.1 | 3.7 | 0.1333 |
| 2608 | 0.0011 | 1.7 | 1.2 | 0.2951 |

Bell205
2 GPA
2.3 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.2472 | 77.1 | 53.8 | 0.0376 |
| 25 | 0.1575 | 61.1 | 43.5 | 0.0413 |
| 50 | 0.0970 | 48.2 | 34.5 | 0.0458 |
| 100 | 0.0605 | 36.2 | 26.0 | 0.0521 |
| 250 | 0.0328 | 22.2 | 16.0 | 0.0675 |
| 500 | 0.0165 | 13.3 | 9.6 | 0.0915 |
| 1000 | 0.0071 | 6.9 | 5.0 | 0.1405 |
| 1320 | 0.0045 | 5.0 | 3.7 | 0.1753 |
| 2608 | 0.0009 | 2.3 | 1.6 | 0.3127 |

AT802A
15 GPA
1 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.1671 | 44.3 | 32.3 | 0.0737 |
| 25 | 0.1409 | 41.3 | 30.6 | 0.0749 |
| 50 | 0.1127 | 39.1 | 28.7 | 0.0765 |
| 100 | 0.0754 | 34.8 | 25.6 | 0.0788 |
| 250 | 0.0387 | 28.9 | 21.2 | 0.0826 |
| 500 | 0.0240 | 24.3 | 17.7 | 0.0863 |
| 1000 | 0.0179 | 19.0 | 13.8 | 0.0944 |
| 1320 | 0.0162 | 16.4 | 11.9 | 0.1011 |
| 2608 | 0.0048 | 9.0 | 6.5 | 0.1468 |

Bell205
15 GPA
1 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.2281 | 68.5 | 48.7 | 0.0920 |
| 25 | 0.1403 | 59.2 | 42.6 | 0.0958 |
| 50 | 0.0814 | 51.7 | 37.3 | 0.0994 |
| 100 | 0.0472 | 44.8 | 32.5 | 0.1026 |
| 250 | 0.0328 | 36.7 | 26.6 | 0.1102 |
| 500 | 0.0246 | 28.8 | 20.9 | 0.1200 |
| 1000 | 0.0161 | 20.2 | 14.7 | 0.1410 |
| 1320 | 0.0129 | 15.0 | 10.8 | 0.1558 |
| 2608 | 0.0021 | 8.0 | 6.4 | 0.2140 |

AT802A
15 GPA
2 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.1738 | 75.8 | 55.3 | 0.0565 |
| 25 | 0.1472 | 70.3 | 52.2 | 0.0577 |
| 50 | 0.1186 | 66.0 | 48.4 | 0.0590 |
| 100 | 0.0808 | 57.9 | 42.6 | 0.0615 |
| 250 | 0.0425 | 46.8 | 34.2 | 0.0677 |
| 500 | 0.0271 | 38.1 | 27.8 | 0.0710 |
| 1000 | 0.0197 | 27.9 | 20.2 | 0.0835 |
| 1320 | 0.0171 | 22.7 | 16.5 | 0.0936 |
| 2608 | 0.0041 | 10.3 | 7.5 | 0.1606 |

Bell205
15 GPA
2 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.2343 | 96.7 | 68.6 | 0.0708 |
| 25 | 0.1461 | 82.8 | 59.6 | 0.0741 |
| 50 | 0.0870 | 71.5 | 51.6 | 0.0776 |
| 100 | 0.0515 | 61.2 | 44.3 | 0.0814 |
| 250 | 0.0360 | 48.8 | 35.3 | 0.0889 |
| 500 | 0.0256 | 37.3 | 27.0 | 0.1008 |
| 1000 | 0.0155 | 25.2 | 18.3 | 0.1240 |
| 1320 | 0.0118 | 20.7 | 15.0 | 0.1390 |
| 2608 | 0.0021 | 11.5 | 8.3 | 0.2040 |

AT802A
15 GPA
2.3 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.1745 | 84.1 | 61.4 | 0.0574 |
| 25 | 0.1480 | 77.9 | 57.9 | 0.0587 |
| 50 | 0.1194 | 73.0 | 53.6 | 0.0602 |
| 100 | 0.0813 | 63.7 | 46.9 | 0.0629 |
| 250 | 0.0429 | 51.3 | 37.5 | 0.0676 |
| 500 | 0.0273 | 41.5 | 30.3 | 0.0735 |
| 1000 | 0.0198 | 29.9 | 21.7 | 0.0875 |
| 1320 | 0.0167 | 24.1 | 17.5 | 0.1001 |
| 2608 | 0.0041 | 10.6 | 7.7 | 0.1740 |

Bell205
15 GPA
2.3 lb ai/ac

| distance downwind (ft) | horizontal deposition (fraction) | Air concentration (ng/L) at 1.7 ft | Air concentration (ng/L) at 5.0 ft | fraction <=10um |
|---|---|---|---|---|
| 10 | 0.2355 | 107.4 | 76.2 | 0.0732 |
| 25 | 0.1472 | 91.7 | 65.9 | 0.0759 |
| 50 | 0.0879 | 78.9 | 56.9 | 0.0804 |
| 100 | 0.0522 | 67.1 | 48.5 | 0.0851 |
| 250 | 0.0362 | 53.2 | 38.5 | 0.0926 |
| 500 | 0.0254 | 40.2 | 29.1 | 0.1058 |
| 1000 | 0.0154 | 26.9 | 19.5 | 0.1313 |
| 1320 | 0.0117 | 22.0 | 15.9 | 0.1481 |
| 2608 | 0.0021 | 12.7 | 9.2 | 0.1769 |